ENVIRONMENTAL MANAGEMENT PLAN

Closure and Rehabilitation Strategy

Voyager Quarry Relocation, The Lakes WA.

Prepared for

BGC (Australia) Pty Ltd

18 Mount Street
Perth WA 6000

March 2007

MINISTERIAL CONDITIONS: RELOCATION OF VOYAGER QUARRY

URS

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1.1 Aspect of the environment to be protected

The environmental factor assessed by the EPA relevant to this management plan is "Closure and Rehabilitation".

The development of the quarry will require the eventual clearing of 85 hectares of vegetation in a staged proposal and the creation of a void remaining after the removal of overburden and granite resources. The closure and rehabilitation of such voids presents specific problems, particularly when a final land use for the void is yet to be determined and the quarry has a projected lifespan of more than 50 years. Visual impact on the local community is also an aspect of the proposal to be considered (EPA 2005).

Preliminary studies in regard to this aspect of the proposal include:

URS (2003). Public Environmental Review Proposed Relocation of the Voyager Quarry. Land Clearing and Quarry Expansion, Avon Loc 1881, Lot 14 Horton Road, The Lakes. Prepared for BGC Quarries, January 2003.

URS (2004b). Draft report: Preliminary Closure Plan – relocated Voyager Quarry.

1.2 Legal framework

The proposal for the relocation of the Voyager Quarry was assessed under Part IV of the *Environmental Protection Act 1986* (see below). In addition to Ministerial approval of the proposal (Statement 706) , the proponent will need to comply with a range of statutory and policy requirements as outlined in Table 1 below.

Table 1. Statutory, policy and other guideline requirements

Agency	Statute/ Guideline	Applicability
State Legislation		
Dept of Environment & Conservation	*Environmental Protection Act 1986*	Ministerial Statement 706 was issued under Part IV of the Act. Condition 706:M10 provides conditions to be met prior to clearing operations
Department of Consumer and Employment Protection	*Mine Safety Inspection Act 1994*	Applies to the safe operation of mines
	Mine Safety and Inspection Regulation 1995	Applies to the safe operation of mines
State Agency Guidelines		
Department of Consumer and Employment Protection	*Safety Bund Walls around Abandoned Open Pit Mines (1971)*	Safety measures to be employed around abandoned pits.
Dept Industry and Resources	*Environmental Management of Quarries (1994)*	Provides detailed guidelines for Development, Operation and Rehabilitation of Quarries
Department of Consumer and Employment Protection	*Project Management Plan*	All aspects of safety to be addressed in accordance with DoCEP guidelines MSH_GMP_ProjectManag.pdf
	Geotechnical Considerations in Open Pit Mining (1999)	Safety aspects of pit closure.
Australian and New Zealand Minerals & Energy Council (2000)	*Strategic Framework for Mine Closure (2000)*	EPA Condition 706:M10 requires the Closure Plan to be consistent with these requirements. The objectives and principles of the ANZMEC document will be developed in greater detail with the Closure and Rehabilitation Strategy prior to the quarry expanding into areas beyond Areas 1 and 2 (Fig.3). This is a voluntary code that provides guidelines to state regulators and mining companies.
Dept Environment & Conservation (2006)	*Preparing Environmental Management Plans (2006)*	Draft guidelines for the preparation of Environmental Management Plans submitted in compliance with Ministerial Conditions.

Note that the *Mining Act 1978* does not apply to the proposed operation because the quarry is located on private land.

The proposal, which was initially described within the proponent's Public Environmental Review (PER) (URS 2003), was referred to the EPA on 19 December 2001 by the Commissioner for Soil and Land Conservation.

The proposed relocation of the quarry is to an area of land (Lot 14, Figure 1) owned by the proponent. In December 2001, the EPA determined the level of assessment for the proposal at PER, and this level of

assessment was subject to a two week appeals process. A number of appeals against the level of assessment were considered by the Minister for the Environment and dismissed on 1 May 2002. The subsequent PER document released for public review for a period of eight weeks from 6 January 2003, closing on 3 March 2003. An extension was then provided to allow for further public submissions until April 2003. Following a review of the submissions, the proponent modified its proposal and incorporated details of additional monitoring work and data within its Response to Submissions (URS 2004).

The proposal was approved by the Minister for the Environment with the signing of Ministerial Statement 706 on 16 December 2005. Relevant to this management plan is Condition 10 reproduced below.

10-1 Prior to clearing of vegetation or excavation of soil or rock, whichever is the sooner, the proponent shall prepare a Closure and Rehabilitation Strategy, to the requirements of the Minister for the Environment.

The objective of this Strategy is to ensure that closure planning and rehabilitation are carried out as an integral part of quarry planning, development and operation.

The Strategy shall be consistent with the "Strategic Framework for Mine Closure (2000)" produced by the Minerals Council of Australia and the Australian and New Zealand Minerals and Energy Council, and shall:

1. *detail the rehabilitation practices and timing of rehabilitation of all disturbed areas including stockpiles, overburden disposal areas, access roads, quarry pits and sumps;*
2. *detail the rehabilitation work to be undertaken in conjunction with site operations;*
3. *address rehabilitation of areas already cleared which do not form part of the operational footprint; and*
4. *incorporate a Visual Impact Strategy formulated to manage, ameliorate and screen visual impacts of the operations, including impacts from artificial lighting.*

10-2 The proponent shall implement the Closure and Rehabilitation Strategy required by condition 10-1 and any subsequent updates as required by condition 10-3, to the requirements of the Minister for the Environment.

10-3 The proponent shall review and update the Closure and Rehabilitation Strategy required by condition 10-1 every five years, and shall include the outcomes of consultation with the owners and residents of land surrounding the project area to the requirements of the Minister for the Environment.

10-4 The proponent shall make the Closure and Rehabilitation Strategy required by condition 10-1 publicly available.

Other conditions that relate to Ministerial Condition 706:M10 include the following.

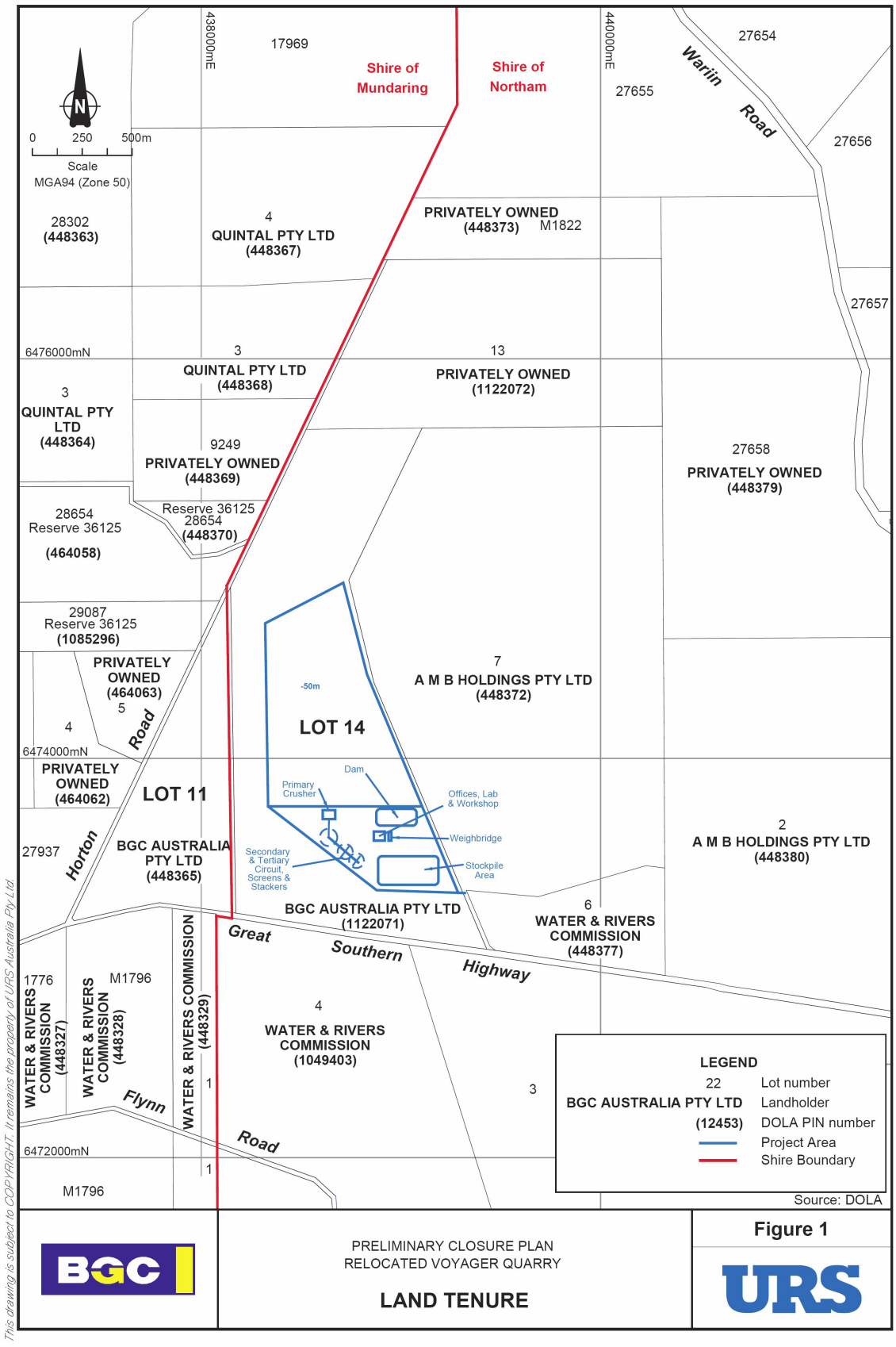
5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

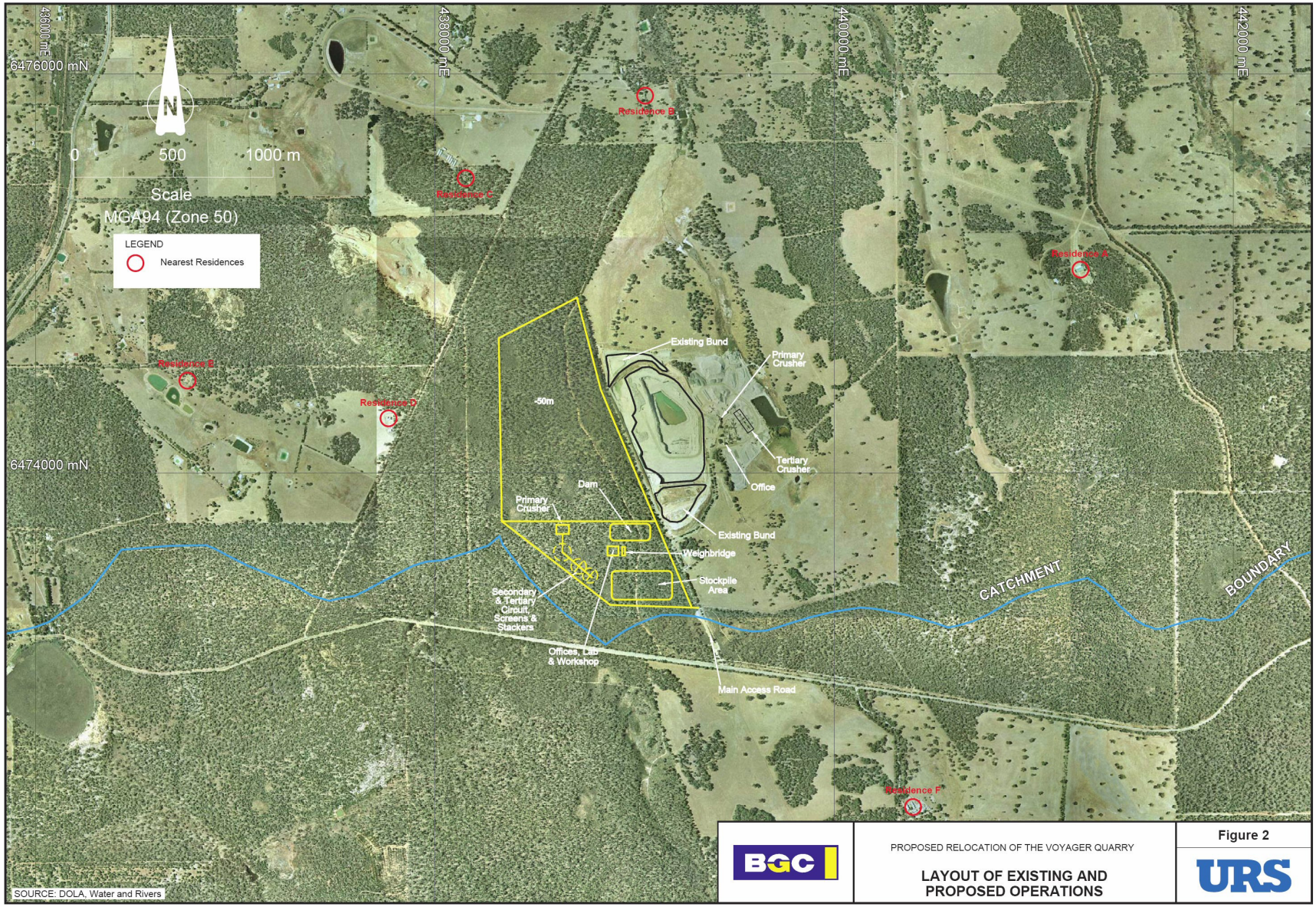
1. *The status of implementation of the proposal as defined in schedule 1 of this statement;*
2. *Evidence of compliance with the conditions and commitments; and*
3. *The performance of the environmental management plans and programs.*

5-2 The proponent shall prepare a performance review program and submit annual performance review reports to the Department of Environment which address:

1. *The major environmental issues associated with the project; the environmental objectives for those issues; the methodologies used to achieve these; and the key indicators of environmental performance measured against those objectives;*
2. *The level of progress in the achievement of sound environmental performance, including industry benchmarking, and the use of best available technology;*
3. *Significant improvements gained in environmental management, including the use of external peer reviews; and*
4. *The proposed environmental objectives for the operations, including improvements in technology and management processes.*

19-1 Prior to the finalisation of plans, strategies and programmes required by conditions 8-1, 9-3, 10-1, 12-1, 13-1, 15-1, 16-1 and 18-1, the proponent shall make reasonable endeavours to establish a Community Liaison Group to the requirements of the Minister for the Environment

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Existing Bund
Primary Crusher
Tertiary Crusher
Office
Dam
Primary Crusher
Existing Bund
Weighbridge
Stockpile Area
Secondary & Tertiary Circuit, Screens & Stackers
Offices, Lab & Workshop
Main Access Road
CATCHMENT BOUNDARY
SOURCE: DOLA, Water and Rivers
BGC
PROPOSED RELOCATION OF THE VOYAGER QUARRY
LAYOUT OF EXISTING AND PROPOSED OPERATIONS
Figure 2
URS

2.1 The project

The proposal is for the relocation of the Voyager Quarry to Lot 14 Horton Road (Avon Location 1881), The Lakes, Shire of Northam (Figure 1). The existing quarry is located on cleared farmland immediately to the east of Lot 14.

The relocated quarry is for the extraction of a resource which is an extension of a Key Extraction Area designated in the Western Australian Planning Commission's Basic Raw Materials Planning Policy Statement. Indicative stages for the quarry development over time are shown in EPA Bulletin 1169 (EPA 2005, Figure 3).

The development of the quarry will ultimately require the clearing of 85 ha of vegetation over the estimated 50 or-more-year life of the proposal. It is anticipated that the project's development will occur in six stages (Figure 3), with Stage 1 and Stage 2 being initially developed to provide room for the new below ground level facilities and infrastructure. Subsequent Areas 3 to 6 will then be developed as the need to access further granite resources arises. The anticipated staged development of the quarry is indicated in Figure 3 of EPA Bulletin 1169. The staged approach will also ensure that excavation of the topsoil and subsoil (gravel and clay) will only occur on 5 occasions during the life of the mine. All infrastructure, crushing and screening plants and product stockpiles will be housed below ground level, and the site will be surrounded by a buffer of trees and vegetation. Over the life of the project it is estimated that 2 million tonnes of gravel, 12 million tonnes of clay and 60 million tonnes of granite will be extracted.

2.2 Receiving environment

2.2.1 Landforms and soils

The proposed site for the Voyager Quarry relocation is located in the mid-western section of the South Western Province of the Yilgarn Block, within the Western Shield. The Darling Scarp and Darling Fault, which delineates the western boundary of the Yilgarn Block (Biggs and Wilde, 1980), lie east of the proposed site. The Archaean rocks of the Yilgarn Block within the study area predominantly consist of granite, gneiss, migmatite and intruded dolerite dykes (King and Wells, 1990).

The stratigraphy of the area is dominated by Archaean granite, which is coarse and even-grained, and has been dated at approximately 2.6 billion years. The exposed granite has minor variations. Minor jointing mainly occurs in a regular northeast–southwest direction. A simplified stratigraphic profile for this area comprises:

- hard caprock, laterite and gravel (0 – 2 m);
- weathered granite, gravel and clay material with some granite chips (2 – 5 m);
- fractured granite, abundance of quartz and granite chips (5 – 18 m); and

- fresh granite, with granite fragments (>18 m).

Small north to north westerly trending quartz-dolerite dykes, which were formed as a result of movements associated with the Darling Fault, occur throughout the area. The dykes are expected to date between 450 and 750 million years (Williams, 1975).

The proposed site for the relocated quarry is situated in the Darling System and the landforms and soils of this system were characterised by Churchward and McArthur (1980) and revised by King and Wells (1990). The soil types at the proposed site for the Voyager Quarry are typical of the 'lateritic uplands', with a small portion on the eastern section of the proposed site located in a 'minor valley'.

The land units within the proposed site are listed below (Churchward and McArthur, 1980; King and Wells, 1990):

- **Yalanbee:** Gently undulating landscape, inclined crests and upper slopes dominated by moderately deep fine gravels; some duricrust on ridges. The Yalanbee Land Unit has moderately well drained yellow duplex soils and yellow and brown massive earths. The topsoil is classified as a sand to sandy loam with respect to the texture, and the subsoil is sand to clayey sand. These soils have high surface permeability and low runoff potentials. Runoff tends to occur mainly as a result of baseflow seepage in lower areas of the landscape, or as overland flow in saturated areas.

- **Pindalup:** Valleys on the central part of the plateau; gravely duplex soils on the slopes, some rock outcrop, grey sands, yellow duplex soils and yellow and brown massive earths in broad floors. These tend to have a lower permeability than the soils in the Yalanbee land unit. The topsoil has a sand to sandy loam texture, which has a moderately slow permeability.

- **Cooke:** Level to gently inclined hillcrests; hills rising above general plateau level; mainly dominated by granite outcrop, very shallow yellow duplex soils and yellow and brown massive earths. The permeability of the soils in the Cooke land unit is moderately low.

Other land units near the proposed site include Goonaping and Murray. Goonaping is located south-east of the proposed site. This land unit is associated with shallow valleys located on level to gently inclined upland flats (Churchward and McArthur, 1980; King and Wells, 1990). The typical soil type for the Goonaping land unit is grey sand. The Murray land unit is located directly to the north of the proposed site. The Murray land unit comprises of deeply incised valleys, which have red and yellow soils on the slopes (Churchward and McArthur, 1980).

2.2.2 Surface hydrology

The proposed quarry relocation site is located near the top of the local catchment divide (Figure 4). The site is located in the southeast corner of the Wooroloo Brook catchment, which in turn forms part of the Swan-Avon catchment. The site is located in a proposed *Priority 3 Drinking Water Source Area* and the catchment is proclaimed under the *Rights in Water and Irrigation Act 1914*.

Runoff from the proposed quarry site reaches the Avon River via Wooroloo Brook to the north. Wooroloo Brook is a major contributing catchment to the Swan-Avon system, with a catchment area of around 266 km^2 (26,600 ha). The confluence of Wooroloo Brook with the Avon River marks the change in name from the Avon to the Swan River.

The proposed quarry site is located on the western side of a small valley. Surface drainage in the valley is from the south to the north. The average topographic gradient of the slope at the site is around 7% and the general direction of flow on the valley slope is towards the northeast. Elevation in the quarry area site varies from 300 to 350 m AHD.

There are no substantial drainage lines, wetlands or sensitive water bodies in the proposed quarry area, which is located approximately 7 km south of Wooroloo Brook. A small stream passes to the east of the site (the "Eastern Stream"), joining with a small stream from the west (the "Western Stream") about 750 m north of the existing quarry site. The streams have incised channels 0.5-2 m wide and 0.5-1 m deep in a broad valley. A dam on the Eastern Stream is used as a water supply for the existing quarry. The streams are ephemeral, flowing mainly during winter as a result of seepage from local groundwater or surface runoff.

There are several obvious areas of salinisation in the pasture land downstream of the existing quarry site (URS 2002). Vegetation in these areas is sparse, runoff rates are high, and the areas are erosionally unstable. Disturbance and trampling by stock exacerbate the erosion and lead to increased stream flow turbidity. Observations of salinity in the streams, storages and groundwater bores over a period of time clearly show that seepage from surrounding agricultural land is the main source of salt load in the local catchment. This seepage is a result of rising water tables caused by clearing of vegetation for agriculture and is not related to the existing quarry operations (URS 2004). Controlled discharge from the current quarry has increased stream flows, but the salinity of the discharge water is low, leading to an overall lowering of salinity levels in the streams near the quarry (URS 2004).

2.2.3 Groundwater hydrology

The proposed quarry site occurs in the Darling Scarp Province of Western Australia. The province has reliable rainfall and is characterised by streams that deeply incise the laterite profile into underlying granite bedrock. Small amounts of potable groundwater are available from bores and wells that intersect fractures within the granite bedrock, but generally yield less than 15 kL/day. Those sited in valleys or on some hill slopes may give larger supplies, but the groundwater salinity is generally higher (Wilde & Low 1978).

Kirchner (2002) describes three types of aquifers present in the Wooroloo Brook Catchment, as follows:

- a semi-confined aquifer;
- superficial aquifers; and
- perched aquifers.

Only the semi-confined aquifer has been found in the proposed quarry area. This aquifer is expected to be widespread in the catchment area.

The salinity of groundwater in the upper parts of the Wooroloo Brook Catchment varies from less than 1,000 to more than 7,000 mg/L total dissolved solids (TDS). There is an increase in salinity from west to east across the catchment.

The proposed quarry occurs in the very upper-most reaches of the Wooroloo Brook Catchment, immediately adjacent to the catchment divide which lies immediately to the south (Figure 4). Groundwater yield to bores is therefore very small and groundwater salinities are between 1,200 and 3,700 mg/L TDS.

Due to low bore yields and generally poor groundwater quality, the area containing the existing and proposed quarry is not within a proclaimed groundwater area under the *Rights in Water and Irrigation Act 1914*. A licence is therefore not required to extract groundwater in this area.

2.2.4 Vegetation and flora

Vegetation

A vegetation survey of the proposed quarry relocation site was conducted in January 2002 by Mattiske Consulting Pty Ltd.

In total, 11 site-vegetation types were defined and mapped for the survey area. All of these site-vegetation types are represented in the wider conservation estate (Mattiske Consulting Pty Ltd, 2002). However, as only sections of the south-west forest region have been mapped at the scale of site-vegetation type level, it is not feasible to place percentages on representation.

Vegetation types are considered significant when they are restricted in distribution, and/or support populations of significant flora. The site-vegetation type G (open to closed heath of Proteaceae) is locally significant as it is associated with localised outcropping supporting a range of species and taxa, including the Priority 4 species, *Hemigenia viscida.* Although local variations are noted in composition, this site-vegetation type is well represented in the conservation estate (Heddle *et al.* 1980).

Flora

Two flora surveys were conducted at the proposed quarry relocation site in 2002. The first survey was undertaken in January 2002 by Mattiske Consulting Pty Ltd which recorded 200 vascular plant taxa (including seven introduced taxa) from 39 plant families and 102 genera. Mattiske conducted a follow-up flora survey in spring 2002 to identify any additional species not recorded during the January 2002 survey. During this survey, an additional 23 vascular plant taxa were recorded, which included orchids and trigger plants. Therefore, a total of 223 vascular plant taxa from 42 plant families and 112 genera have been recorded within the survey area.

No Declared Rare Flora (DRF) species gazetted under the *Wildlife Conservation Act* 1950 were recorded during the surveys. However, a species listed as Priority 4 (Rare Flora) on the State Declared Rare and Priority Flora List and as Vulnerable under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) was recorded at the site. This species, *Hemigenia viscida,* was recorded in four of the 17 areas of heath present in the Project Area (Mattiske Consulting Pty Ltd, 2002). Almost 95% of *Hemigenia viscida* plants within Lots 11 and 14, Horton Road, (1,612 plants) were recorded in one heath community (H5).

A survey to identify other locations or potential locations for *Hemigenia viscida* populations beyond the immediate site was conducted by Mattiske Consulting Pty Ltd in February 2002. This was undertaken through an interpretation of aerial photographs and follow-up ground-truthing. The survey identified a population of at least 110 plants in a heath community on Shire of Mundaring land to the west of Horton Road, and south of a Shire of Mundaring gravel quarry pit. No plants were located in nearby State Forest areas.

In Western Australia, *Hemigenia viscida* has also been recorded previously on the eastern edge of the jarrah forest and in pockets in the Wheatbelt region.

Seven introduced plant species have been recorded in the Project Area. The species are *Briza maxima* (Blowfly Grass), *Lagarus ovatus* (Hare's Tail Grass), *Ehrharta longifolia* (Annual Veldt Grass), *Chamaecytisus palmensis* (Tree Lucerne), *Anagalis arvensis* (Pimpernel), *Conyza bonariensis* (Flaxleaf Fleabane) and *Pseudognaphalium luteoalbum* (Jersey Cudweed). All of these weeds are widespread in the south-west of Western Australia, particularly on disturbed areas (Hussey *et al.,* 1997).

Dieback

A field survey was conducted by Glevan Dieback Consultancy Services in December 2001 to assess the presence of *Phytophthora* spp. at the proposed site. *Phytophthora* spp. are soil-borne pathogens which affect a wide range of plant species of the south west of Western Australia. An area of *Phytophthora cinnamoni* infestation was identified, running parallel to Great Southern Highway for approximately 1.65 km (Glevan 2001). It was suggested that the introduction of the pathogen may have occurred during initial road construction and that the infestation has had an impact on the plant communities, particularly on the species, *Banksia grandis*. The remainder of the area assessed during the study was deemed to be free of the symptoms associated with the *Phytophthora* sp. pathogen (Glevan 2001). It is important to note that the *Phytophthora cinnamoni* infested area is not within the operational area. It should also be noted that the dieback infestation lies to the south of the catchment divide and consequently the pathogen will not be carried into the remainder of Lots 11 and 14 due to water movement.

Any vehicles entering the conservation area for fencing, safety bund construction or firebreak maintenance should have undergone dieback hygiene cleansing if brought in from an outside area or if these have operated in the die-back infestation area adjacent to the Great Southern Highway.

2.2.5 Fauna

EPBC Act 1999 and WA Wildlife Conservation Act 1950

Species listed under the WA Wildlife Conservation and Four species listed also under the EPBC Act 1999 are known or expected to occur within the general site location. These are:

- Carnaby's Black Cockatoo, *Calyptorhynchus latirostri* (which is listed as Endangered under the EPBC Act and as Threatened [Schedule 1]under the State *Wildlife Conservation Act 1950*).
- The Southern Death Adder**,** (*Acanthophis antarcticus*) is listed under Schedule 1 and could possibly be found within the project areas. This reptile is highly venomous and should not be handled except by an expert.
- Baudin's Black Cockatoo, *Calyptorhynchus baudinii* (which is listed as Vulnerable under the EPBC Act and as Threatened [Schedule 1] under the State *Wildlife Conservation Act 1950*). This species appears to be generally scarce in the Voyager Quarry area. Recorded in small parties at Gidgegannup, Chidlow, The Lakes area, Mt. Helena, Flynn Road and the northern end of Yarra Road. Mainly reported in family parties (male, female and juvenile or immature), occasionally in small flocks (up to 20), rarely larger flocks (up to 50), not recorded for the quarry site but small numbers had recently been feeding on the seeds of several large marri trees near north-eastern boundary of the site. As for Carnaby's Cockatoo, there are few suitable hollows available.
- The Chuditch, *Dasyurus geoffroii* (which is listed as Vulnerable under the EPBC Act and as Threatened [Schedule 1] under the State *Wildlife Conservation Act 1950*). A Chuditch release programme was undertaken by CALM in 1998 at several sites within the Mundaring area to the north and south of the Mundaring weir. Results based upon monitoring exercises recorded in 1999 showed that there were no records of Chuditch to the south, but there was a 14% capture peak recorded in the northern sites, dropping to between 4-8% over the course of the year (Orell & Morris 1994). Evidence of Chuditch was recorded from an Elliott trap within the development footprint (Biota 2003). No further details on Chuditch are available for this area.
- The Numbat (*Myrmecobius fasciatus*) (which is listed as Vulnerable under the EPBC Act and as Threatened [Schedule 1] under the *Wildlife Conservation Act 1950)*. No records of Numbat were recorded for the survey area, however a Numbat release programme for the Mundaring area was undertaken in the Nochine Forest Block, between Pool road and Bericine road area in 1999. A radio-collar monitoring exercise was undertaken in 2000 with reasonable results, showing Numbat still to be present within the area. In September 2003, a search of the area was conducted in order to find scats and diggings indicative of use of the area by Numbat. As reported within the monitoring report no evidence of use of the area by Numbat were recorded at this time. This may be due to the following:

  The proposed quarry relocation area is considered by DEC to be within the expected expansion range for Numbat populations, based upon known Numbat ranges and the localised suitable habitat

- the Fork-tailed Swift (*Apus pacificus*) and the Rainbow Bee-eater (*Merops ornatus*), which are listed under the EPBC Act as they are protected under international agreements for migratory birds.

Wildlife Conservation Act 1950 Schedule 4

Species gazetted under Schedule 4 ('In Need of Special Protection') of the *Wildlife Conservation Act 1950* which could potentially occur within the Project Area include:

- Peregrine Falcon (*Falco peregrinus*): This species occurs throughout Australia in most habitats with a preference for cliff faces and timbered water courses. There is high probability of occurrence throughout the general Project Area as Peregrine Falcons are known to readily use ledges within quarried areas for roosting and possibly nesting. They are also able to forage widely for food and can coexist with human disturbance.
- Western Brush (or Black-Gloved) Wallaby (*Macropus irma*): Scats of this wallaby were observed in heath, Jarrah and Jarrah-Sheoak communities during field surveys. Hence, it is likely that this species occurs throughout the Project Area, particularly wherever dense vegetation is present.
- Western False Pipistrelle (*Falsistrellus mckenziei*): This species is more common further south. It is unlikely that this bat will occur in the Project Area as the area is outside the known distribution for this species. Extensive surveys conducted in the Darling Range by Alcoa and Worsley have not found this species and there are no historic records of this species in the Darling Range.
- Crested Shrike-tit (*Falcunculus frontatus*): Due to the limited areas of preferred Wandoo woodland habitat in the Project Area, there is only a moderate probability of this species occurring.
- Dell's Skink (*Ctenotos delli*): This skink occurs in the Darling Range from Darlington and Mundaring South nearly to Collie. It is patchily distributed in its geographic range and may occur within the Project Area.
- Carpet Python (*Morelia spilota imbricate*. This sub-species is broadly distributed across much of the southwest, but has been given its protected status due to the fact that it is not common anywhere in its range. Individuals would probably shelter amongst rock piles and in hollow branches and logs on site. None were recorded from the study site during the survey but the species is known to occur in the locality.

Wildlife Conservation Act 1950 Schedule 3

The following vertebrate species listed as Priority 3 ('Taxa with several, poorly known populations, some on conservation lands') on DEC's Priority Fauna list may occur within the proposed Project Area:

- Wambenger/Brush-tailed Phascogale (*Phascogale tapoatafa*). This species may be found in most forest types in the south-west of the State.
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*). Research on this subspecies shows that suitable hollows within the breeding areas are at a premium, as most of the study sites

have been previously logged or mined. They do not breed until at least four years of age and the breeding population is small. This species was not identified during the 2003 survey of the Voyager project area.

Priority Listed Fauna

The following species listed on CALM's Priority database as Priority 4 taxa ('Taxa in need of monitoring') may also occur within the Project Area:

- Western Brush Wallaby (*Macropus irma*): Scats of this wallaby were observed in heath, Jarrah and Jarrah-Sheoak communities during field surveys. Hence, it is likely that this species occurs throughout the Project Area, particularly wherever dense vegetation is present.
- Western False Pipistrelle (*Falsistrellus mckenziei*): This species is more common further south. It is unlikely that this bat will occur in the Project Area as the area is outside the known distribution for this species. Extensive surveys conducted in the Darling Range by Alcoa and Worsley have not found this species and there are no historic records of this species in the Darling Range.
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2.2.6 Social environment

The proposed site for the relocated quarry is situated at Lot 14 Horton Road, in the Shire of Northam. Lot 14 is owned by BGC (Australia) Pty Ltd (Figure 2) and is zoned as *Rural Zone 3*. The Rural Zone 3 classification implies that Council will not support further subdivision of the land, except where this may be necessary for the protection of the natural and rural environment or the acquisition of additional reserves. The nearest settlement is a privately owned property in the Shire of Mundaring, which will be approximately 560 m to the west of the site; other settlements are located to the north and east of the proposed quarry site (Figure 2). The residence to the north is located approximately 1 km from the proposed quarry pit. The residence to the east of the proposed pit is located approximately 2.4 km from the site.

Lots 44327, 44328 and 44329 are located to the south of the Project Area and are designated areas for water protection held by the WRC (Figure 1). A review of tenure data obtained from the Department of

Land Administration (DOLA), indicated that the majority (75%) of residences in the vicinity of the proposed Project Area were purchased after the existing Voyager Quarry had become fully operational in 1991, with 25% of properties purchased prior to 1991. The transport routes to the distribution centre in Midland are Great Southern Highway and Great Eastern Highway. Approximately 40% of the total volume of material leaving the quarry is distributed to BGC Concrete plants located at Hazelmere, Armadale, Malaga, Rockingham, Quinns Rock and Canning Vale. Approximately 5% of the material is transported to BGC Asphalt with the remaining 55% transported to various locations in the metropolitan area and country locations. Distribution centres in the northern suburbs are accessed using Reid Highway and then Mitchell Freeway. The distribution centres in the southern suburbs are serviced via Roe Highway, then Tonkin Highway and Leach Highway.

3.1 Potential environmental impacts of the project

Impacts of the proposal on groundwater, surface water, catchment issues and the biological environment are dealt with in other management plans prepared in compliance with Ministerial Statement 706. This Management Plan provides strategies for managing the open void as resource removal progresses over the fifty-or-more year life of the proposal.

In general terms, the environmental impacts, unless properly managed, include:

- Visual impacts on the aesthetic values of the local environment;
- Risks presented by the open void after abandonment, including unstable slopes and pit edges and precipitous edges which are safety risks to stock, wildlife and humans;
- Monitoring bores and drill holes that are a risk to stock and native fauna if left open;
- Disturbed areas that are likely to result in wind and water erosion and are not conducive to natural regrowth unless satisfactorily rehabilitated; and
- Unsightly remains after abandonment of the quarry including abandoned quarry equipment, refuse and abandoned buildings and stockpiles unless and acceptable abandonment strategy is employed.

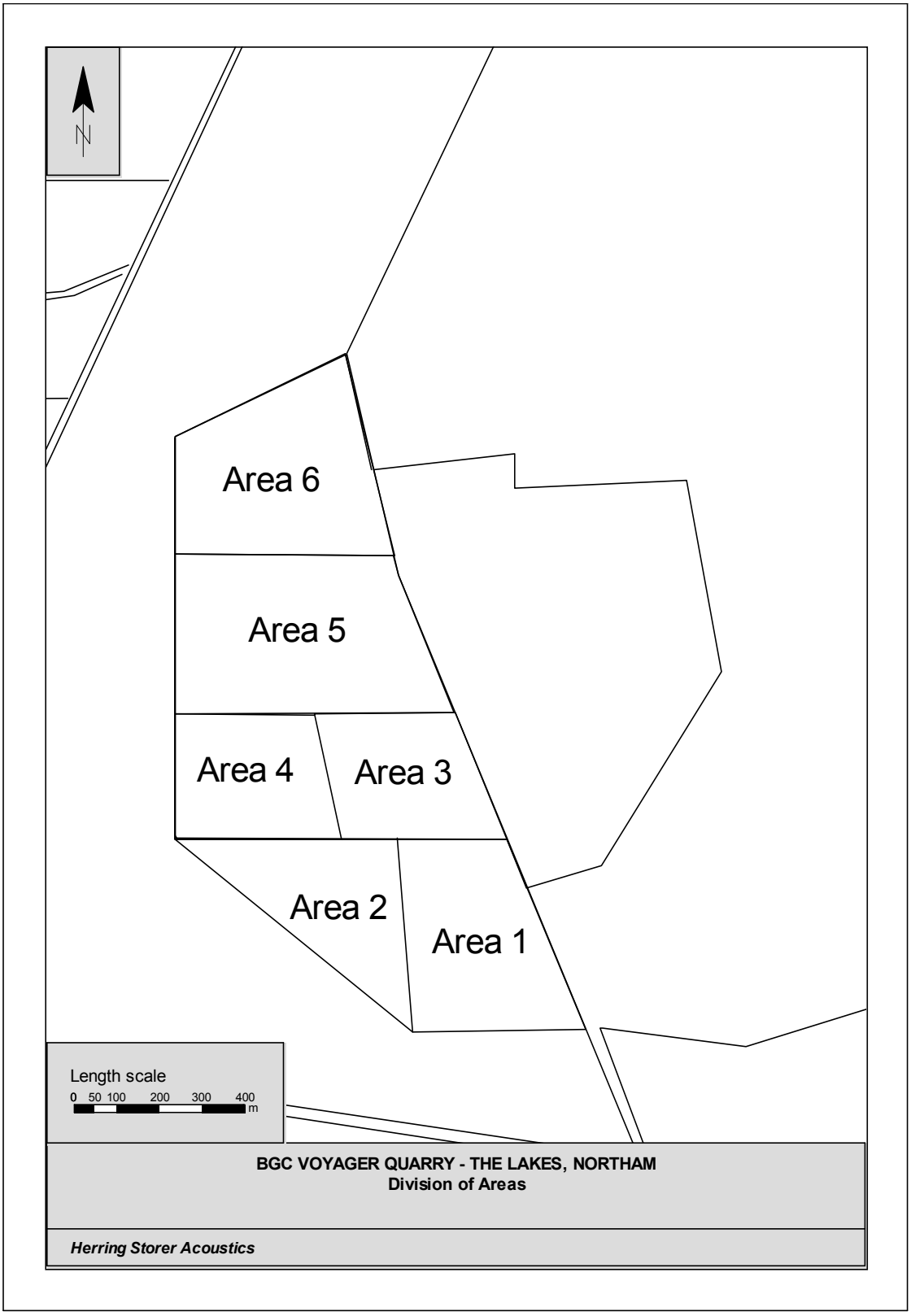


Figure 3: Division of Areas within the proposed relocation proposal (from Herring Storer 2004); see also EPA, 2005: Figure 3.

4.1 Principal environmental objectives

The objective of the Strategy is to provide a framework for closure planning for the proposed relocation of the Voyager Quarry and to identify issues that need to be addressed as the closure planning progresses to narrow closure options over time.

The EPA's objective is that the post-mining landform is safe, stable, non-erodable, and is, as far as is practicable, integrated into the surrounding landscape. Other generic considerations given to the closure planning are dealt with in separate ground and surface water management plans required by Condition 706:M13.1 and are outlined in Section 5 below.

Ministerial Statement

Condition 706:M10 provides the following environmental objectives:

The objective is to ensure that closure planning and rehabilitation are carried out as an integral part of quarry planning, development and operation.

The Strategy shall be consistent with the "Strategic Framework for Mine Closure (2000)" produced by the Minerals Council of Australia and the Australian and New Zealand Minerals and Energy Council, and shall:

1. *Detail the rehabilitation practices and timing of rehabilitation of all disturbed areas including stockpiles, overburden disposal areas, access roads, quarry pits and sumps;*
2. *Detail the rehabilitation work to be undertaken in conjunction with site operations;*
3. *Address rehabilitation of areas already cleared which do not form part of the operational footprint; and*
4. *Incorporate a Visual Impact Strategy formulated to manage, ameliorate and screen visual impacts of the operations, including impacts from artificial lighting.*

The above requirements are expanded in detail in the following section. The ANZMEC guidelines are discussed below

ANZMEC Guidelines

The Australian and New Zealand Minerals and Energy Council (ANZMEC) 2000 guidelines for mine closure suggests that planning for closure should be undertaken during the design of the mine. The Guidelines have been developed as advice for mining companies and also regulatory state agencies.

However it must be noted that the ANZMEC guidelines are framed more for the traditional concept of a mine, rather than a hard-rock quarry. Typical rehabilitation issues for mine sites include ongoing rehabilitation during the life of the mine that may include any of the following: road networks, waste rock dump shaping and vegetating, tailings dams and large areas of mining disturbance that require

revegetation. This proposal is for quarrying operations that will create a void that is fundamentally stable, non-eroding and has limited capacity for rehabilitation within the concept of a heavy minerals or iron-ore mine that are associated with the issues outline above. During the life of the quarry there will be no overburden dumping, tailings dams or extensive disturbed areas that will be required to be contoured and revegetation on an ongoing basis. Very limited rehabilitation can take place within the quarry as all benches are required to access to the working faces of the quarry. Consequently there can be very little ongoing rehabilitation during the life of the quarry as would be expected for a mine. Furthermore, the proposed quarry has very little in common with quarries that work into hillside rock slopes where ongoing rehabilitation can be an option. In the proposed quarry, revegetating can take place on a limited scale where exposed bench faces may be visible from outside the quarry. In this case trees may be planted against the vertical face upon a prepared surface of overburden and topsoil.

All the quarry operations are to take place within the void itself. including stockpiling, processing and loading. In terms of final closure, the fundamental requirements for the quarry is that it be left in a condition that is non-eroding, does not present a hazard to stock, wildlife or people and does not present an adverse visual impact on the environment. Table 2 outlines the potential final outcomes for the final use of the void. It may either be left as a void with options for abandonment, aquaculture or as a water resource. Alternatively the void may be filled using landfill options with final surface rehabilitation. A further option, considering the 50-year life of the quarry, is that granite resource requirements in the future may be such that the best environmental/social/cost requirements will be that the quarry be extended beyond the presently approved boundaries, subject to further approvals which could push the operational life out to many more years; however, such a possibility cannot be canvassed at the present time. The option of leaving the quarry as a void will create significant cost/safety considerations and these have to be taken into account during forward planning for closure.

The *Strategic Framework for Mine Closure*(ANZMEC 2000) is structured around a set of objectives and principles grouped under six key areas (stakeholder involvement, planning, financial provision, management, standards and relinquishment). These principles and objectives are taken into account as far as is possible considering that the proposal is for a hard-rock quarry, and not a mine as such. It should be borne in mind that rehabilitation and mine closure planning can only proceed in more defined terms once the quarry has been established in its initial phase within Areas 1 and 2 (Figure 3). Areas 1 and 2 are to be the main operational areas of the quarry for product processing and quarry management requirements; hence these initial quarrying areas will only be subject to rehabilitation in the final phase some 50 years hence.

Thus detailed rehabilitation considerations, particularly costing and completion criteria, will await until the quarry is to expand into those areas beyond Areas 1 and 2. This first expansion is likely to take place within five years following commencement of work on Areas 1 and 2. Condition 706:M10.3 requires a review of this Closure Plan every five years in consultation with relevant stakeholders. These reviews provide an opportunity for narrowing down the closure options as outlined in Table 2 in terms of practicality and social, environmental and cost implications.

In regards to the limitations of the *Strategic Framework* in its application to a hard-rock quarry, it is worth reiterating that where a quarry will have limited capacity for rehabilitation, there is little point in

setting funds aside at this time for rehabilitation where ongoing management will ensure visual screening, safety and rehabilitation of cleared areas outside of the operational area. Final removal of infrastructure will have minimal cost where quarry machinery (loaders and trucks) can be used for final demolition and removal of buildings. Processing equipment will have residual capital value either for resale or scrap; such costs may be considered at a much later date when the final closure plan is developed five years before closure. As the cost implications for the various closure options are investigated for each five-year review, funding may need to be set aside should any of these options appear to be both likely and costly.

5.1 Rehabilitation practices

This section addresses the objectives of Condition 706:M10 that are given in the previous section.

5.1.1 Disturbed areas

Operational disturbance will be limited to the boundaries as indicated in Figures 1 and 2. After establishing operations in Areas 1 and 2 the quarry will progressively utilise the resources in Areas 3 through to 6 (Figure 3) by advancing benches into new resource areas. This is likely to take place over the next 50 or more years (EPA 2005, Figure 3).

Fencing: The first activity in a new area to be quarried will require a fence-line to be cleared through vegetation followed by the construction of a "fauna-proof" fence to 1.8 m using "Cyclone Diamond Mesh Chainwire" or equivalent. The fence will be buried to 50cm where trenching is possible or bent outwards and secured with rock in caprock areas. Felled trees will be used to create woodpiles in adjacent bushland for habitat enhancement.

The fence will minimise the chance of local fauna from straying into operations areas or from falling into the pit, once quarry operations have commenced. A significant portion of the bushland-end of the fencing enclosure will be left open to allow any fauna remaining within the enclosed area to escape as clearing progresses from open, cleared areas towards bushland areas. The bushland end of the project area will only be closed by fencing once clearing has been completed for the area to be enclosed; this will minimise the probability of local fauna from returning to the project area.

Topsoil: Stripped topsoil removed for the initial phases of the proposal will be used for rehabilitation outside of the project area as soil biota would not survive storage for the extended period of years when rehabilitation will be required within worked operational areas. As the quarry progresses into Areas 3 to 6, topsoil may then be directly transferred to any areas that may be required for tree planting in the event that vertical bench faces are visible outside of the quarry. Consequently it is not anticipated at this stage that there will be any stockpiling of topsoil.

Gravel: Gravel is anticipated to average one metre thick and will be removed as a basic resource in the manufacture of various BGC products.

Clay: Up to 12 metres of clay may be removed, depending on location, and be used either as a resource or will be used for safety bunding or for backfilling the existing quarry. Statutory safety requirements necessitate the construction of a safety bund on the periphery of quarry workings.

Note: Figure 1 of Ministerial Statement 706 indicates stockpile areas outside of the intended resource area. These are likely to be used from time to time as operational needs dictate for temporary storage as space limitations may dictate.

5.1.2 Rehabilitation in conjunction with site operations

Objective: To rehabilitate worked areas when these are no longer required for quarry operations.

The quarry will consist of a pit with progressive benching into new resource areas. Existing benches will function as haul roads and access to new worked faces as these are created. However, where bench faces are visible from outside of the quarry, these will be subject to tree planting against the bench face over a prepared surface of overburden and topsoil. In this contingency, between 50 cm and 1 m of overburden should be applied with topsoil spread over this layer. The tree species most likely to flourish in this environment would be *Eucalyptus wandoo*, whose preferred habitat is within the greater region where clay layers and underlying granite protrude or lie close to the surface. Use of water sprays in summer, normally available for dust suppression should be applied to any plantings against vertical faces. The natural seed bed within the topsoil would provide understory vegetation to planted Wandoo tube stock.

Abandonment options are canvassed in Table 2. DoIR guidelines *Environmental Management of Quarries* provides detailed advice for ensuring the best possible outcomes for quarry management and planning. The quarry operator will implement the guidelines insofar as these are applicable to the proposed operations (the *Guidelines* apply to many different types of quarrying activities).

5.1.3 Cleared areas outside of operational footprint

Objective: To ensure disturbed areas outside of the operational area of Lots 11 and 14 are rehabilitated.

Prior to the proposal being assessed by the EPA, a portion of Lots 11 and 14, outside of the existing approved operational area, was subject to tree clearing. However, underlying shrubs and topsoil were not removed. Consequently, if left on its own, this area will regenerate without further manipulation or intervention. The Shire of Mundaring currently monitors the progress of regrowth through opportunistic inspections and periodic reports submitted by the quarry operator. The quarry operator has agreed to replant a number of those species as recommended by the Shire.

Consideration should be given to introducing *Hemigenia viscida*, a Priority Listed species found within the project areas (URS 2003), should monitoring indicate that the species has not recovered or is absent.

The majority of Lots 11 and 14 are free from dieback (*Phytophthera sp*.) except for a band adjacent to the Great Southern Highway (URS 2004, App.C). The rehabilitation area should remain dieback-free, provided vehicles entering dieback-free areas for firebreak maintenance and safety bund construction are cleaned before entering. The outer boundaries of Lots 11 and 14 are to be fenced in accordance with Condition 6706:M7.2 which will prevent as far as possible, illegal vehicle entry into Lots 11 and 14.

5.1.4 Visual strategy

Objective: To ensure that the operations of the quarry do not compromise the aesthetic values of the local environment.

The worst-case results provided by a viewshed analysis (URS 2003) assumed that there is no vegetation between the viewing points (Figure 4) and the project area, and there is no allowance for atmospheric conditions over distance. In Figure 4 each residence is assigned a colour and coloured hatched areas represent the areas visible from that residence.

Note: The view points in Figure 4 (coloured stars) coincide with nearest residences shown in Figure 2.

Predictions of the viewshed model are as follows:

- The quarry would be visible from the residence located 2.4 km to the east (View Point 1, Figure 4) of the project area. However there is a vegetation buffer in close proximity to the viewing point, which is likely to obscure the visibility of the proposed project. The physical detail of the proposed operations, that is form, line, colour and texture, will be reduced as distance from the viewing point increases. This effectively results in a reduction of potential impact.

- The quarry would be partially visible from the residence to the north (View Point 2, Figure 4). The model predicts that the south-east corner of the proposed quarry pit would be visible if there was an absence of screening vegetation, but it is likely that that vegetation within Lot 14 will obscure the view from this residence. As structures were modelled at ground level (0 m) and the processing plant and other infrastructure are to be placed below ground level, these structures will be effectively screened by the walls of the quarry pit.

- There will be no visual impact on the residence to the west (View Point 3, Figure 4). The topographic features of the landscape naturally screen the proposed operations from this viewing point.

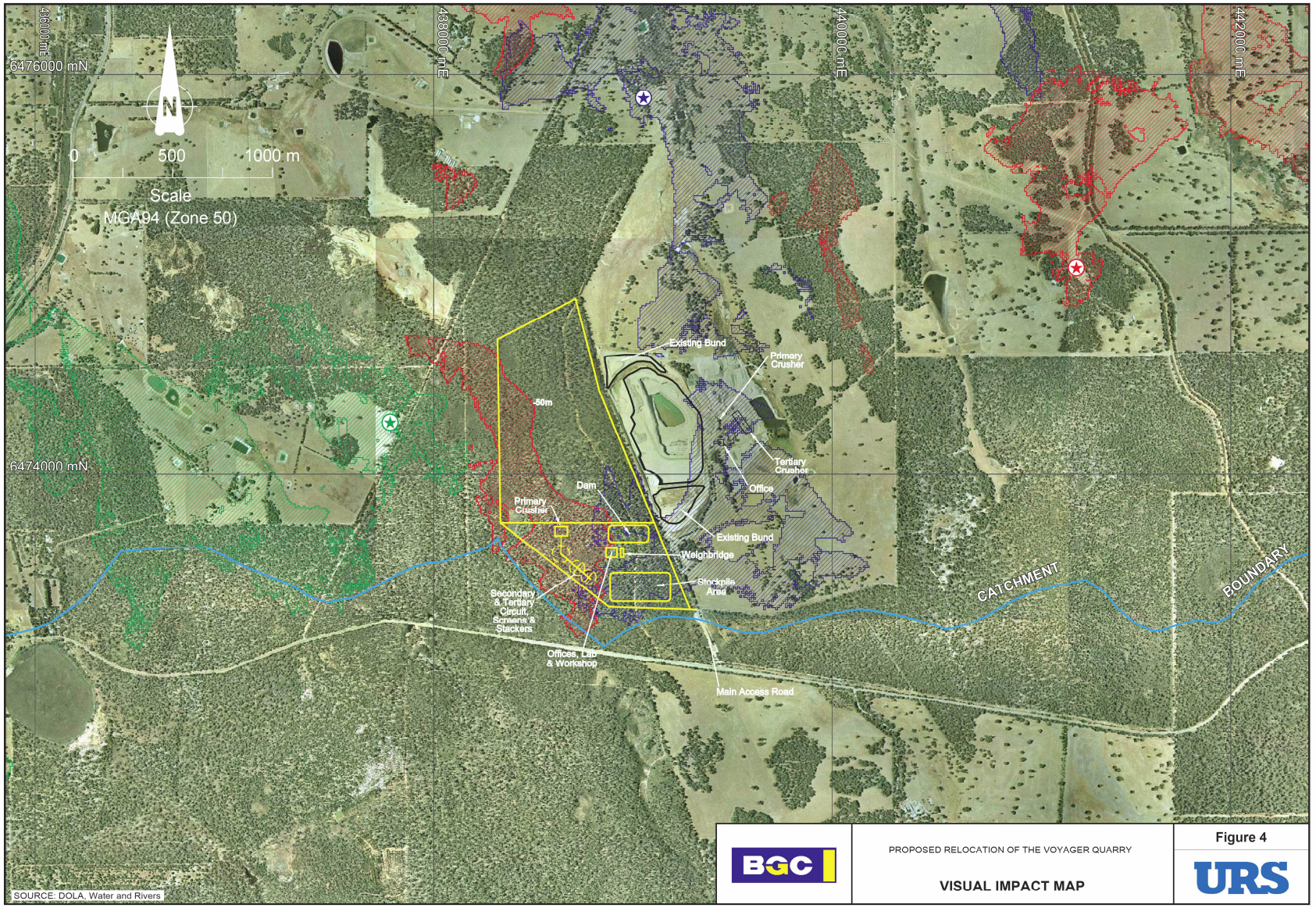
- There will be no visual impact from public roads, such as Great Southern Highway and Horton Road. Photographic records were collected to demonstrate that the vegetation provides an effective screen for the operations (URS 2003).

The visual modification of the landscape will be managed through the implementation of the following strategies:

- Vegetation will be retained around the quarry to screen the operations from roads;

- Access routes will be screened using native vegetation and roads will be angled away from the quarry to ensure that the line-of-sight is not directly at the quarry;

- The site will be kept tidy through the implementation of good house-keeping practices;
- A complaints register will be maintained and include any complaints received in regard to adverse visual impacts on neighbouring properties indicated in Figure 4;
- Additional tree plantings will be undertaken to shield residences to the north east of the quarry (Figure 4); and
- The quarry operator will provide tree tube-stock for visual screening for local residents who will have line of site into the quarry.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Primary Crusher
50m
Tertiary Crusher
Office
Dam
Primary Crusher
Existing Bund
Weighbridge
Stockpile Area
Secondary & Tertiary Circuit, Screens & Stackers
Offices, Lab & Workshop
Main Access Road
CATCHMENT
BOUNDARY
SOURCE: DOLA, Water and Rivers
BGC
PROPOSED RELOCATION OF THE VOYAGER QUARRY
VISUAL IMPACT MAP
Figure 4
URS

Artificial lighting

Objective: To ensure that the artificial lighting of the quarry does not compromise the aesthetic values of the local environment.

There are three types of lighting effects that could be experienced with the use of conventional lighting:

- where lighting structures are directly visible and where the light source is directed at the viewer;
- where lighting structures are indirectly visible where the light source is not directed at the viewer; and
- general night-glow which results from light of sufficient strength from a single or multiple source being reflected in the atmosphere. As such it will also be influenced by atmospheric conditions such as fog, low cloud and/or dust particles, which will reflect the light. Conversely, on a clear night this effect would be lessened.

It is considered that there will be an extremely low potential for neighbouring residents to experience lighting impacts as the plant facilities will be located below ground level and the lighting would be screened by the walls of the pit. Indirectly visible lighting and general night-glow may be experienced under some atmospheric conditions, such as when fog is present.

Lighting impacts can be managed through a number of measures, the most effective being that of intervening topography and vegetation. Other strategies to be implemented include:

- Quarrying, crushing and screening operations will operate at most between 0700 and 1900 hrs; thus reducing the lighting requirements for these operations;
- Lighting will be kept to the minimum necessary for operational needs and safety;
- Lights will be installed at as low a level as possible and where possible, lights will be directed away from incoming views and away from pit walls where lighting is not required;
- Lights will be directed to the ground and work areas and avoid being cast over long distances;
- Where feasible, foreground planting at sensitive view locations such as residences that may have direct line of sight to the quarry will be undertaken;
- Installation and use of appropriate lighting technology will be investigated to further minimise potential lighting impacts; and
- A complaints register will be maintained and include any complaints received in regard to adverse artificial-lighting impacts on properties indicated in Figure 2 and viewpoints indicated in Figure 4.

5.2 Post-operational environment

This section lists outcomes arising from the implementation of strategies to minimise the potential adverse impacts identified in Section 3.1. and addresses the issues enumerated by the ANZMEC guidelines (Section 4.1).

Objective: To ensure the process of closure occurs in an orderly, cost-effective and timely manner.

The ANZMEC Strategic Framework document (ANZMEC 2000) recommends establishing a set of indicators which will demonstrate the successful completion of the closure process. The following principles apply to ongoing rehabilitation and closure planning:

- It is in the interest of all stakeholders (for the quarry operator) to develop standards that are both acceptable and achievable;
- Completion criteria are specific to the mine (quarry) being closed, and should reflect its unique set of environmental, social and economic circumstances (the unique circumstances have been described in Section 4.1); and
- An agreed set of indicators should be developed to demonstrate successful rehabilitation of a site.

5.2.1 Built environment

At the time of site closure for the relocated Voyager Quarry, it is assumed that all buildings and infrastructure will be decommissioned and removed from the site. The decommissioning and rehabilitation activities for the relocated quarry would involve the following:

- Decommissioning the primary, secondary and tertiary crushers. These components of the plant will be sold; removed to other operations or salvaged as scrap material;
- Decommissioning and removing the screens;
- Removing the offices, workshops and weighbridge and ripping up and removing all concrete and masonry structures and foundations; where all of these, if uncontaminated by hydrocarbons or other contaminants, will be buried in the quarry pit where this is consistent with the finally agreed closure plan;
- Removing any hydrocarbon or other contaminated masonry, concrete (or soil) to DEC-approved landfill;
- Removing any stockpiled material;
- Capping and plugging monitoring bores;

- Exploratory drill holes will be securely plugged with concrete conical plugs during the operational lifetime of the quarry. Any drill holes likely to lie outside of the operational area should be backfilled or otherwise made safe;
- Rehabilitating any disturbed surfaces outside of the quarry pit such as roads, stockpile and operations areas that are not required for the future land use. This will require a combination of deep ripping, filling with overburden if required and spreading available gravel and topsoil; and
- Monitoring the progress of surface rehabilitation against completion criteria to the satisfaction of the Shire of Mundaring for areas presently disturbed outside the operational area or to the requirements of criteria that will be decided upon when closure options for the quarry are agreed (Table 2).

Option	Assessment Criteria					Sustainability as Post-Operation Void Use*
	Safety and Stability	Practicality of Implementation	Environmental Sustainability	Cost Effectiveness	Acceptability to Stakeholder*	
Leave as an abandoned void	Granite is a competent rock that is able to stand at vertical or near vertical angles for significant periods of time, depending on the intensity of fracturing. However, some slumping or slippage may occur. Would require establishment of an abandonment bund.	Practical, depending on a range of issues including the nature of any water body that may form in the void and slope stability. Forward planning required for both the cost and siting of the abandonment bund.	May be environmentally sustainable depending on issues such as the nature of any water body that may form in the void.	Costs may be incurred for any monitoring and maintenance requirements. A start to constructing an abandonment bund could begin when and if this option is taken. The bund would require prior costing.	May be acceptable to stakeholders if there is no impact outside of the Project Area.	Low-medium.
Water Supply for Human Consumption	If the void is sold on for this purpose, the safety implications and likely costs of implementing these for water managers would have to be made clear in the transferral agreement.	Would require evaluation of the quality and quantity of water that would likely to accumulate in the void. Impractical if water quality is not suitable for human consumption.	Could be sustainable depending on rate of inflow and abstraction. Not sustainable if abstraction exceeds inflow. The operational period would provide water balance information to indicate viability of this option.	Costs would depend on water supply design and implementation, and need to be assessed. The berms may need to be battered down to ensure safety for those entering the void. This would incur significant costs.	May be acceptable to stakeholders if there is no impact outside of the Project Area.	Low.

Option	Assessment Criteria					Sustainability as Post-Operation Void Use*
	Safety and Stability	Practicality of Implementation	Environmental Sustainability	Cost Effectiveness	Acceptability to Stakeholder*	
Water Supply for Watering of Stock.	As above.	Evaluation required of the quality and quantity of water that would be likely to accumulate in the void.	As above.	As above.	May be acceptable to stakeholders if there is no impact outside of the Project Area.	Low-medium.
Water Supply for Crop Irrigation.	As above.	As above. Practicality of this option will depend on a range of factors including distance between the supply and the crop and the salinity of the water.	Not environmentally sustainable if abstraction exceeds inflow. Irrigation may contribute to salinisation of the catchment, which would not be acceptable.	As Above. Cost of installing an irrigation system not quantified. Cost of rehabilitating any land that becomes salt-affected due to irrigation could be significant.	Increase in land salinisation in the catchment would not be acceptable to stakeholders. If no risk of salinisation, then may be acceptable to stakeholders.	Low-medium.
Recreational Use.	Will depend on a range of issues: nature of any water body that forms; surface stability of quarry walls, ease of access and type of recreational activities proposed at the site. Public liability for water managers would have to be made clear in the transferral agreement.	Pit walls may be suitable for rock climbing or abseiling. If a water body forms in the void, it may be suitable for swimming. The bushland around the void could be used for picnicking, camping, bush walking and bird watching.	May be environmentally sustainable depending on issues such as the nature of any water body that may form in the void.	The berms may need to be battered down to ensure safety for those entering the void. Liability and safety considerations to be included in any transfer agreement.	May be acceptable to stakeholders if there is no impact outside of the Project Area.	Low to Medium.

Option	Assessment Criteria					Sustainability as Post-Operation Void Use*
	Safety and Stability	Practicality of Implementation	Environmental Sustainability	Cost Effectiveness	Acceptability to Stakeholder*	
Waste Disposal for Waste Rock (Overburden)	Containment of inert waste material would assist in reducing the risk of surface slumping or slippage.	Practical, depending on potential sources of fill material.	Environmentally sustainable, provided the final land surface is re-contoured appropriately and a stable vegetative cover is established on the surface.	Cost-effective depending on potential sources of fill material. Existing guidelines require fill sourced from overburden to be set aside for capping.	Possible acceptable to stakeholders provided that the material is not contaminated with putrescible waste.	High.
Waste Disposal for Municipal Waste Class I (Inert); or Class II (Putrescible)	Containment of municipal waste material would assist in reducing the risk of surface slumping or slippage.	Practical for the local councils to utilize the space in the void, instead of constructing new landfills.	The permeability of the walls may need to be assessed to determine whether the material could be properly contained.	Could be a cost-effective option. Will depend on the suitability of the quarry void for the containment of municipal waste or if liners or other membranes are required. Capping requirements as above	Not considered to be an appropriate option by stakeholders.	Low.
Aquaculture	Will depend on a range of issues such as the nature of any water body that forms in the void, surface stability of the quarry alls, and ease of access to the void.	Currently cannot be quantified, but would depend on a range of factors including water depth, turbidity, salinity and temperature stratification.	Environmentally sustainable depending on the way in which such a land use is developed and managed.	Not able to be quantified.	This option may be acceptable to stakeholders. Safety and liability issues to be considered in transfer agreement.	Medium.

* Subject to ongoing review by Community Consultation Group and other relevant Stakeholders.

5.2.2 Landform and soils

The main change in the landform will be the presence of a quarry void, instead of the original granite outcrop and overlying vegetation. The void will be approximately 900 m long, 450 m wide and 30 to 50 m deep. Based on available drilling results, it is expected that the top 18 m of granite is fractured. This is associated with the saprolitic zone of the weathered granite profile. Due to the presence of this zone, there is potential for some surface slumping or slippage at the edge of the open pit. If the pit is not backfilled, a geotechnical study needs to be undertaken prior to closure to assess the risk of slumping of the pit edge. Abandonment bunds (DoIR 1997) are to be constructed during the lifetime of the quarry in accordance with DoIR requirements. These bunds are for the purpose of making the quarry safe by keeping stock, fauna and people away from the edges of the void. The bunds also prevent inflow of surface water into the void.

At the completion of the operations at the relocated quarry, the only created landforms will be abandonment bunds if the pit is not going to be backfilled.

5.2.3 Surface hydrology

The subject of surface hydrology has been dealt with in a separate management plan prepared in compliance with Condition 706:M13.1. A brief outline of this document is given below.

The cessation of the proposed quarry will result in a return of the stream flows and water quality to levels experienced prior to the development of the existing and relocated Voyager quarries (URS 2004). The operation of the relocated quarry will increase the stream flow in the local catchment because of the controlled discharge of water from the quarry. The operation of the relocated Voyager Quarry will also decrease the downstream salinity of the water in the local catchment, as the discharged water will have much lower salt concentration than the existing stream flow. Therefore, the closure of the relocated quarry will reduce the stream flow and increase salinity of watercourses downstream of the quarry only because water will no longer be pumped from the quarry to these streams.

The quarry will be surrounded by a safety bund which will direct water flows away from the quarry void. Consequently, there will be no overflow to nearby streams from the quarry due to surface water inflows.

All approaches to the quarry will be topsoil spreading and ripped with consequent vegetation regrowth, consequently there should be no sediment runoff from any disturbed areas outside the quarry void.

Any hydrocarbon contaminated soils will be disposed of in accordance with regulatory requirements, consequently there should be no contaminates within or outside of the quarry void likely to contaminate local streams.

5.2.4 Groundwater hydrology

The subject of groundwater hydrology has been dealt with in a separate document in compliance with Condition 706:M13.1.

The groundwater levels within the immediate area of the pit wall are expected to return to levels prior to the development of the existing and relocated Voyager quarries (URS 2004). As both of the quarry operations require the dewatering of groundwater to allow quarrying activities to be conducted below the water table, this results in the lowering of groundwater levels immediately adjacent to the quarry.

The quality of the regional groundwater will not be affected by the closure of the proposed quarry.

If the pit void is left empty, limited groundwater seepage would flow into the pit. Based on preliminary hydrogeological work, it is estimated that if surface runoff is directed away from the pit, as will occur due to safety bunding, groundwater seepage, direct rainfall collected within the pit and evaporation will come into balance (URS 2004). However, this information is uncertain and estimates of likely water levels in an abandoned void will need to be updated as water monitoring data, required by the Groundwater and Surface Water Monitoring Programmes (Condition 706:M13.1), is accumulated and analysed during the operation life of the quarry.

5.2.5 Vegetation and flora

During quarry closure, rehabilitation will be undertaken for any surface disturbances, such as roads that are not required for the future land use and any stockpile areas.

When the quarry is expanded into new areas, available topsoil will be used for rehabilitation outside of the quarry as rehabilitation within the quarry is expected to be very limited. This will be subject to proposed outcomes and development of the final Closure Plan (Table 2).

Lots 11 and 14 are largely free of dieback disease (See 2.2.4) and will remain so provided ongoing management of the quarry ensures vehicles and/or plant entering these areas for fencing, bund construction and fire break maintenance are subject to dieback hygiene measures. The only area infected with dieback is a narrow band of forest adjacent to the Great Southern Highway. The flow of surface and groundwater is towards the highway, as the water shed is to the north of the infected area, and consequently dieback will not spread due to natural causes.

5.2.6 Fauna

Potential risks to the fauna caused by the closure of the quarrying operations will be addressed. All operational areas, and therefore abandoned pits, will be fenced using “fauna-proof” fencing. Monitoring bores will be plugged to ensure that small animals do not become trapped in these structures and that larger animals will not be at risk of injury. Exploration drill holes will be plugged with concrete conical plugs and those remaining in undisturbed land will be backfilled.

5.2.7 Social environment

The closure of the quarry is likely to bring an alternative use including landfill. In this case, although there would be no more blasting, issues such as dust and noise would remain.

The operational area is wholly owned by the quarry operator, consequently relinquishment or final disposal of the land would depend on financial and social factors at play at the time of closure. If the quarry is to be relinquished it would depend on the options for final use. If left as a void, as outlined in Table 2, each option (water supply, aquaculture, recreation) would require separate consideration that would have safety implications and costs associated with making the quarry safe, such battering down berms. If used for landfill, the local government authority or contracting agency at the time would assume responsibility depending on relinquishment or purchase by the land fill operator.

Indicators

The EPA's objective is that the post-mining landform is safe, stable, non-erodable, and is, as far as is practicable, integrated into the surrounding landscape. The performance indicators for stability, non-erodability and integration are intrinsic to the nature of the quarrying process.

- *Stability*: Granite bedrock, to be quarried will form the floors and walls of the void and as such are highly stable structure. Slumping at the edges of the quarry void will have to be assessed and appropriate planning and costing taken into account for future safety issues.
- *Non-eroding*: The quarry will be non-eroding as it will consist of a void below the surrounding landscape. A Separate Surface Water Monitoring and Remedial Programme (Condition 706:M13.1) includes ongoing measures and actions to prevent and monitor for any erosional influences outside of the quarry void.
- In*tegration into the landscape*: The closure options include leaving either as a void with various use options (Table 2) with visual screening from surrounding areas or else use as a Class 1 landfill with final surface rehabilitation by the authority managing the landfill.
- *Safety* is to be addressed in the ongoing development of the quarry where quarry voids are to be securely fenced and with safety bunds constructed in accordance with DoCEP requirements. Safety issues associated with abandonment are subject to statutory requirements.

Rehabilitation practices

Stripped topsoil from Areas 1 and 2 will be used for rehabilitating areas outside the quarry due to limits on storage time for soil biota because worked areas within the project area will not be available for rehabilitation for many years into the future. Benching operations, as will be required for the proposed quarry, require that nearly all bench surfaces are required as roadways and access to working faces almost to the end of the quarry life.

As an example of how closure may be planned for the relocated quarry, closure planning for the existing quarry, whose closure is planned to commence within five years or thereabouts, is now proceeding. The current closure planning, particularly for void, demonstrates that detailed planning in regard to current concerns and opportunities and stakeholder input is far more relevant when closure is anticipated in time lines considerably less than the 50 or more years anticipated for the proposed operations on Lot 14.

BGC are currently in negotiation with the landowners of the existing quarry site. The negotiations centre around utilising the void as an inert landfill (Class 1). This would possibly be structured as a joint venture between BGC and the landowners. Time frames, with respect to how long to fill the void up to existing ground level cannot be estimated at this time. However once ground level is reached there would be a program to rehabilitate the surface. Criteria for this would need further discussion when this stage is approaching. To date the landowners have expressed a wish for the land to be used for farming by future generations of their family.

BGC could very well apply this scenario to the new quarry subject to stakeholder consultation

The performance indicator will be an agreed closure plan for the quarry to be developed in consultation with relevant stakeholders and community at least five years before planned closure.

Erosion

Special consideration will have to be given to planning the route of the safety and abandonment (if required) bunds to ensure that these take terrain features into account to prevent ponding of stormwater or discharge of silt to down stream areas. This requirement is included in the Surface Water Plan (Condition 706:M13.1)

Cleared areas outside of operational footprint

Those areas of Lots 11 and 14 outside of approved operational areas that were cleared prior to the impact assessment by the EPA are being monitored in liaison with the Shire of Mundaring. The quarry operator has agreed to implement such plantings as may be recommended by the Shire. At the time of closure the plantings will have taken place and the success of rehabilitation will be evident. Any additional work that may be required should be agreed at the time of preparing the final closure plan.

To provide a satisfactory performance indicator for cleared areas outside of the operational area, the quarry operator should take photographs from a given vantage point of the rehabilitating area at the same time each year. Successive photographs should be included in the report to the Shire of Mundaring. Monitoring may cease once regrowth had advanced to a level satisfactory to the Shire.

Visual strategy and artificial lighting

Vegetation will be maintained around the quarry to provide screening; with additional tree planting taking place on the eastern margins of the quarry to shield quarry workings from the north west (Figure 4). Where benches may be visible from outside of the quarry, trees may be planted against the vertical face of the bench over a prepared surface of overburden and topsoil as may be made available from ongoing operations.

Prior to closure, acceptable lighting practices will have been implemented.

A complaints register will be maintained to ensure the quarry management is aware of any visual intrusion.

7.1 Ongoing monitoring

Ongoing monitoring for closure will be limited to:

- Monitoring the progress of rehabilitation of disturbed areas outside of the project area in consultation with the Shire of Mundaring. Take photographs each year from the same vantage point to monitor the progress of rehabilitation until the Shire of Mundaring is satisfied with the state of rehabilitation;
- Consultation with stakeholders to ensure any visual impacts are remediated;
- Monitoring the continued visibility of warning signage, the security of bunds and fencing;

The complaints register will track any problems that are likely to occur in regard to visual amenity or light overcast

When completing the Annual Report, the Quarry Manager will indicate any remedial action that has been taken in regard to complaints received.

Note that other aspects of the quarry operations such as dust, noise and vibration are addressed in documents specific to these aspects. These are addressed as follows

- Dust: Dust Monitoring and Remedial Action Plan;
- Construction Noise: Area Noise Management Plan and in the Area 1 &2 Noise Management Plan
- Operational Noise: Operational Noise Management Plan

7.2 Contingencies

The Annual Performance Review Report will indicate if any breaches of visual screening or occurrences of quarry lighting visible at night.

8.1 Stakeholders

Objective: To enable all stakeholders to have their interests considered during the mine closure process

The following stakeholders have expressed an interest in viewing and commenting on this document.

Stakeholder	Stakeholder Contact (2006)
Shire of Northam*	Mr Phil Steven
Shire of Mundaring	Mr Jeremy Hofland
Commissioner for Soil and Land Conservation:	Mr Andrew Watson
Department of Industry and Resources*	Mr Eugene Bouhuis
Department of Consumer and Employment Protection*	Mr Anil Atri
Department of Environment and Conservation	Mr James Treloar
Community Liaison Group (ongoing consultation)	Mr Bert Llewellyn, Shire President, Shire of Northam

* Comments received by 27 October deadline.

Note: Department of Water requested not to be involved.

8.2 Community and Stakeholder liaison

Ministerial Condition M19.2 has been set in regard to communicating the outcomes of certain Ministerial conditions to a Community Liaison Group.

M19.2 Prior to the finalisation of plans, strategies, and programmes required by Conditions 8.1, 9.3, 10.1, 12.1, 13.1, 15.1, 16.1 and 18.1, the proponent shall make reasonable endeavour to establish a Community Liaison Group to the requirements of the Minister for the Environment

The outcome of this requirement will be provided in a separate communication to Department of Environment and Conservation.

The following Agencies have been consulted to date regarding the development of this Plan:

- Department of Industry and Resources: Mr E Bouwhuis, Senior Environmental Officer/Inspector Ms Xuan Nguyen; General Manager Environment (Mining).
- Department of Consumer and Employment Protection: Mr Anil Atri, Regional Mining Engineer, Senior Inspector of Mines, Mines Safety Branch.

- Water Corporation of WA: Mr Karina Congdon, Environmental Engineer, Surface Water Operations, Water Technology Division.

8.3 Ongoing liaison

Liaison with the Department of Environment and Conservation (DEC) Environmental Audit Branch through Annual Reporting and the Community Liaison Group as required. The quarry operator will continue to liaise with Local Government Authorities, particularly Mundaring in regard to rehabilitation of disturbed areas outside of the operational area.

9.1 Auditing

The Quarry Manager and Environmental Officer will be required to ensure that all management actions as per Section 10 of this document are carried out. An audit of Management Plan Actions (Section 10) is to be conducted each year prior to compiling the annual report to DEC.

The DEC Environmental Audit Branch has a policy of conducting audits from time to time to verify compliance by proponents with Ministerial Conditions

The ANZMEC *Strategic Framework* document (ANZMEC 2000) recommends that there be adequate accountability to manage the closure plan:

- The accountability for resourcing and implementing the closure plan should be clearly identified.
- Adequate resources must be provided to assure conformance with the closure plan.
- The on-going management and monitoring requirements after closure should be assessed and adequately provided for.
- A closure business plan provides the basis for implementing the Closure Plan.
- The implementation of the Closure Plan should reflect the status of the operation.

The above ANZMEC requirements are to be updated and taken into account in forward mine planning and included in the updated Closure and Rehabilitation Strategy prior to the expansion of the quarry into each of Areas 3 to 6 inclusive. An auditor's report should be provided to verify these requirements.

9.2 Review and revision

The life of the Voyager Quarry is expected to be over 50 years with a series of clearing operations to occur as indicated for Areas 1 through to 6 in Figure 3. (See also EPA 2005, Figure 3)

The experience gained during the first phase of the operations for Areas 1 and 2 will be documented and reported to the DEC Audit Branch in the first annual report as required by Condition 706:M5.2. This information will be used to review and revise this Closure and Rehabilitation Strategy prior to clearing operations being approved prior to any additional clearing operations.

Experience gained as the quarry is expanded into each new area will enable a final closure plan to be developed prior to operations extending into Areas 5 and 6. All stakeholders are to be consulted prior to finalising the revised document. Experience gained in terms of water balance (net gains or losses to water contained in the quarry), visual screening and bunding to be taken into account in the revision.

The ANZMEC Strategic Framework document (ANZMEC 2000) objectives: To ensure the cost of closure is adequately represented in company accounts and that the community is not left with a liability.

- A cost estimate for closure should be developed from the closure plan.
- Closure costs should be reviewed regularly to reflect changing circumstances.
- The financial provision for closure should reflect the real cost.
- Accepted accounting standards should be the basis for the financial provision.
- Adequate securities should protect the community from closure liabilities.

The above ANZMEC requirements are to be updated and taken into account in forward mine planning prior to the expansion of the quarry into each of Areas 3 to 6 inclusive. A statement of compliance with the above requirement to be provided with each updated Closure and Rehabilitation Strategy to be submitted to the DEC.

9.3 Reporting

Within three months of the completion of clearing, a report will be provided to the DEC providing an outline of compliance with this Management Plan. Thereafter, Annual Reports will be required every twelve months following completion of clearing.

The experience gained during the first phase of the operations for Areas 1 and 2 will be documented and reported to the DEC Audit Branch in the first annual report as required by Condition 706:M5.1

Table 3. Key Management Actions.

Issue	Management Action	When	Responsibility
Visual Impact	Ensure vegetation buffers are maintained through foreground plantings as required to screen quarry operations particularly from the north west.	Ongoing.	Env. Officer
	Angle roads to ensure there is no line of site into the quarry.	When constructing quarry access routes.	Quarry Manager
	Maintain a complaints register.	Ongoing.	Env Officer
	Use topsoil and overburden for tree plantings (*E.wandoo*) against vertical bench faces if these are visible outside of the quarry.	As required when developing Areas 3 to 6.	Env Officer
	Ongoing consultation with community to ensure minimal visual impacts.	Ongoing.	Env Officer
	Provide tube stock trees to any local residents for screening direct line of site into the quarry.	Ongoing.	
Ongoing Monitoring	Progress of rehabilitation of areas outside of quarry operational area in consultation with Mundaring Shire. Ensure dieback hygiene is maintained for any vehicles entering this or other conservation areas for bund construction, fencing or firebreak maintenance. Take photographs each year from the same vantage point, as evidence of progress, until the Shire of Mundaring is satisfied with the rehabilitation.	Annual.	Env Officer
Review & Revision	The Closure and Rehabilitation Strategy to be periodically revised .	Before advancing the quarry into new Areas 3, 4, 5 and 6 respectively.	Quarry Manager
Final Closure Strategy	A final Closure Strategy, will be prepared and submitted for review by all relevant stakeholders.	Before advancing operations into the remaining Area – either 5 or 6.	Quarry Manager

Issue	Management Action	When	Responsibility
DEC Annual Report	Provide an update on the status of quarry operations and intentions for next year including any rehabilitation undertaken.	Each year in Annual Report.	Env. Officer
	Provide an update on regrowth and rehabilitation of disturbed areas outside operational area.	Each year in Annual Report.	Env. Officer
	Provide an update on regrowth of vegetation in bench areas subject to rehabilitation.	Commencing in the year following first bench rehabilitation efforts.	Env. Officer
	Provide DEC with a copy of the complaints register.	Each year in Annual Report.	Env. Officer

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SECTION 11

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Limitations

SECTION 12

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of BGC (Australia) Pty Ltd and only those third parties who have been authorised in writing by URS to rely on the report. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 10 August 2006.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

This report was prepared between 21 August 2006 and 27 March 2007 and is based on the conditions encountered and information reviewed at the time of preparation. URS disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.