ENVIRONMENTAL MANAGEMENT PLAN

Dust Monitoring & Remedial Action Plan

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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Contents

Contents

Tables

Figures

Contents

1.1 Aspect of the environment to be protected

The environmental factor assessed by the EPA relevant to this management plan is "dust".

Management of dust is a key issue for all extractive industry operations. Whilst it is accepted that some dust generation is unavoidable during most types of ground disturbing activity, it is unacceptable for this dust to have health, environmental or significant amenity implications for the surrounding community.

The following quarry operations have the potential to cause dust lift-off:

- Drilling and blasting;
- Loading, hauling, conveyor movements;
- Crushing and screening involving primary, secondary and tertiary crushing with associated screening to various product specifications; and
- Trucking operations.

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

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 on behalf of BGC (Australia) Pty Ltd. Perth, WA.

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.

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.

Table 1. Statutory, policy and other guideline requirements

Agency	Statute/ Guideline	Applicability
Dept of Environment & Conservation	*Environmental Protection Act 1986*	Ministerial Statement 706 was issued under Part IV of the Act. Condition 706:M12 provides conditions to be met prior to clearing operations. Quarry Crushing and screening operations are licensed under Part V of the Act and are subject to both Works Approvals and Operating Licences principally for the purpose of minimising dust emissions for crushing and screening operations.
Department of Consumer and Employment Protection	*Occupational Safety and Health Act 1984* *Occupational Safety and Health Regulations 1996*	Occupation and safety measures required in regard to worker safety and health have relevance to the aspect of dust.
Dept Industry and Resources (1999)	*Environmental Management of Quarries* (1994)	Provides detailed guidelines in regard to dust management.
Dept Environment & Conservation (2006)	*Preparing Environmental Management Plans* (2006)	Draft guidelines for the preparation of Environmental Management Plans submitted in compliance with Ministerial Conditions.
Australian Standards	AS2923 *Ambient Air- Guide for measurement of horizontal wind for air quality applications*. AS 2922-1987 *Ambient air – Guide for the siting of sampling units*.	Standards/guidelines for the placement of weather monitoring and air sampling units.

The proposed relocation of the quarry is to Lot 14 (Figure 1), Horton Road, The Lakes, Shire of Northam that is 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 was 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 activities 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 12 reproduced below.

12-1 *Prior to clearing of vegetation or excavation of soil or rock, whichever is the sooner, the proponent shall prepare a Dust Monitoring and Remedial Action Programme, to the requirements of the Minister for the Environment.*

The objective of this Programme is, by monitoring dust concentrations, to ensure that dust associated with all operations (including land clearing, excavation, blasting, dust lift-off from stockpiles and general operational activities such as screening, crushing and transport) which emanates from and leaves the site complies with the standard prescribed in condition 11-1 (see below).

This Programme shall include but not be limited to:

1. *Continuous dust and meteorological monitoring;*
2. *Ambient dust monitoring at two or more Sensitive Sites in the vicinity of the quarry[1]);*
3. *A reporting schedule for monitoring data and results;*
4. *Improvements to monitoring and reporting; and*
5. *Remedial action to be undertaken to prevent exceedances if the dust source is within the proposal area, or the dust arises from operational activities (including vehicular movements).*

12-2 *The proponent shall implement the Dust Monitoring and Remedial Action Programme required by condition 12-1 and any subsequent updates as required by condition 12-3.*

12-3 *The proponent shall review and update the Dust Monitoring and Remedial Action Programme required by condition 12-1 annually.*

12-4 *The proponent shall report to the Department of Environment any exceedances of the standard prescribed in condition 11-1.*

[1] *A "Sensitive Site" is defined as including any land within 10 metres of a residence, hospital, school or other premises in which people could reasonably be expected to be free from undue annoyance and nuisance caused by blasting.*

12-5 The proponent shall provide a report to the Department of Environment relating to the exceedances referred to in condition 11-1 within seven days of being recorded, identifying the sources of the dust, and, if the source is within the proposal area, or from operational activities (including vehicular movements) and indicating remedial action undertaken to prevent further such exceedances.

12-6 The proponent shall make the Dust Monitoring and Remedial Action Programme required by condition 12-1 publicly available.

Other conditions that relate to Ministerial Condition 706:M12.1 include

11-1 The proponent shall ensure that dust emissions from Lot 14 do not exceed an ambient PM10 level of 50 micrograms per cubic metre averaged over a 24 hour period when measured at the property boundary.

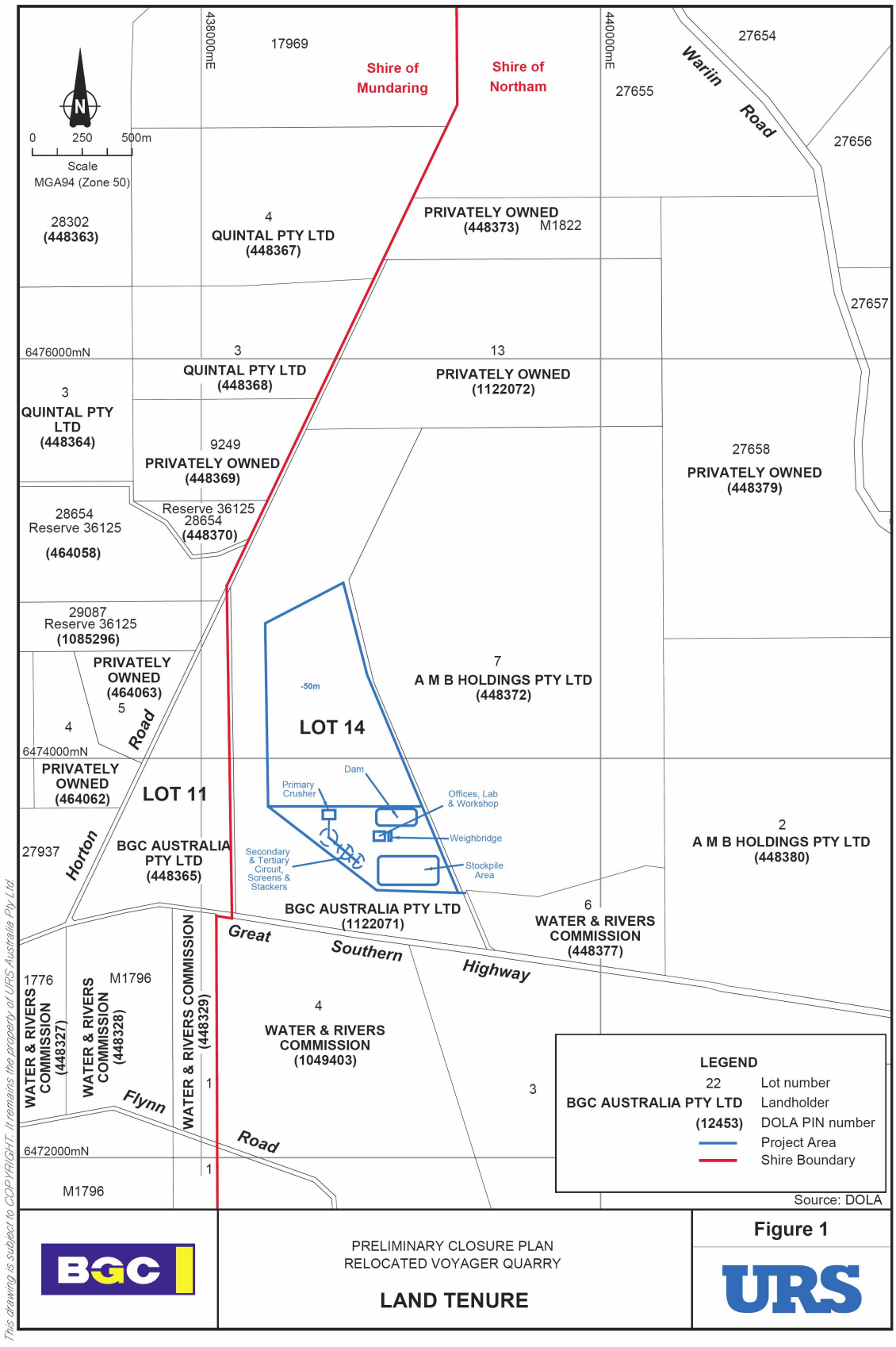
5-1 The proponent shall prepare an audit program and submit compliance reports to the Department of Environment which address:

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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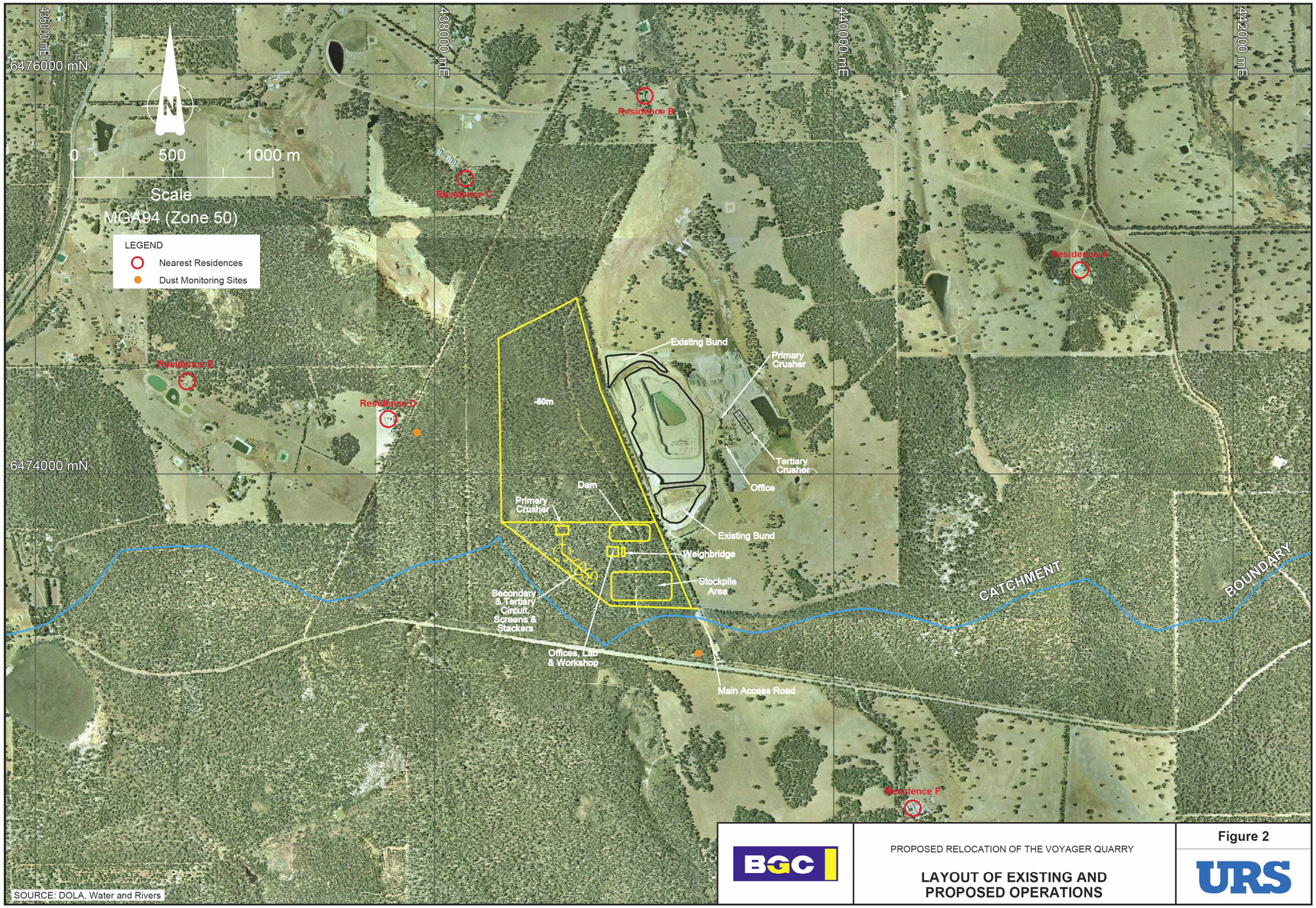
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LEGEND
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Residence A
Residence B
Residence C
Residence D
Residence E
Residence F
-50m
Existing Bund
Primary Crusher
Tertiary Crusher
Office
Dam
Primary Crusher
Existing Bund
Weighbridge
Stockpile Area
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 (Figure 2).

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

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 stages will then be developed as the need to access further granite resources arises. The staged approach will also ensure that excavation of the topsoil and subsoil (gravel and clay) will only occur on five 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 other vegetation.

2.2 Receiving environment

The receiving environment relating to the aspect of dust is the amenity and health of nearby residents that could potentially be impacted by the proposed operations. Figure 2 indicates the nearest residential locations that are potentially at risk from dust emissions.

The nearest residence to the proposed quarry site 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).

3.1 Potential environmental impacts of the project

Concerns have been raised by residents about dust from all operational aspects of the existing project. The potential for unacceptable off-site impacts from dust is most affected by the prevailing wind direction during dry summer conditions when east to south easterly winds prevail.

A large number of submissions were received on this particular issue (URS 2003); the majority of these pertained to the perception that the proponent's current operations were performing poorly with respect to management of dust, and expressed concern with respect to the impacts of dust on nearby residents' health, well-being and amenity.

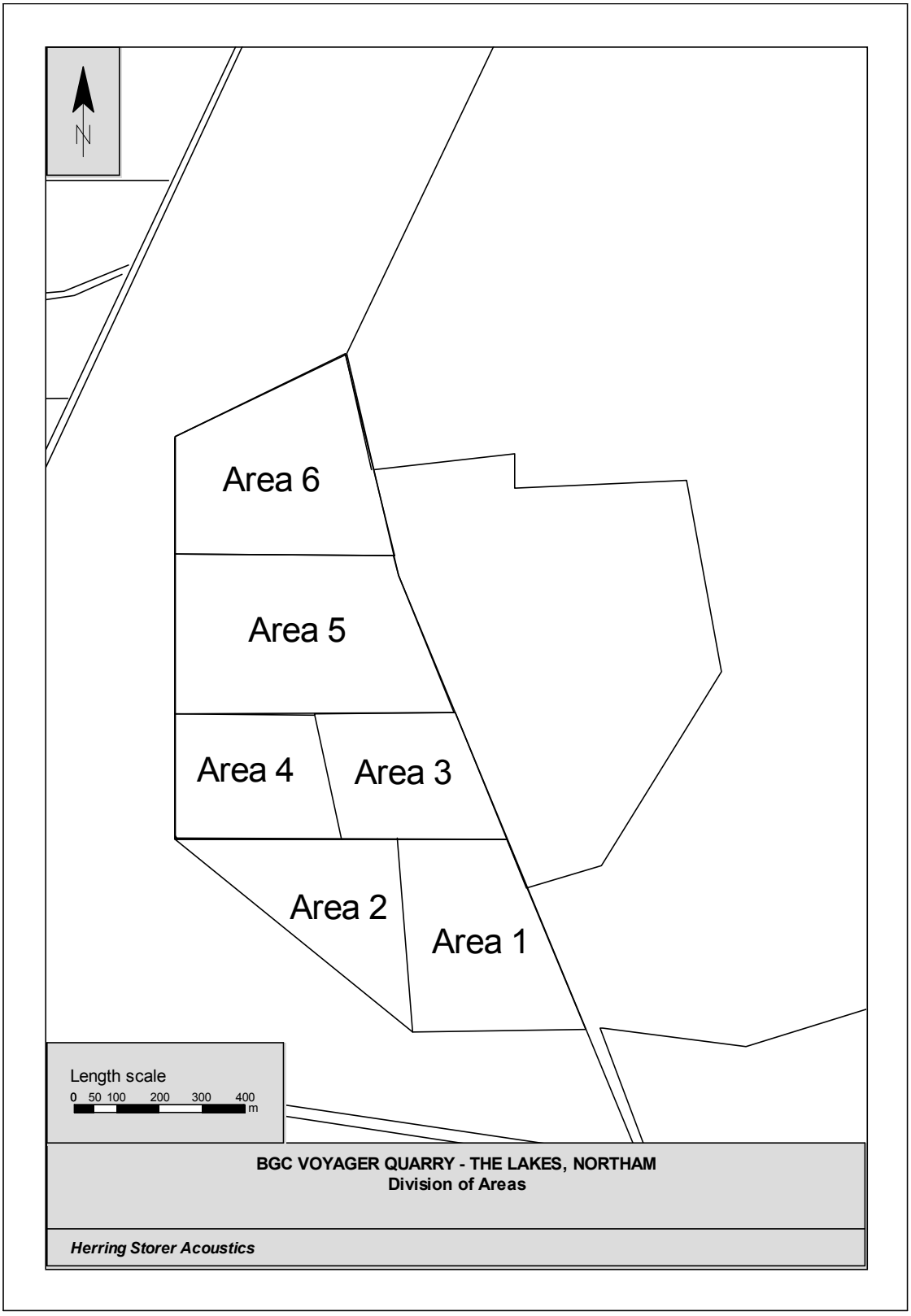

Figure 3: Division of Areas within the proposed relocation proposal (from Herring Storer 2004).

4.1 Principal environmental objectives

4.1.1 DEC objective

Current DEC operating licence conditions (issued under Part V of the *Environmental Protection Act*) for the existing quarry, relating to dust emissions, requires that visible dust should not leave the boundary of the premises.

4.1.2 EPA objectives for dust management

Ensure that particulates/dust emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental, health or amenity issues.

4.1.3 Proponent commitments

The proponent provided the following objectives for the dust management plan (URS 2004). The objectives are to ensure that:

- Nuisance dust levels are not experienced by neighbours and do not cause any health problems;
- Dust generated during the developmental and operational phases of the quarry expansion does not significantly impact on amenity;
- The operational layout for the proposed quarry expansion will minimise dust and particulate emissions from the quarry; and
- The levels of dust and particulate emissions comply with DEC licence requirements.

4.1.4 Ministerial Statement

Ministerial Condition 706:M12.1 provides the following environmental objectives

The objective of this Programme is, by monitoring dust concentrations, to ensure that dust associated with all operations (including land clearing, excavation, blasting, dust lift-off from stockpiles and general operational activities such as screening, crushing and transport) which emanates from and leaves the site complies with the standard prescribed in condition 11-1.

Condition 706:M11.1 provides the following standard:

The proponent shall ensure that dust emissions from Lot 14 do not exceed an ambient PM10 level of 50 micrograms per cubic metre averaged over a 24 hour period when measured at the property boundary.

This section provides strategies to manage the specific impacts identified in Section 3.1.

Quarry employees with responsibilities for actions required in this section are included in the Table 9.

5.1 Dust control strategies implemented to date

The quarry operator will, when relocating to Lot 14, have had considerable experience over 18 years in managing dust issues in the existing quarry; this experience will be applied and improved upon, where required, to relocated quarry. Consequently, this previous experience is outlined below.

Potential dust sources in the existing operations

The following quarry operations have the potential to cause dust emissions:

- Drilling and blasting;
- Materials movement – loading and unloading, conveyor transfer points;
- Materials processing – crushing and screening;
- Vehicle movement over unsealed ground;
- Vehicles leaving the premises with dust on chassis; and
- Vehicles leaving the premises without loads properly secured.

In the existing quarry operation, the proponent has modified its blasting practices to minimise the potential for blast dust to reach residences and has set blasting for Monday or Tuesday with the aim of delaying blasting in the event that wind conditions are unfavourable. However, because regulations forbid explosives being left unattended in the ground when the quarry is closed, they must be detonated on Friday afternoons under less than optimal wind conditions if it has not been possible to detonate them earlier in the week. It is expected that such circumstances would arise only on a few occasions each year.

In responding to submissions, the proponent identified that a number of actions have been undertaken over the last few years to improve dust management and other environmental issues at the existing quarry. These improvements which include the use of improved capital equipment, facilities and procedures are outlined in Table 2.

Reports of inspections performed by the Department of Industry and Resources for worker occupational heath and safety purposes, note that dust management at the site, particularly, that associated with material processing activities, was of a high standard.

Dust control measures implemented to date

Table 2 below includes those dust control measures implemented to date.

Table2. Improvements implemented at the existing Voyager Quarry, 2002-2004

Improvement	Details of Improvement	Location of Implementation	Date of Implementation
Sealing access road	The access road was sealed with bitumen.	Access road	April 2002 to Oct 2003
Replacement of earthmoving machines (More efficient material movement)	All loaders at the existing quarry are new or near new.	Pit	23 April 2002
	Two new Komatsu HD785 (85 tonne) dump trucks were purchased to replace the Cat 773B (50 tonne) dump trucks.	Pit and primary crusher	3 Sept 2002
	A near-new Komatsu HD465-3 with a 45,000 L tank to supplement the existing 30,000 L watering truck was purchased.	Secondary crusher	10 Oct 2002
Videotaping	All blasts are recorded on video to monitor fly-rock and dust in relation to wind strength and direction	Pit	21 Aug 2002
Revised blasting procedures (reduction in dust emissions)	BGC issued an internal memo regarding blasting procedures. It included the following instructions: • delay blasting on days when wind strength and direction is likely to cause dust emissions; • delay blasting as late as possible until conditions (winds) are favourable; and • delay blasting if wind conditions are not favourable, however charges cannot be left in the ground over a weekend and cannot be delayed beyond Friday.	Pit	10 Feb 2003
	BGC issued an internal memo for the revised blasting instructions, including: • blasting to be planned for a Monday or Tuesday; if wind directions are between east and south of south east, then the blast must be delayed until wind conditions are more favourable.	Pit	28 Sept 2004
Reduced dust emissions	Total enclosure of the primary crusher to reduce noise and dust emissions.	Primary crusher	19 May 2003
	A new pump and sprinkler system was commissioned. The sprinkler system is more efficient as it waters product stockpiles at short regular intervals to reduce wastage and runoff from product stockpiles. The pump now fills up the water truck five times quicker than the previous pump enabling more frequent watering.	Stockpile areas	23 Dec 2003
Revised procedures for trucking movements	BGC issued an internal memo requiring mandatory use of tarpaulins on every departing load.	Overall	29 Jan 2004

5.2 Dust control strategies to be employed at the relocated quarry

Strategies required

There are two separate quarry operations to be considered when planning dust management strategies. These are

- Clearing and overburden removal: These are carried out close to surface wind conditions, special precautions and planning are required for these operations.
- Quarrying operations that include those activities listed in Section 5.1 and dust management strategies are required for each type of operation. However, the risk of dust emissions crossing the proponent's boundaries are less likely due to the depth of the quarry operations being well below ambient wind conditions.

The above are further detailed in the sections below.

5.2.1 Clearing and overburden removal

Proponent commitments

The following commitments have been previously provided by the proponent (URS 2004) in regard to dust management during clearing and overburden removal.

- Develop the quarry in a staged process (refer Figure 3) so that possible impacts from clearing and overburden are limited to five separate occasions (Areas 1 and 2 being initially cleared) over the life of the quarry.
- Clear only the minimum area required at any one time for removal of topsoil and overburden.
- Undertake clearing and overburden removal only under favourable weather conditions – principally during the wetter months July to September or during north westerly winds
- Establish a phone link to the construction manager for nearby residents.
- Keep residents informed of when activities are likely to occur.
- Ensure that no large bare expanses of soil and overburden are left exposed over the dry summer period.
- Ensure that dust control mechanisms (spray and tanker trucks) are implemented where and when required.
- Undertake visual monitoring of dust at the boundary during these activities and stop work if unfavourable wind conditions cause dust to lift-off in the direction of residences.

Action to be taken for the above commitments and additional dust control and management measures are outlined in Tables 3, 4 and 7.

Additional restrictions on clearing (fauna)

Advice received from DEC Nature and Conservation Division is that vegetation clearing should only be undertaken between January and April inclusive to ensure the best survival prospects for any fauna with home ranges, nesting or refuge sites within any of the six Areas set aside for quarry development (see *Fauna Relocation and Habitat Plan*; Condition 706:M8). For example:

- Microchiropteran bats leave young in tree hollows in late spring early summer;
- Most bird species nest in late winter and spring utilising tree hollows and canopies; and
- During the January to April period Chuditch (*Dasyurus geoffroii*) home territories are destabilised and are better able to re-establish home ranges in new areas; out of this period Chuditch are unlikely to survive if displaced into territories established by other animals, could be carrying young or could have left vulnerable young hidden within a refuge.

The above place further restrictions on clearing vegetation and consequently require resolution of conflicting stakeholder advice in regard to dust management on one hand (clearing during wetter months) and minimising the possible impacts on native fauna (clearing only between January and April) on the other. It is probable that insufficient rain may be experienced by the start of April to allow clearing.

Proposed clearing period

Ideally, fauna trapping and relocation should be immediately followed by clearing and overburden removal to ensure that fauna that are relocated do not return to home ranges before clearing commences.

The Fauna Relocation Plan (Condition 706:M8) includes the following fauna options:

- Trap and release to adjacent bushland; or
- Trap and release into existing relocation plan; or
- Trap and hold in existing captive breeding programs.

Consequently where the fauna *Trap and release to adjacent bushland* applies, the following is to be instigated:

- *If insufficient rainfall in April to allow clearing and overburden removal*: proceed with trapping program in last half of April. Knock down vegetation in the week following the completion of the trapping program. Vegetation and overburden removal should only proceed after sufficient winter rainfall to prevent dust emissions.

Table 3 below provides an outline of activities, strategies and methods to be employed during clearing and overburden removal for each of Areas 1 & 2 and for each of Areas 3, 4, 5 and 6.

Table 3. Strategies and control measures to minimise dust emissions during vegetation & overburden removal phase

Activity	Strategy or Control Measure	How
Clearing	Clear minimum area required.	Only clear Areas 1 and 2, and then each of Areas 3 through to 6 on separate occasions.
	Minimise impacts of vegetation clearing on fauna (see Fauna Relocation and Habitat Plan).	By only clearing between January and April inclusive if sufficient rainfall.
	Undertake clearing only under favourable weather; ie do not clear when moderate to strong East to Southerly winds are experienced and only clear if sufficient rainfall to allow subsequent overburden removal.	Clear only after sufficient rainfall between January and April inclusive. If no rain then proceed to instigate requirements of Fauna Plan in last week of April and arrange approved captive holding of animals. Proceed with vegetation knock-down; release animals to adjacent bushland; only remove vegetation and overburden when sufficient rainfall to minimise dust lift-off.
Overburden removal	As above.	Should be undertaken immediately after vegetation removal to prevent leaving an open, cleared area.
Monitoring: clearing & overburden removal	Conduct continual visual monitoring for dust lift off.	If dust emissions threaten to cross the boundary of Lots 11 and 14 – stop work immediately and do not resume until optimum weather conditions return or until water sprays have been applied.
	Install dust monitoring equipment and automatic weather station.	As required by Section 5.3.
Community Liaison	Establish a residents' phone link to Operations Manager.	Advise local community by email, telephone and post information on the company website
	Keep residents informed of when activities are planned.	

5.2.2 Quarrying operations

Proponent commitments

The following commitments have been provided by the proponent (URS 2004) in regard to dust management for quarrying operations.

- Watering the haul roads.
- Watering of benches and pit floors.
- Watering of stockpiles using automatic sprinklers.
- Watering of shot-rock in the pit before it is loaded and hauled to the crushing plant.
- Using wet drilling practices for the quarrying operations.
- Using water sprays throughout the plant and at all transfer points.
- Watering and covering loads when transporting material off-site.
- Implementing speed restrictions within the quarry.
- Enclosure of the primary crusher.

All quarry improvements already implemented (Table 2) will be carried forward into the new operations. Monitoring requirements are given in Table 7.

Table 4 below provides an outline of activities, strategies and methods to be employed for the quarry operations (granite mining) phase for each of Areas 1 & 2 and 3, 4, 5 and 6.

Table 4 below includes those strategies required to ensure that dust emissions are minimised during operational activities.

Table 4. Strategies and control measures to minimise dust emissions during quarry operations phase

Activity	Strategy or Control Measure	When	How
Buffers	Maintain vegetation buffers between the boundary of the operational area and adjacent land holdings.	Commence tree planting spring '07	Undertake tree planting as required.
Blasting	BGC blast procedures include the following instructions: • Use wet drilling techniques. • Avoid blasting when wind direction is unfavourable in regard to dust dispersion. • Delay blasting until conditions (winds) are favourable. • Delay blasting until the next day if conditions are not favourable, however charges cannot be left in the ground over a weekend. • Areas set for blasting to have water sprayed beforehand. • All blasts recorded on video to monitor fly-rock and dust. (The complaints register indicates changes to blasting procedures have substantially reduced dust emission impacts.)	Install weather station before start of construction. All actions to be carried out for the life of the proposal.	• Automatic weather station with data-logger on-line to operations area. • Review five-day weather forecasts.
Materials Movement	• Water down blasted rock before transfer to primary crusher. • Use water sprays for loading and unloading of raw materials and product as required. • Water sprays to conveyors and transfer points.	All actions to be carried out for the life of the proposal	For stock piles use sprinkler systems at short regular intervals to maximise dust control and efficient water use.
Materials Processing	Water spray to rock-feed hoppers		Primary crusher enclosed.
Raw Materials & Product storage	All materials storage will be below the surrounding ground level which will minimise wind action and fugitive dust lift off.		
Fugitive dust	Sprinkler systems to be installed for dust control. A water truck is available as required.	Sprinkler system to be installed prior to start of operations.	As required – sprinklers and water truck.
Trucking	• Access roadways to be sealed and subject to water spray as required. • Departing trucks to be covered by tarpaulin. • Trucks to depart in clean condition. • Truck to obey 50 kph speed restriction on quarry approach; road outside of weighbridge and obey speed limits within the quarry as required by safety considerations.	Seal road prior to start of operations. All actions to be carried out for the life of the proposal.	BGC operational procedures. If dust from trucks on local roads becomes an issue, install a rumble track at a location before trucks reach the exit gate.

5.3 Weather information required

Information required to ensure the best possible outcomes for dust management includes:

- Installing and maintaining an automatic weather station for monitoring wind data;
- Reviewing World Wide Web (www) forecasts for current and five-day long-term weather information;
- Installing and maintaining ambient dust monitoring equipment, in two locations at boundaries adjacent to nearby residents, most likely to provide upwind and downwind suspended dust comparisons;
- Video recording of dust and fly-rock generated by all blasting events;
- Visual monitoring of dust emissions; and
- Maintaining liaison with the local community.

5.3.1 Weather monitoring requirements

Objective: To provide data to support dust control measures required by Ministerial Condition 706:M11.1.

Ministerial Condition 706:M12.1 has the following requirements

This Programme shall include but not be limited to continuous dust and meteorological monitoring;

Where there is the potential for dust lift-off, in order of importance, dust impacts on amenity are primarily influenced by:

- wind strength;
- wind direction; and
- ground level moisture.

As ground-level moisture is to be artificially controlled by spraying, the key parameters for managing the effectiveness of dust suppression and management are wind strength and wind direction.

It is important for quarry planning purposes that long-range weather forecasts be obtained on a weekly basis to ensure that adequate planning is in place for conditions likely to cause dust emissions. This information must be followed up on daily basis by monitoring real-time data available from the dedicated weather station.

The Quarry Operator must be aware when hot, dry and windy conditions are likely to occur and he must take appropriate action in deploying water sprays on the day, before such conditions arise so as to prevent dust emissions or to avoid operations that would be most likely to cause excessive dust emissions.

Wind Direction and strength

The York Weather Station is located approximately 45 km east of the project area. Table 5 below provides Bureau of Meteorology average dominant 9 am and 3 pm wind directions derived from Bureau of Meteorology weather station at York collected between 1957 and 2006.

Wind roses were down-loaded from http://www.bom.gov.au/climate/averages/wind/selection_map.shtml

Table 5. Dominant wind directions for York Weather Station derived from BoM seasonal wind roses.

Season	9am	3pm
Winter	West to North	West to North
Spring	East to South	South West to North West
Summer	South East	East to South East and West
Autumn	East to South	West and East (more variable)

The information in Table 5 suggests that placing dust monitoring equipment on a north-west/south-east axis would enable both up-wind and down-wind dust data to be obtained under the most common weather conditions, especially during summer when the risk of dust emissions is highest due to strong desiccating east to south easterly winds. However, as the quarry progresses to Areas 3, 4, 5 and 6 in turn, dust monitoring will need to be reviewed to ensure that dust monitors are optimally placed to record any possible dust emissions from quarry operations.

The Bureau of Meteorology (BoM) document *Weather Stations for Agricultural and Other Applications* available from:

http://www.bom.gov.au/inside/services_policy/pub_ag/aws/aws.shtml

provides comprehensive advice on how to achieve the best possible outcomes from an automatic weather monitoring station.

For the purposes of the project area, any automatic weather station should satisfy the requirements outlined in Section 6.2.3 and should be capable of transmitting real-time data to the quarry operators.

Weather forecasting information on the www.

The following World Wide Web (www) links provide a guide to planning quarry operations over at least five days:

Seabreeze: http://www.seabreeze.com.au/graphs/wa.asp This is a commercial website that gives seven day forecasts for concurrent wind strength, wind direction, cloud cover and rain. However, the data is for coastal locations and local conditions should be taken into account when summer sea breezes are predicted. This site also provides BoM five-day morning and afternoon synoptic forecasts which are very useful for inland locations.

University of Wyoming: http://weather.uwyo.edu/models/fcst/index.html?MODEL=gfs003 This website provides a multitude of sophisticated weather forecast data. To obtain 180 hour regional wind strength and wind direction data set the parameters below

Initial Time:	Do not change.
Forecast:	set to Loop.
Level:	set to 975 mb.
First Color Fill:	set to Wind Speed.
Second Color Fill:	None.
F*irst and Second Contours*:	None.
Vector:	set to Streamlines.

The best possible wind strength and wind direction forecasts can be obtained for at least five days ahead using the University of Wyoming and Seabreeze websites in conjunction.

5.3.2 Dust monitoring requirements

EPA Objective: Ensure that particulates/dust emissions, both individually and cumulatively, meet appropriate criteria and do not cause an environmental or human health problem.

Ministerial Condition 706:M12.1 has the following requirements

The objective of this Programme is, by monitoring dust concentrations, to ensure that dust associated with all operations (including land clearing, excavation, blasting, dust lift-off from stockpiles and general operational activities such as screening, crushing and transport) which emanates from and leaves the site complies with the standard prescribed in Condition 11-1.

This Programme shall include but not be limited to:

1 Continuous dust and meteorological monitoring;

2 Ambient dust monitoring at two or more Sensitive Sites[2] in the vicinity of the quarry;

3 A reporting schedule for monitoring data and results;

[2] *Any land within 10 m of a residence, hospital, school or other premises in which people could reasonably be expected to be free from undue annoyance and nuisance caused by blasting (Note 1 Condition 706:M17)*

4 *Improvements to monitoring and reporting; and*

5 *Remedial action to be undertaken to prevent exceedances if the dust source is within the proposal area, or the dust arises from operational activities (including vehicular movements).*

Specific Monitoring Requirements

Condition 11.1 requires continuous PM_{10} monitoring at the boundary of the proponent's premises against the NEPM 24-hour concentration standard of 50µg/m3. However, the NEPM standard is not to exceed the limit more than five times in one year whereas the Condition 11.1 does not allow one exceedance. It should be noted that the NEPM standard was developed for air-monitoring stations in urban areas.

Condition 12.1 requires that monitoring be conducted at a minimum of two "Sensitive Sites" – the requirement for such sites being that the monitoring be done within 10 m of a residence (see above). This monitoring is in addition to a standard to be observed at the operational boundary.

Requirements: Air sampling/monitoring equipment will be placed in accordance with the relevant standards indicated in Table 6.

Condition 11.1: Required equipment and placement

To satisfy the requirement of the "Standard" set by Condition M11.1 – The Department of Environment and Conservation requires the use of dust-monitoring equipment that is approved under a recognised standard. The only continuous dust-monitoring device available that is acceptable under a recognised standard is the TEOM PM_{10} particulate monitor (tapered elemental oscillating micro-balance).

Consequently, the proponent has committed to installing two TEOM dust monitoring devices:

- Within the boundaries of Lots 11 and 14; one north west and the other south east of the operational area as indicated in Figure 2;
- On a north-west/south-east axis of the operational Areas 1 and 2; and
- In direct line as is practical between the operational Areas 1 and 2 and Residences "D" and "F" respectively.

Condition 12.1: Required equipment and placement

The sensitive sites selected for dust monitoring are those residents which are located the closest to the Quarry and are located in the dominant prevailing seasonal wind direction as described in Section 5.3.1. The dust deposition monitors are similar to those currently in use at the existing quarry. Permission will have to be obtained from the land owners to erect and maintain these monitoring sites. The Department of Environment and Conservation will be informed as soon as an agreement is reached.

6.1 Relevant standards

National Standards

National standards apply to the measurement of atmospheric particulates are summarised in Table 6 below.

Table 6: Relevant standards applying to measurement of atmospheric particulates

Standard	Application
National Environmental Protection Measure (NEPM)*	Atmospheric particulates PM_{10} not to exceed 50 µg/m^3 (averaged over 24 hours) on more than 5 occasions per annum.
AS 3580.9.8-2001	Method for sampling and analysis of ambient air - Determination of suspended particulate matter - PM(sub)10(/sub) continuous direct mass method using a tapered element oscillating microbalance analyser
AS 2922 - 1987	Ambient air – guide for the sighting of sampling units

Note: Condition 706:M11.1 does not allow any exceedances of the limit.

The National Environmental Protection Measure (NEPM) air quality standard is 50 µg/m^3 (averaged over 24 hours) for particulates with an aerodynamic diameter less than 10 µm (PM_{10}) (http://www.ephc.gov.au/nepms/air/air_nepm.html). This level should not be exceeded on more than 5 days per year. However, it should be noted that the criteria are designed for use in assessing regional air quality and are not intended for use as industrial site boundary criteria (http://www.ephc.gov.au/pdf/Air_Quality_NEPM/air_review_draft_ISP_October_2005.pdf).

EP Act Part V operating licence

The current DEC operating licence issued to the existing quarry under Part V of the *Environmental Protection Act* specifies that visible dust should not leave the boundary of the premises. Since the issue of Statement 706, the DEC Swan Regional Office has notified the Quarry Manager that the dust management conditions imposed under Ministerial Statement 706 will be applied as licence conditions for the operating conditions as well.

Ministerial Condition 706:M11.1

The proponent shall ensure that dust emissions from Lot 14 do not exceed an ambient PM_{10} level of 50 micrograms per cubic metre averaged over a 24 hour period when measured at the property boundary.

It should be noted that Condition 706:M11.1 has a much more stringent requirement in that it does not allow a single exceedance whereas the NEPM standard allows five exceedances of the guideline per annum.

The Department of Environment and Conservation requires that only equipment approved under a recognised standard is used for monitoring the NEPM standard. Appropriate standards are given in Table 6 above.

In calculating the concentration of dust discharged from the quarry, both up-wind and down-wind dust monitors must be taken into consideration to ensure that ambient wind-blown dust in the local region is not regarded as originating from quarrying operations.

6.2 Performance criteria

The following are indicators for tracking the progress in managing and controlling dust emissions.

6.2.1 Visual monitoring

Visual monitoring of dust emissions will be the first line of action for dust management, particularly during clearing and overburden removal. Actions may be instigated without delay at the observed source of dust emission. In the case of overburden removal this would include ceasing the offending operation, application of water sprays and only restarting operation at a low intensity and slowly increased to ensure dust emissions are minimised. In the case of quarry operations, the application of corrective water sprays at the offending operation would be appropriate.

6.2.2 Short-term corrective monitoring

A short-term "corrective action" dust concentration target is recommended to assist in maintaining ambient standards. Should the target concentration of PM_{10} particulates be exceeded, this would initiate management procedures as for Section 6.2.1 to ensure that ambient dust standards are met. A target of 250 micrograms PM_{10} per cubic metre averaged over one hour is recommended. The dust monitors may be configured to send an SMS message to the quarry operator (Environmental Officer) notifying of the exceedance.

However, both dust concentration records of both monitors should be checked to ensure that the exceedance is not due to local/regional ambient dust.

6.2.3 Video blast monitoring

Video monitoring is a management tool which may be used to confirm the relative amounts of dust emitted for any given blast against observations and record of particulate sampling data should wind direction at the time of the blast coincide with the sampling axis.

6.2.4 Automatic weather station and particulate sampling

The automatic weather station will provide evidence of wind direction and strength to match and support particulate sampling data as well as aid in the timing for quarry blasting.

Relevant standards/guidelines for meteorological monitoring and particulate sampling include:

- *AS2923 Ambient Air- Guide for measurement of horizontal wind for air quality applications; and*
- *AS 2922-1987 Ambient air – Guide for the siting of sampling units.*

Other guidelines include:

- Bureau of Meteorology Guidelines*: Weather Stations for Agricultural and Other Applications (www.bom.gov.au)*

6.2.5 Complaints register

A complaints register will be maintained to verify that operating parameters are effective.

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

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

7.1 Ongoing monitoring

Table 7 below provides all dust monitoring activities require to minimise the risk of dust emissions crossing the boundaries of Lot 14 and 18.

Table 7. Ongoing dust monitoring activities

Monitoring	Location	Parameter/Frequency	Reporting
Visual dust monitoring.	All quarry locations.	Opportunistic observation of visual dust lift-off or emission.	Log report, include analysis of log in annual report.
Continuous Dust Monitoring using two continuous dust monitoring devices.	On NW/SE axis of operational area on boundaries of Lots 11 and 14.	Continuous recording of PM_{10} particulate concentrations. Dust monitoring data to be interrogated as soon as practicable after receiving any dust complaints.	Report exceedances of 706:M11.1 to DEC Audit Branch on next working day of being aware of exceedance including concurrent wind data. Statistical summary in annual report. Maintain records as may be required by DEC operating licence.
Short-term Continuous Dust Monitoring (as above).	As above.	A "corrective action" PM_{10} target of not more than 250µg/m^3 averaged over 1 hour is recommended.	Log exceedance of target PM_{10} concentration. Monitor can be programmed to SMS an arranged mob telephone number (Env Officer).
Video Monitoring Blasts.	Adequate view of blast area from camera.	For all blasts.	Keep video records as required by DEC licence.
Dust monitoring at sensitive premises	Two residences located closest to the quarry on a NW/SW axis	Dust Deposition monitors to be monitored monthly	Maintain records of monthly data. Provide summary in annual report.
Wind direction and strength.	Locate weather station in accordance with appropriate standards/guidelines	Wind strength and Direction.	Maintain records as required by DEC Licence.
Complaints Register.	All quarry operations.	Log complaint as required by register.	Include analysis of all complaints received and action taken over previous 12 months in annual report to DEC.

7.2 Contingencies and remedial action

Table 8 below provides actions to be taken in the event that certain contingencies arise which are likely to cause dust emissions beyond the boundaries of Lots 11 and 14.

Table 8. Monitoring contingencies and management actions

Monitoring	Trigger	Management Action
Visual dust monitoring.	Observation of dust lift off or dust emission.	Operational personnel to report observation to Quarry Manager who will log report and require remedial action to be taken: either to cease the reported activity or immediately apply water spray. Activity should only be restarted at low intensity and gradually increased to observe if dust suppression measure has been successful.
Continuous Dust Monitoring.	Exceedance requirement of Condition 706:M11.1.	Compare Dust and Wind data. Instigate enquiry into cause of exceedance; if cause is known, take remedial action.
Short-term Dust monitoring.	Exceedance of short term PM_{10} target of 250µg/m^3 averaged over 1 hour.	Log exceedance and notify operations personnel to take corrective action as for visual dust monitoring.
Complaints Register.	Dust Complaint.	Compare Dust and Wind data to verify complaint. If complaint verified, take remedial action and notify complainant of outcome.

8.1 Stakeholders

Objective: To take into account stakeholders views in developing a Dust Monitoring and Remedial Action Plan.

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.
Department of Environment and Conservation.	Mr James Treloar.
Community Liaison Group Chairman	Northam Shire President

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

8.2 Community liaison

Ministerial Condition 706: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.

A community Liaison Group was established under the chairmanship of Mr Bert Llewelyn, Northam Shire President, for the purposes of receiving community comment in regard to environmental plans distributed to the community group.

8.3 Ongoing liaison

The quarry operator will continue to liaise with Local Government Authorities. Liaison with the Department of Environment and Conservation (DEC) Environmental Audit Branch will be via Annual Reporting and the Community Liaison Group as required.

9.1 Auditing

The Quarry Manager and Environmental Officer will be required to ensure that all management actions as per Table 9 are carried out. An audit against the Management Plan actions (Table 9) is to be conducted by the Environmental Officer 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.

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.

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:M12.3. This information will be used to review and revise this Dust Monitoring and Remedial Action Plan prior to any further quarry expansion to Areas 3 to 6 being approved.

9.3 Reporting

The Quarry Manager will report any exceedances of the requirements of Condition 706:M11.1 on the next working day after becoming aware of the exceedance.

Annual Reports will be required every twelve months following completion of clearing of Areas 1 and 2.

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

Key Management Actions

SECTION 10

Table 9: Key Management Actions

Issue	Management Action	When	Responsibility
Dust emissions	Only clear minimum area required for each of Areas 1, 2, 3, 4, 5 and 6 as these areas are sequentially required over the life of the quarry.	Over the life of the quarry.	Quarry Manager
	Integrate Fauna Relocation Plan (706:M8) and this Dust Management Plan.	As seasonal rainfall allows between April and late winter rains.	Quarry Manager
	Do not undertake clearing and overburden removal under dry conditions and when wind is from east to south east.	Only remove overburden when sufficient rainfall has occurred to prevent dust emissions over boundaries of Lots 11 and 14.	Quarry Manager
Monitoring	Conduct continual visual monitoring for dust emissions.	Especially during clearing and overburden removal and during all operational activities.	Environmental Officer
	Install dust monitoring equipment and automatic weather station.	Before the start of clearing operations.	Quarry Manager
	Install and operate video monitoring of all blasts.	Prior to the commencement of blasting activities.	Quarry Manager
	Review www for long term weather forecasts.	Prior to the commencement of clearing operations.	Env. Officer
Review & Revision	The Dust Monitoring and Remedial Action Plan to be annually revised in consideration of operational experience gained and any verified complaints regarding dust emissions.	Before advancing the quarry into new Areas 3, 4, 5 and 6 respectively. However, revisions may be made in consultation with DEC and community liaison group according to experience gained in monitoring and operation of the quarry as required by Condition 706:M12.3.	Quarry Manager
Community Liaison	Establish a phone link from community to the Operations Manager.	Before the start of clearing.	Quarry Manager
	Keep residents informed of when clearing, overburden removal or blasting operations are planned.	On going.	Quarry Manager Environmental Officer
Dust Suppression	Instigate dust suppression measures as per Table 4.	During operations.	Env. Officer

Key Management Actions

SECTION 10

Issue	Management Action	When	Responsibility
Any dust monitoring incident as per Table 7. Visual observation, continuous target monitoring exceedance or complaint received.	Following visual confirmation of dust emission, dust complaint received or exceedance of the requirement of Condition 706:M11.1, take remedial action in regarding the source of the dust emission if this is known. Either cease activity or immediately apply water spray. After applying remedial action, the activity, if previously ceased, should be started and only slowly increased to judge the effectiveness of action taken. Complainants to be notified of verification outcome and remedial action taken.	As soon as is practicable.	Quarry Manager
DEC Annual Report	Provide detailed information regarding any dust monitoring exceedances including date, wind/particulate data, if source confirmed and remedial action taken.	Annually after commencement of clearing Areas 1 and 2.	Environmental. Officer Quarry Manager
	Provide analysis of Complaints register including date, issue, if verification confirmed, action taken and confirm complainant notification.		
	Provide log of significant dust issues reported and action taken.		

References

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National Environment Protection Council (1998) National Environment Protection Measure for Ambient Air Quality. 26 June 1998.

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

URS Australia Pty Ltd (2004) Final Report: Response to Submissions. Proposed Relocation of the Voyager Quarry. Land Clearing and Quarry Expansion, Avon Loc 1881, Lot 14 Horton Road, The Lakes. Prepared on behalf of BGC (Australia) Pty Ltd. Perth, WA

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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 and 19 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.