EIS 1566

AA067930

Environmental impact statement : Glen Isla Quarry, Tin Pot Hill

Bland Shire 2003

Environmental Impact Statement

Glen Isla Quarry, Tin Pot Hill
Bland Shire

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SUMMARY

H. R. D. Ready Mix Pty Ltd proposes to increase the extraction capacity of the Glenisla quarry at Tin Pot Hill, approximately 20 km northeast of Barellan in the Bland Shire. This quarrying on the property occurs in association with ongoing cropping, and grazing by sheep. The quarry at the site but is restricted in the amount that can be extracted each year to 10,000 tons per year. This proposal plans to extend the permissible extraction rate to 100,000 tons per year and this development requires preparation of an Environmental Impact Statement (EIS) under the Environmental Planning and Assessment Act 1979. The EIS is to be assessed by Bland Shire Council with the Environment Protection Agency (EPA) the lead State agency.

Production of the EIS for the initial development followed the presentation of an Issues paper that provided the basis for a Planning Focus Meeting held at the proposed Quarry Site in December 1998. The development was approved. Another planning focus meeting to address the proposal to increase the extraction capacity was held at the Quarry in November 2001 and guidelines for the EIS were prepared by the EPA to address this proposal. This EIS addresses requirements for the proposed development as identified by the Environmental Protection Agency, and addresses all requirements and issues raised by the public and NSW Government agencies.

The proposal involves extraction of rock from a quarry face through blasting, with crushing, sieving and stockpiling on site. The aggregate will be transported to Leeton for use in concrete, or regionally for use in road construction and maintenance. The quarry is seen as a long-term commitment to ensure the supply of material for the H R D Ready Mix business and for developments in the region. The proposal provides regional benefits through the development of competitive sources of material, reduced transport distances, and additional employment.

The rock is finely devitrified acid welded tuff that is unweathered, hard, strong, and finely crystalline. The physical properties are suitable for concrete aggregate, good quality road base, and rail ballast. The chemical properties that may influence use are the potential for alkali-silica reactivity, and the finely quartzofeldspathic nature of the rock. The volume of rock available readily meets projected requirements over 25 years.

On-site infrastructure requirements will be met by the proponents with power provided by generators, and water from existing dams and proposed buildings. Site developments include upgrading the existing access track and quarry face, establishment of areas for stockpiling aggregate and topsoil, establishment of a track linking the stockpile areas with the quarry, and the development of an office/amenities block. Equipment includes loaders, crushers, screens, and conveyors. At present the quarrying operations, including blasting and crushing, are conducted by contractors.

The on-site issues focus meeting identified transport safety as the main public issue and blast vibration of particular significance to the closest residence. Noise, dust, and conservation of water, soils and biota as issues were of most consequence to the State. Transport issues were addressed by identifying the route that best addresses needs and local requirements, and by controlling the conditions under which transport will occur. A transport impact assessment was also undertaken but the final route was determined through extensive consultation with the Narrandera Shire engineer. The proposal meets the criteria

for noise and vibration (traffic, machinery, and blasting), and the quarry design further abates any impact of noise on local residents.

Dust has been addressed through quarry design, AUSPLUME dust modelling, and a requirement for monitoring of dust levels, with vegetation and quarry material being used for dust suppression. The potential for soil erosion by water is low because of the sandy soils. The potential for wind erosion of the soil is low because of the dense regrowth woody vegetation around the quarry site. Also, the site works have been designed to prevent significant erosion. The potential for effects on the regional surface and subsurface water flows is negligible. The potential for pollution is low, and will be controlled by removing wastes from the site, and the bunding of fuel storage.

The initial proposal involved limited clearing of native vegetation, mainly grassland, but no plant or animal species or community identified as significant by the State is adversely impacted. A plant species listed by the Commonwealth at a low level of vulnerability will be impacted, but the proposal will not threaten the viability of the species, its habitat, or local populations. This proposal does not alter this situation. The rehabilitation of the site takes account of this species, and is designed to promote development of natural woody vegetation. Overall, the proposal provides regional benefits and meets all environmental requirements.

THE PROPOSAL

Objectives and Characteristics of the Proposal

H. R. D. Ready Mix Pty Ltd proposes to further develop the Glenisla quarry at Tin Pot Hill, approximately 20 km northeast of Barellan in the Bland Shire (Fig. 1). Quarrying on the property will continue to occur in association with ongoing cropping, and grazing by sheep.

A quarry developed at the site over 20 years ago was recently restored and has approval to extract up to 10,000 tons of aggregate per year. This proposal seeks to increase the permitted extraction rate to 100,000 tons per annum, where this increases the extraction and crushing of rock at the quarry site and its transport to Leeton for use in concrete, or regionally for use in road construction and maintenance.

The proposed increase in the extraction rate requires production of an Environmental Impact Statement (EIS) for assessment under the *Environmental Planning and Assessment Act 1979 (EPA Act 1979)* before it can be approved. Bland Shire is responsible for implementing the approval process (the consent authority) due to the location of the quarry.

The environmental assessment comes under the EIS Guidelines for Extractive Industries Quarries, NSW Department of Urban Affairs and Planning. The proposal relates to quarries for non-riparian zones, and is a permitted land use under the Local Government Plan. Guidelines for the preparation of the EIS under the *EPA Act 1979* were given by the Director-General. The proposal is an integrated development under the *EPA Act 1979* and the lead State agency, the Environment Protection Agency (EPA), has issued guidelines that identify the issues to be addressed in the EIA.

There is currently effectively only one supplier of aggregate in the Leeton Shire, and there are no other quarries in the vicinity of the proposed site. The quarry is essential to the long-term competitive position of H. R. D. Ready Mix, and regional benefits will arise through this competition, and the proximity of material for road construction.

Key Issues

The specific requirements identified by the EPA are:

- General information about the proposal
- Impacts on surface and groundwater
- Wastewater treatment
- Air quality issues
- Noise and blasting
- Rehabilitation and environmental monitoring
- Broader environmental issues

The key concern of local residents and stakeholders is transport safety but dust, noise and vibration are also of concern. These have been addressed by the conduct of detailed studies annexed to the EIS and by mitigations identified in the report. While transport is addressed in a specific study the final recommendations are based on recommendations of the Narrandera Shire that were developed in close consultation with local residents.

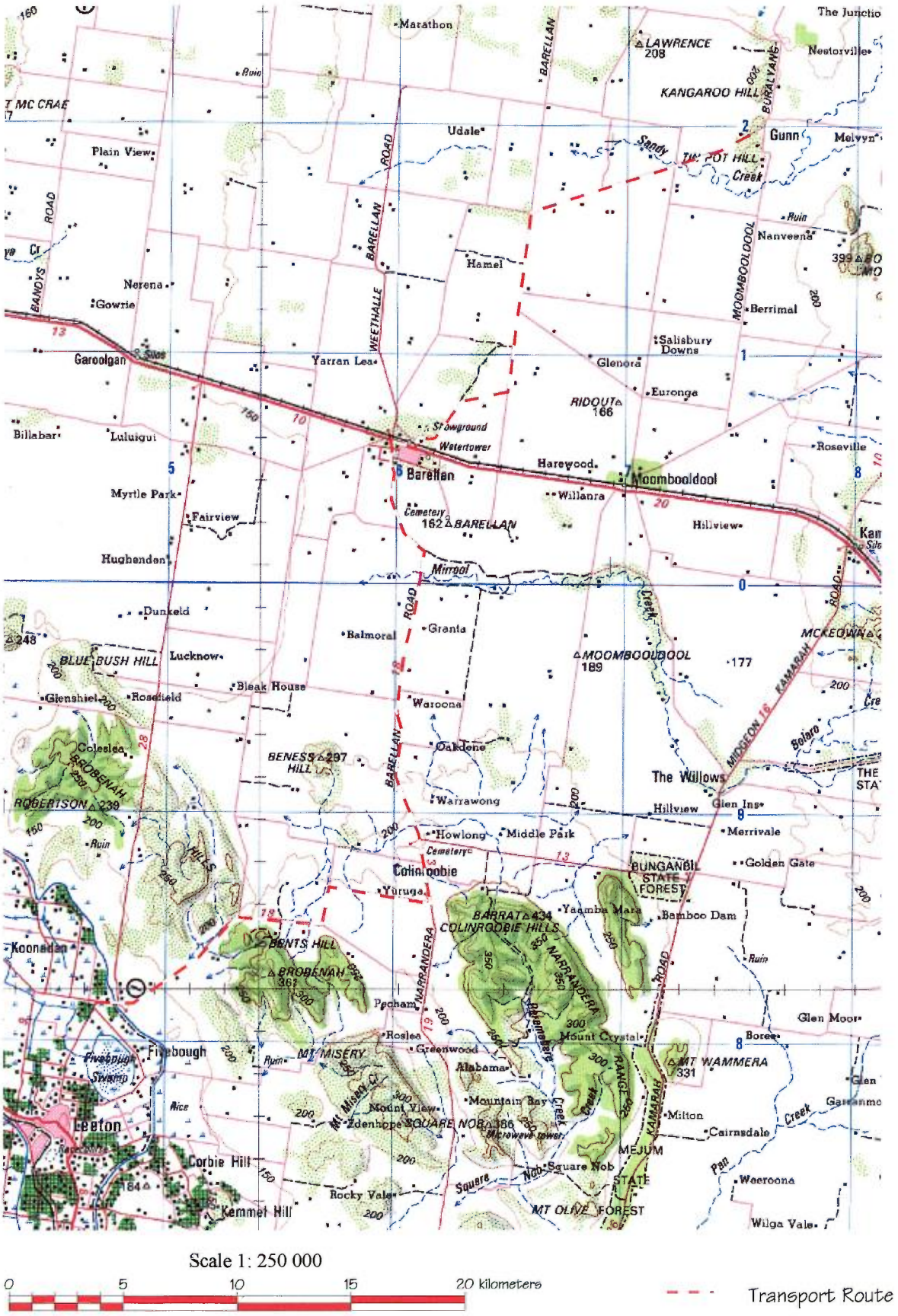


Figure 1. Regional location of the proposed development (Tin Pot Hill) and the Transport route to Leeton

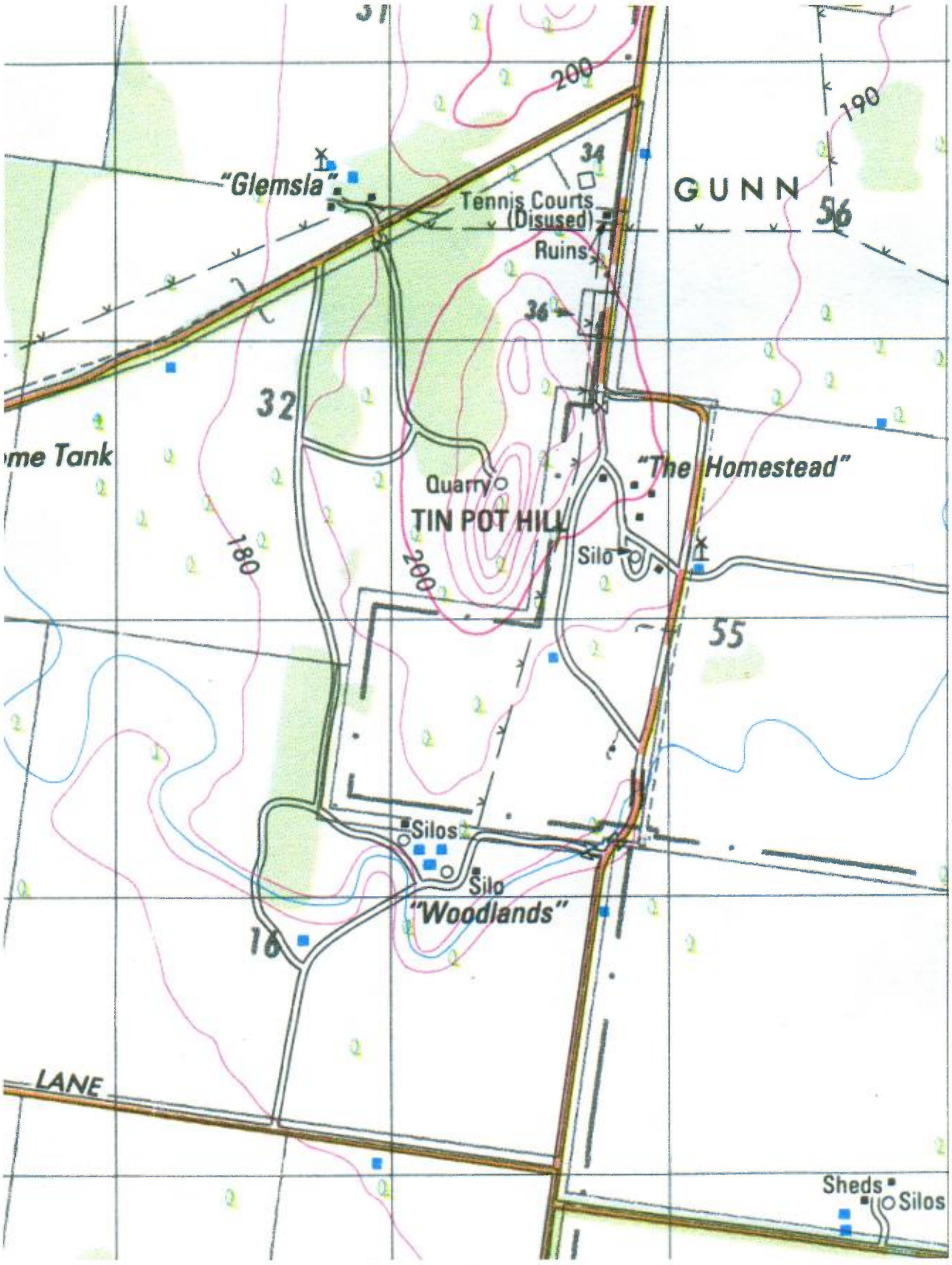


Figure 2. Contour map of Tin Pot Hill

Characteristics of the Resource

Occurrence / Abundance of Material

The regional land surface is generally flat to undulating but is broken by outcrops of rock represented locally by Tin Pot Hill, Kangaroo Hill, and an unnamed hill located between the two. While surface expressions of the rock material are locally isolated, the hill represents a local outcrop of a very large igneous structure that underlies surficial sand deposits. The extent of igneous formation is most evident in the airborne magnetic data for the region, with Tin Pot Hill occurring close to the southern limit of a large rock mass. The major network of hills to the north is the main surficial expression of the geological formation at Tin Pot Hill.

The topography of the quarry site is given in Fig. 2 by way of 10 m contours. More detailed elevation information was obtained for the outcrops by numerical analysis of stereo pairs of aerial photographs (soft photogrammetry), where this provided a resolution of 2 m in the x, y and z. This detailed information on the topography of the outcrops was developed to allow estimation of extractable volumes. This information was also used for locating stockpiles, modelling noise and dust, and for producing three-dimensional plans of the quarry development.

Rock Type and Properties

Visually, the unweathered rock is described as robust, hard, dark grey, fine grained, speckled with paler phenoclasts of feldspar and a few lithic clasts up to 15mm in size. On analysis the rock contains abundant fine K-feldspar, and a few K-feldspar phenoclasts, and displays remnant primary textures of welded, acid tuffaceous style (Table 1).

Table 1. Approximate composition of the rock material at the Glenisla Quarry.

75%	Finely microcrystalline feldspars (orthoclase & plagioclaise) and quartz after vitric clasts
8%	Sericite
5%	K-feldspar phenoclasts
5%	Biotite
3%	Remnant plagioclase phenoclasts
3%	Quartz phenoclasts
1%	Lithic clasts of porphyritic rhyolite
<1%	Leucoxene
trace	Tourmaline
trace	Garnet
trace	calcite

The rock is interpreted as originating as a moderately to densely welded vitric lithic ashflow tuff (or ignimbrite). This is similar to rhyolite, and acid volcanic rock, but formed through pyroclastic processes rather than simple lava flow. The rock was originally dominated by welded shards of glass, but these have now devitrified into a finely microcrystalline assemblage of dominant feldspar, subordinate quartz and minor micas.

The mechanical and chemical properties of the rock for aggregate are summarised in Table 2. The mechanical properties meet the requirements for all uses of aggregate. The result for the chemical properties is ambiguous in relation to alkali reactivity, and depends on the assessment criteria. Also, the significance of alkali reactivity depends on environmental factors, particularly temperature.

The aggregate meets standard alkali reactivity tests but is close to the limits. While many sources of aggregate fail this test, these tests are ongoing to more fully determine the characteristics of the aggregate. Regardless of the result, the aggregate is undoubtedly suitable for use with GB cement (25% fly ash, 75% GP cement).

In summary, the rock is described as finely devitrified acid welded tuff that is unweathered, hard, strong, and finely crystalline. The physical properties are suitable for concrete aggregate, good quality road base, and rail ballast. The chemical properties that may influence use are the potential for alkali-silica reactivity, and the finely quartzofeldspathic nature of the rock.

Table 2a. Mechanical properties of the aggregate from the Glenisla Quarry

Crushing		**Soundness**		**Bulk particle density**	
Sieve size (mm)	% passing	fraction	% loss		
19	100	19 – 13.2	0.4	Mean water absorption (%)	0.5
13.2	59	13.2 – 9.5	0.1	Mean APD (t/m^3)	2.66
9.5	37	9.5 – 4.75	0.8	Mean PDD (t/m^3)	2.63
6.7	25	4.75 – 2.36	0.7	Particle density (t/m^3)	2.64
4.75	17	Total weighed	0.5		
2.36	11				
0.425	3				
0.075	1				

Table 2b. Results of alkali reactivity tests, standard and CSIRO modified.

Standard			**AS1141 (CSIRO modified)***	
Silica dissolved as SiO2	m moles/l	30	Age (days)	% expansion
Reduction in Alkalinity	m moles/l	17	2	0.02
Potential reactivity classification	AS1141.39	Innocuous	4	0.12
			7	0.24
* Expansions greater than 0.1% in 10 days considered reactive.			11	0.40
			14	0.49
			16	0.54
			18	0.58
			21	0.65

Description of the Quarry Operation

The quarry operation will involve blasting to obtain material from a rock face, transport of the rock to crushers, sieving to size the aggregate, stockpiling, and transport to Leeton or regional projects. The proposed pattern of development of the quarry calls for development of the existing face at the current level. Charges are laid following drilling, with the face of the quarry being developed to minimise the frequency of blasting. Further extraction would involve development of a face at a lower level.

Efficient blasting involves the establishment of a sufficient workface to produce the annual requirements in few blasting operations. The anticipated maximum rate of blasting would be less than monthly as the number of blasts each year will be minimised. The existing workface of around 30m will therefore be extended. Blasting will always be implemented by a licensed contractor. The stages in the development of the quarry are illustrated in Figs. 3 a, b, c using a three-dimensional representation.

The material will be transported from the rock face to a mobile crusher using a front-end loader. The crushed and sieved material will be transported and stockpiled using conveyors. Stockpiled material will be loaded onto semi-trailers for transport using loaders.

A minimum of two personnel is required to operate the plant with additional personnel involved in transport. These personnel will reside elsewhere, and hence will commute to work at Tin Pot Hill. The crushing is currently implemented by contractors and this may continue.

The pattern of development is identified in the site layout plan (Fig. 4). Extraction would remove the most visible part of the existing hill, leaving a largely level surface, but with a sound barrier between the operation and the nearest residence. The final form of the site following rehabilitation would be a low rocky ridge along the existing eastern edge of the hill, with the floor of the quarry contoured to provide surface drainage following existing topographic flow patterns.

The life of the quarry has been estimated from the volume of material and the anticipated extraction rate. The volume of Tin Pot Hill is around 6 million cubic meters above 206 m elevation, for a basal area of around 45 hectares. The volume of the hill on Block 31 is around 4 million cubic meters above 205m elevation, for a basal area of around 10.5 hectares.

The total extraction over 50 years at an extraction rate of 100,000 tons pa and would be around five million tons, or 2.5 million cubic meters. (The specific gravity of the rock is in excess of 2.6 t/m^{-3}, but a conservative value of 2 has been used in converting from cubic meters to tons.) The quarry on Tin Pot Hill would easily meet the desired longevity of 25 years.

Operational Requirements

The onsite activities associated with the proposal are:

- Blasting to obtain the material.
- Loaders to move material.

- Conveyors to move material.
- Crushing and sieving to produce aggregate.
- Stockpiling of aggregate.
- Stockpiling of topsoil.

The off site activities are:

- Transport of material to the H. R. D. Ready Mix site in Leeton, or to sites of road works within the region (predominantly in the Griffith, Leeton and Narrandera Shire Council areas).

The facilities required on site to support the operation are:

- Areas for plant operation and storage.
- Areas for storage of processed material.
- Areas for storage of topsoil for rehabilitation.
- Fuel storage.
- Electricity generation.
- Water.
- Office and amenities.

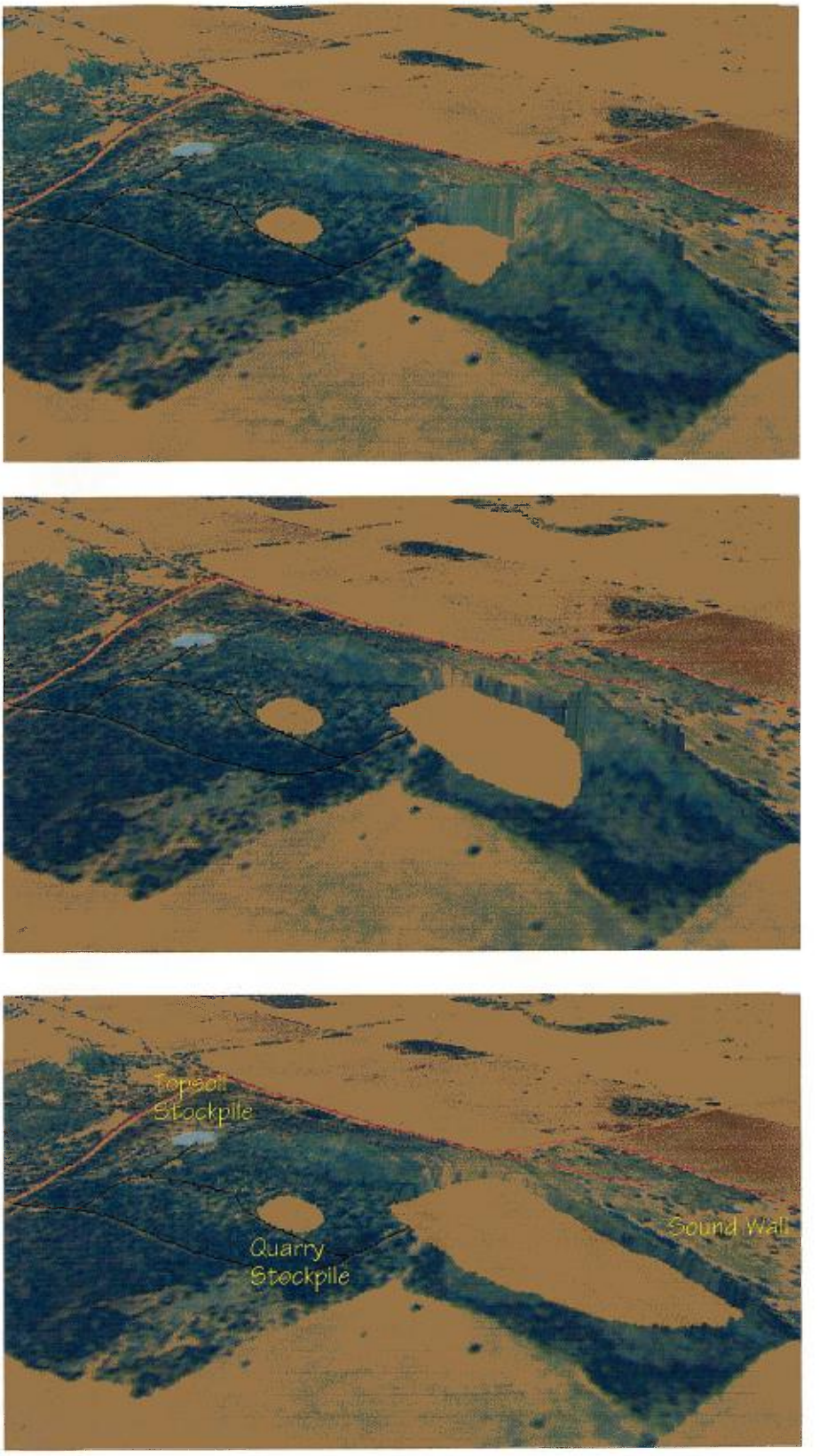
The general specification calls for the development of a quarry face for the extraction of rock through blasting, the transport, crushing and sieving of material, and the establishment of a work area near the quarry to accommodate the facilities, equipment and processed materials. An on-site generator will provide electricity. Potable water will be obtained from roofs, and water for other purposes from property dams. The office and amenities will be close to the work site.

The current use of contractors means that all facilities are currently transportable and supplied by the contractors. Development of permanent facilities would be subject to planning approval by Bland Shire subject to submission of detailed plans.

The projected onsite plant includes:

- 2 x Front end loaders
- 20 m^3 feed bin
- Mechanical vibrating feeder
- 42 x 32 jaw crusher
- Scalping screen
- Transfer conveyor
- 1,200 g cone crusher
- Sizing screen
- Transfer and stockpile conveyors
- Generating plant

Figure 3. Progressive Development of Glen Isla Quarry



Progressive Development of Glen Isla Quarry
Tin Pot Hill, Bland Shire
Prepared for HRD Ready Mix, Leeton NSW
by Natural Resource Intelligence Pty Ltd (NRI)
July 2003, using TNTmips (GIS).

View Direction: North East
Look Angle: -14 degrees
Vertical Exaggeration: 3x

Established Roads
Proposed Roads

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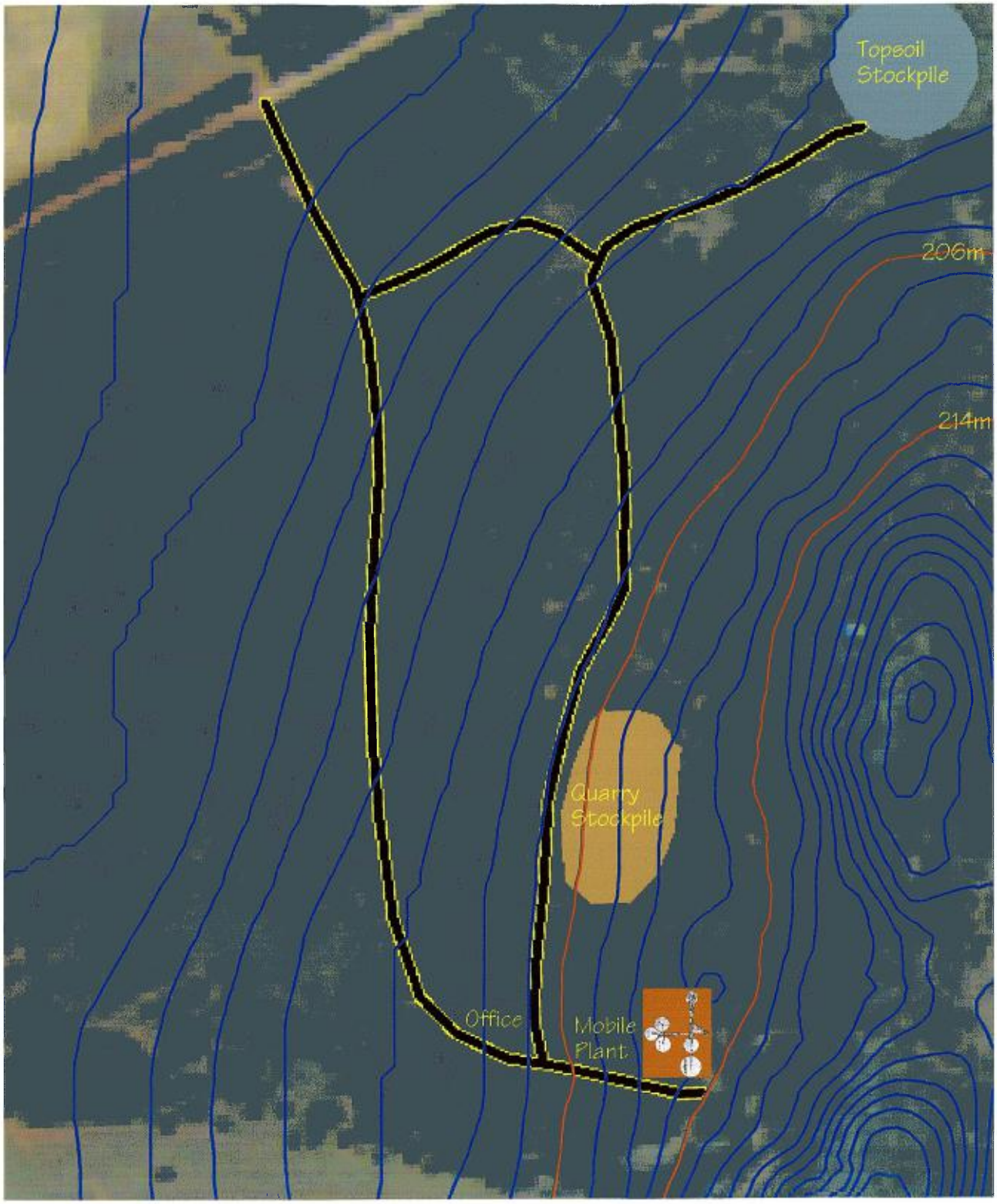
Figure 4. Plan of Site Development



0 100 200 300 400 500 meters

Scale 1 : 4 500

N

Plan of Glen Isla Quarry site development
Prepared for HRD Ready Mix, Leeton NSW
by Natural Resource Intelligence Pty Ltd (NRI)
July 2003, using TNTmips (GIS).

Road surface
Road verge
2 metre contours
206m and 214m contours

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Site Layout Plans

The general site layout (Fig. 4) identifies locations of development activities. The existing track on Block 32 provides access and was slightly widened to provide visibility. To limit the need for clearing and to address safety requirements, the track to the stockpile may be extended to South Yalgogrin Road to provide separate entry and exit routes for the quarry. The quarry will develop from the existing face located at the end of the access road. The second track will link the quarry with the stockpile areas for quarry material and topsoil for use in rehabilitation.

The existing main access track is 1km long and heads north from the quarry and contacts the road at a safe entry point. The total length of roads to be constructed on the property is 2km, where this produces a requirement to 2ha to be clear of woody vegetation. However, as some of this area was already cleared, the additional area to be cleared to meet the road requirements was around 1.5 ha.

The existing tree cover is being maintained to control noise[1] and dust, maintain the visual appearance and address conservation requirements. Roads have been located along existing tracks, and work areas in open areas to minimise the clearing of woody vegetation. Clearing of large eucalypt trees has been avoided.

The area required for the crushing and sieving plants, and storage and work areas is around 1.5 ha, where this provides for the movement and turning of vehicles. As with the road, these areas were previously cleared.

The area identified for the storage of topsoil is level, and effectively clear of woody vegetation. This minimised the clearing of woody vegetation and limits the potential for erosion. The 1ha area indicted in Fig. 4 will be extended within the clearing as required to maintain the topsoil in a viable condition (as identified under rehabilitation).

Site Preparation Works

Initial development on the site involved improvements to access tracks. Other developments identified in the initial EIS included construction of facilities and storage areas and expansion of the quarry face. Improvements to the access involved widening of existing tracks to improve visibility and prevent damage to vehicles. It may also include the development of a separate exit route to improve safety. The development plan (Fig. 4) identifies road surfaces in black, and clearance for road drainage and maintenance in yellow.

There will be little if any need for further clearing with this proposal above that identified in the initial EIS. Any vegetation that is cleared will be stockpiled and burnt when conditions are appropriate. These stockpiles could be retained as habitat for wildlife, but control of foxes and rabbits would first be required. That is, retention of stockpiles is inappropriate until effective programs for rabbit control have been implemented in the district.

[1] While dissipation of noise by the vegetation may be low, the generation of noise by vegetation can be substantial, particularly with strong winds. By increasing the background noise woody vegetation can reduce the significance of noise arising from operations.

The construction required for forming the roads is minimal because of the permeability of the sandy soils and the low gradients. Most of the roads have a gradient less than 1%, hence concentrated, high velocity flows would have to occur to produce erosion. The location and design of the roads make this most unlikely.

The works required in constructing the roads are the removal of ruts associated with the prior track through grading, and stabilisation of the road surface with material from the quarry. No side drains are required as the permeability of the soil prevents damage to the road through waterlogging. The absence of any need to channel water to protect the road effectively precludes soil erosion through surface water flow[2].

The highest gradient of 4% arises where the access road links with the quarry. The potential for erosion on this short section is limited because of the small catchment area, but it will be further reduced by the incorporation of runoff drains at strategic locations. Forming these drains as described below will prevent erosion, but monitoring will be undertaken to ensure that the procedures are effective. Hay bales will be used to stabilise any localised erosion, noting however, that this represents an interim measure. Long term controls are best achieved by controlling the patterns of water flows by careful shaping of the soil surface, spreading rather than concentrating water flows.

Construction of facilities involves the clearing of a work area to contain the quarry plant and stockpiles, and the erection of an amenities and office block. The locations of the facilities and stockpile is generally the same as for the prior operation. The earth works required are minimal, and mainly involve clearance of vegetation and levelling of the soil, where some of this levelling will repair impacts from the prior operation. The permeability of the soil in the stockpile areas, and the low gradients minimise the potential for erosion of soil erosion by water.

Stockpile areas become surfaced with aggregate as part of the conduct of the operation, where this aggregate prevents erosion by either wind or water. The surrounding woody vegetation also minimises the potential for wind erosion.

The location of the existing dams is identified in Fig. 1 by the small square symbol. These will be cleaned to regain their original capacity.

Infrastructure Considerations

The operation is designed to be internally self-sufficient for facilities, with power being produced by a generator, and water being supplied from the buildings and existing farm dams. The requirements for buildings are minimal, and will be met with a prefabricated structure transported to the site. This building will contain the office, shower, and toilet.

All except human wastes will be removed from the property and disposed of as required by State and Council regulations. Human wastes will be treated to a secondary level using on-site septic. Waste petroleum products will be removed from the site and recycled.

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[2] Erosion primarily arises from the concentration of water flows and hence is promoted by the construction of channels such as road side drains. The sandy soils means that drains are not required to protect the roads as water is rapidly drained by percolation. The potential for increasing erosion through the construction of road drains can therefore largely be avoided.

The quarry operations should not require water, but water is required for human consumption, and may be required for operations such as fire control and dust suppression. Water from the building will be stored in a tank for showers and human consumption. Any additional requirements for potable water will be met through cartage. Water from the dams will be used for fire control. Water for dust suppression will be transported to the site in water tankers.

The generator will be covered and bunded to reduce noise and the potential for pollution. Fuel storage will similarly be bunded to prevent any opportunity for pollution.

External infrastructure relates to roads for transport, and is addressed under this heading.

Rehabilitation

A detailed rehabilitation plan will be developed before works are implemented. This plan will addresses:

- Objectives
- Clearing
- Soil handling
- Rehabilitation earthworks
- Revegetation

Objectives

Quarry development calls for the identification of remediation plans for the restoration of mined areas. With some quarries the rehabilitation can be implemented progressively following the extraction of material but this is essentially restricted to situations where a shallow layer of material is being scavenged. With the Glenisla quarry the form of the hill and the planned patterns of extraction do not readily accommodate this procedure. The area being quarried will remain a work area throughout the life of the quarry, hence rehabilitation will occur when quarrying has finished.

Given that the site surrounding the quarry development is covered with native vegetation, the rehabilitation of the quarry site should be directed towards providing a cover of native vegetation. Given the low relief of the quarry site, erosion risk is very low, so therefore, revegetation should aim to reduce visual scaring of the site.

The objectives of the rehabilitation plan are therefore to:

- Form the landscape so as to minimise erosion and maximise visual amenity.
- Regenerate native vegetation.
- Minimise erosion

Clearing

Minimising the extent of clearing minimises the need for rehabilitation and can aid the final restoration and minimise the visual impact.

The development proposal results in the removal of a hill, resulting in an essentially level area. The quarry site had been previously cleared during its operations of over 20 years ago. Therefore, the quarry site currently supports mainly grasses and weeds, over very shallow

soil, with little to no woody regrowth occurring. None the less, as little extra area as possible should be cleared for safe and efficient operation of the quarry. Given there is likely to be separate entry and exit roads for trucks, the access roads will not need any significant widening.

The soils and vegetation associated with the rock outcrop cannot be replicated in the restored areas because the hill has exceedingly shallow skeletal soils that have formed through slow weathering over hundreds of years. The options for stockpiling of surface material from the hill for later respreading are limited because there is so little topsoil. Also, the quality of the soil derived from the rock is very poor. Despite these limitations the topsoil that does exist will be stockpiled because of its value in providing suitable micro fauna and seed supply to site once rehabilitation commences.

Vegetation clearing is addressed by minimising its extent.

Soil handling

Topsoil for rehabilitation will be obtained from the areas used for stockpiling the aggregate, and from the quarried area. Topsoil from the actual quarry site is very limited, however it will contain microbes and seeds from the site that will be beneficial in the rehabilitation of the site.

The surface soil from the stockpiling area will be removed and stored in the area identified in Fig. 4. Consideration for the timing of soil removal will be given such that it is not too wet but only extreme conditions should preclude stockpiling.

The depth of the stockpile will be minimised, with the soil surface formed to minimise erosion and maximise the regeneration of vegetation. This will involve the spreading of soil to produce a smooth surface with low slopes, where this is aided by the very low gradient of the stockpile area. The stockpile will likely extend beyond the limits identified in Fig. 4. A shallow depth (less than 1m) is desirable to maintaining the viability of the seed and soil. However, extension of the stockpile will be restricted to the existing clearing.

The procedure identified above is designed to maintain all the beneficial features of topsoil, in particular microbial activity and the maintenance of a viable seed pool. This is essential given the time delays between harvesting the soil and its use in rehabilitation. It should be noted, however, that management actions may be needed to suppress the development of Callitris on the stockpiled material.

The very small quantity of topsoil (A soil horizon) on the rock outcrop is the only local material to e excavated that is well suited to promoting plant growth, where the beneficial characteristics arise through accumulation of organic matter from grasses. The stockpile would need to sustain a good grass cover for this characteristic to be maintained. Also, suppression of woody vegetation is required to maximise the development of ground cover species that are important for achieving rapid soil stabilisation. This suppression is best achieved by slashing.

This form of stockpiling will minimise loss of seed viability. It will also promote the regrowth of plants, thereby developing a new seed pool over the life of the stockpile. The stockpiling procedure will therefore provide a source of material with viable microbial activity, as well as a viable supply of seeds of native species.

Soil stockpiling is addressed:

- Requiring the stockpiling of topsoil for later use in rehabilitation.
- Use of shallow stockpiles to maximise plant growth needed to maintain the soil viability and seed pool.

Rehabilitation Earthworks

The rock face will be progressively worked during the operation of the quarry thus rehabilitation will not be possible until work has ceased. Once quarrying has finished a relatively clean face will remain. The best way to prepare this face for revegetation, prior to topsoil spreading, would be to blast the surface so-as to create maximum fracturing. This will maximise potential for deep root penetration. Once fractured the area should be spread with wastes from the quarry, such as rock scree, where this provides a depth of material permeable to plant roots. Though the slope will be minimal, the waste material should be contoured to minimise run-off and maximise water infiltration. The top-soil should then be re-spread over the contoured surface. An appreciable depth of topsoil is desirable to improve conditions for plant growth, but this wastes much of the seed pool because the only seed near the soil surface will germinate. A depth of 5cm is effective when the substrate has been correctly prepared, but the amount used in practice depends largely on the availability of material.

The conduct of earthworks required to stabilise the ground and promote vegetative regrowth is addressed by:

- Fracturing rock using blasting to allow penetration of roots.
- Use of quarry wastes to contour the surface and provide a depth of finer material. The formed surface will disperse (spread) water and avoid the formation of channels.
- Spreading of topsoil over the formed surface.

Revegetation

The hard rock surface resulting from quarrying will not pose a risk of erosion because of the low slopes and the nature of the material, but revegetation is required to eliminate visual scaring. The stockpiled soil surface will be spread over the contoured material to provide a supply of seed of native grasses and shrubs. The topsoil improves the nutrient and water availability to plants, both directly and in providing microbial activity, in addition to providing seed. The spreading of the topsoil should coincide with the optimal germination and growing conditions, this being either early Spring or early Autumn. Spreading topsoil at this time of year will maximise the opportunity for successful recruitment of vegetation and minimise loss of soil through wind erosion.

The proposal calls for the maintenance of a ridge along the eastern edge of the existing hill where this provides a sound and wind barrier for the adjacent homestead. It also provides an opportunity to maintain the local occurrence of *Lomandra patens*. The proposed height of the ridge is five metres, where the slopes from the ridge will be equivalent to the current hill (around 15%). The schematic view of the site following rehabilitation is given in Figs.5 and 6 for two levels of cut. The colour of the quarry floor has been highlighted to identify the cut, but the sound wall has been draped with the existing vegetative cover to indicate the absence of quarrying. After rehabilitation the quarry floor would slope to the west, and be bounded on the east by a low stony ridge.

Seeds of Callitris and eucalypts from local populations will be seeded into rehabilitation areas by cutting fertile branches from local trees, placing them on the soil surface. This procedure maintains any local variations in species, and promotes establishment. Additionally, seed of *Lomandra patens* acquired from the adjacent hill will be dispersed on the hilly parts of the remediated area noting, however, that the availability of such seed will be limited. Such seed is best spread by animals as they generally play an important role in breaking dormancy and hence in promoting recruitment. The maintenance of part of the hill will promote such recruitment.

Promotion of viable revegetation is addressed by:

- Use of topsoil to provide a seed pool of native species.
- Use of top soil to provide a source of soil microorganisms for rehabilitated sites.
- Introducing additional seed by spreading seed bearing stems and branches from local species.
- Preventing the development of a dense stand of Callitris by mechanical thinning if needed.

Schedule

Fig. 3 identifies the pattern of quarry development whereby the cut extends southeast from the existing face. No rehabilitation is possible until the quarry has reached the southern extent, as the cut remains a work area. However, if quarrying is successively conducted on different levels rehabilitation cannot proceed until the ground has been reduced to its lowest planned level.

The quarrying will work north of the existing face once the southern part has been exhausted, and this allows rehabilitation of the southern parts not employed as work areas or for stockpiling. The rehabilitation will therefore be developed from the southern end of the quarry with the timing determined by the rate of extraction of material.

Once rehabilitation has commenced, any freshly scavenged surface soil will be used for the rehabilitation without stockpiling as this maximises seed viability.

Previous Site Operations

A quarry located at the site over 20 years ago was abandoned, apparently because the equipment available then could not cope with the hardness of the rock. The amount of material extracted was around 20,000 m^3. The quarry face from this operation was used as the base for the development of the new quarry.

The existing operations are as identified in this proposal with extraction of rock through blasting, and crushing to produce aggregate. The material from the original operation was transported along the existing track developed for the new operation. Erosion on this track was minimal despite the cartage of a considerable number of heavy loads of material, and the lack of maintenance over the last 20 years. The soil became compacted despite the low clay content. This generally reduced erosion but increased it in a few locations where water became channeled in wheel ruts formed by traffic when conditions were wet.

Erosion of unsealed roads is strongly dependent on the level of maintenance. Erosion of the track previously arose because water was channeled along the track, thereby increasing the volume and velocity of flows. However, erosion has been minimal because of the low

gradients, and because the sandy material tends to form a smooth surface. Such erosion is eliminated by preventing such channeling of water, disposing of the water directly from the road into the surrounding country, where this is most readily achieved by surfacing the road with material from the quarry.

Other activities at the site include grazing, which was associated with the clearing of vegetation, and the felling of trees for fence posts.

Most of the property on which the quarry is located is used for dryland farming and sheep grazing. This land use will continue.

Alternative Sites

The distance to the closest quarry from Tin Pot Hill (Walleroobie) is around 70 km. The distances from H. R. D. Ready Mix at Leeton to the closest existing quarry (CSR) and Tin Pot Hill are 72 km and 65 km respectively.

The Glenisla quarry site has a small advantage over these quarry locations in the distance from Leeton. However, the quarry site has a large advantage in the absence of other quarries in the vicinity. The distance of the quarry from the main site of usage illustrates the difficulty in obtaining suitable material in the region.

Alternative sites exist locally, as with Kangaroo Hill, where these present the same developmental issues as Tin Pot Hill. However, these alternative sites are further from Leeton, and do not have the ready road access of the proposed site. Moreover, the major outcrop of such rock in the region represents a large block of intact native vegetation and is a significant conservation reserve. The small occurrence, the history of disturbance by grazing and quarrying, and the access make Tin Pot Hill the most desirable location for a quarry from environmental and operational perspectives.

Contingency Plans

Contingency planning is incorporated in all of the activities, from blasting through site management to transport. This planning is based on the ongoing conduct of monitoring to ensure that issues are quickly identified. Early identification of a problem minimises any impact and allows rapid implementation of remedial actions.

Blasting / Noise

The outcomes of blasting are monitored to ensure that they accord with expectation and regulations. The initial monitoring identified that blast pressures were higher than expected. The sizes of individual charges will therefore be reduced for subsequent blasts to further reduce the blast pressure.

Erosion / Water Quality

Erosion is to be tightly controlled by the appropriate construction of facilities and the use of protective measures such as hay bales where necessary.

The site will be monitored to identify any occurrences of erosion. These will be addressed by identifying and ameliorating the cause. An example is where erosion arises through the channelling of water. This will be addressed by reforming the surface so as to spread the

water and thereby reduce flow velocities and turbulence. Sites where flows cannot be spread will be addressed using constructions that reduce flow velocities and collect large sediment particles, such as hay bales and other forms of sediment trap.

Dust

Dust will be monitored during operations.

The crushing plant uses water for dust suppression. Operations cease when water is not available.

Onsite dust suppression is to be achieved by use of gravel. Water will additionally be used to suppress dust if this proves inadequate in exceedingly dry conditions.

Transport

Transport of the material from the quarry is to be regulated to meet safety concerns. The contingency plans include restrictions on transport:

- To designated roads
- To daylight hours
- When conditions are wet

Additionally, truck drivers will be directed to ensure that they comply with all safety requirements including the need for reduced speeds in the vicinity of school busses and agricultural machinery.

Transport to centres other than Leeton or Griffith, as would arise with the use of the material for road construction, will be addressed on a case by case basis following referral to the Shires concerned and the Road and Traffic Authority.

Flora and Fauna

Conservation requirements are addressed by minimising the disturbance to the existing native vegetation and by the use of appropriate rehabilitation procedures. The rehabilitation procedures are designed to establish a sustainable native vegetation community.

THE LOCATION

Planning Information / Site Location

The four blocks comprising the property are located in the Parish of Sandy Creek, County of Cooper, and are dissected by the South Yalgogrin Road. The blocks are 23, 4, 31 and 32 in Fig. 2, and have a combined area of 752 ha. The AMG coordinates for Tin Pot Hill are E: 475400, N: 6218300, AGD datum. The regional location of the quarry is identified in Fig. 1, and is located approximately mid way between Barellan and West Wyalong.

The Glenisla Quarry is located on block 32, but an unnamed hill on block 31 also contains suitable material. A disused residence (Glenisla) is located on block 31 around 1km from the quarry site. This is unoccupied, and will remain so.

The closest dwelling (The Homestead) is located 0.5 km east of the quarry. The hill provides a barrier between the work areas and The Homestead. The next closest dwelling (Woodlands) is located 1 km to the south of the southern end of Tin Pot Hill. The residence Glenburnie is around 1.5 km northeast from the hill on Block 31, and 2.5km from Tin Pot Hill.

The Bland Shire Council identifies that quarrying is a permissible land use, but it requires development consent. The requirements for the consent are specified by the Director-General, Department of Urban Affairs and Planning, with the Bland Shire Council being the consent authority. The requirements are addressed by production of an environmental impact statement (EIS), which includes requirements for public consultation.

The legislative requirements are specified in the *EPA Act 1979*. This Act integrates planning for environmental requirements, and integrates the response to requirements in other Acts such as the *Threatened Species Conservation Act (1995)*. EIS Guidelines for Extractive Industries Quarries, have been developed by the NSW Department of Urban Affairs and Planning.

The Commonwealth Environmental Protection and Biodiversity Conservation (EPBC) Act 1999 additionally applies where a proposal is likely to have a significant impact on matters of national importance. For this proposal the only possible impacts relate to plant and animal species and plant communities listed under the Act. Referral is required for indirect as well as direct impacts where indirect impacts arise through developments on a site affecting areas elsewhere. This Commonwealth Act is administered by Environment Australia,

The Environmental Protection Agency (EPA) is the lead agency for the proposal.

Description of Affected Environment

Climate

The climatic characteristics are illustrated using long term records for Ardlethan. The average annual rainfall of 525 mm is reasonably evenly spread across months at around 40 mm/month, but the annual median rainfall is considerably less at 388 mm. As half of all

observations lie above and below the median, the median rainfall represents the amount of rainfall that can be expected each year. The large difference between the average and median rainfalls reflects the high variability associated with the sporadic occurrence of large rainfall events.

The number of rain days averages around 4 in January and 9 in July. Maximum recorded monthly and daily rainfalls occur in January, and are 229 mm and 99 mm respectively. Highest rainfalls by way of intensity and amount occur in summer, but rainy days mainly occur in winter.

The monthly averages for mean maximum daily temperature range from 14 degrees in June to 32 degrees in January. The commensurate minimum temperatures range from 3 degrees in July to 16 degrees in January and February. Ambient temperatures exceed 40 degrees on an average of 0.5, 1.4 and 0.7 days during December, January, and February respectively.

Monthly mean relative humidity at 9 am ranges from 44% in January to 86% in June. The 3 pm values for the same months are 38% and 54%.

Potential evaporation averages around 1600mm annually, but exhibits a marked summer peak reflecting patterns of temperature and humidity. As rainfall is evenly spread across months, the availability of water to plants is winter dominant. Given the ambient temperature regime, conditions are most favourable for growth in spring and autumn, with summer temperatures often being above optimum for plant growth and human comfort.

The prevailing winds would be similar to elsewhere in the region with conditions being calm over the period May, June, July , August. Around two thirds of the nights during this period are recorded as being calm. Winds are more common over the other months, with an average of 20% of nights being calm. Night wind speeds are generally low, and seldom exceed 30 km/hr.

Daytime winds are common in all months, with only 20% of days being calm throughout the year. Winds are strongest from September to November, when they are predominantly from the west / south west. Wind speeds are generally less than 20km/hr, and rarely exceed 50km/hr.

Long term observations of dust provide an indication of the relationship between the current climate and wind erosion. Dust only occurs when wind gusts exceed 15 knots, while the probability of dust is 25% when gusts exceed 40knots. Dust can occur in any month at an annual average probability of 1.5%, but December and March have the highest probability at 3.5 and 3% respectively. These peaks for December and March are attributed to climate and cultivation respectively.

The climatic characteristics of most consequence to the operation are the hot dry conditions, and the potential for high intensity rainfall over summer, and the occurrence of high winds. The hot dry conditions occur regularly, but the intense summer rainfalls and high winds are episodic.

Land Form

The local landforms derive from the aeolian deposition of sand and clay, where this deposition has apparently been promoted by surface expressions of rock. The land surface is undulating, broken by isolated rock outcrops. Factors other than the igneous rock that

have contributed to the regional landform include the existence of residual colluvial material, but none of this material is apparent at the site.

Incised drainage in the region is limited to Sandy Creek (Fig. 2), which rises in hills to the east, and ceases to flow (terminates without forming part of a drainage network) around 20km west of Tin Pot Hill. The small channel and the convoluted stream course are indicative of low flows. The lack of connection to a river indicates also indicates low flows but additionally indicates high soil permeability. That is, flows in Sandy Creek are highly intermittent and at low volumes and velocity due to the high permeability of the soils. The limited significance of Sandy Creek in providing drainage is illustrated by patterns of land use where all vegetation surrounding the creek has been cleared, and the land use in paddocks takes little regard of the channel (Fig. 5)

The original vegetation on the sands and clays was a complex of eucalypt and Callitris woodland, possibly with localised expression of mallee. The vegetation on the rock outcrop of Tin Pot Hill is currently grasses and sparse low shrubs, but a denser shrub layer can apparently develop during extended periods of favourable rainfall. Hills of the same rock formation to the north have grassland / sparse shrubland on the steeper slopes, and eucalypt woodland on lower slopes.

The ridge-line from Tin Pot Hill to Kangaroo Hill represents a minor local drainage divide but all surface drainage flows into Sandy Creek. The slopes to Sandy Creek are gradual, but are higher to the east than to the west, in part because of the mounding of the aeolian material caused by the hill.

The very flat terrain to the east of Tin Pot Hill indicates that surface water flows have been significant in developing the current form of the land surface. Water flows tend to produce a flat, smooth surface whereas aeolian generated surfaces tend to form mounds of dunes.

Land Use

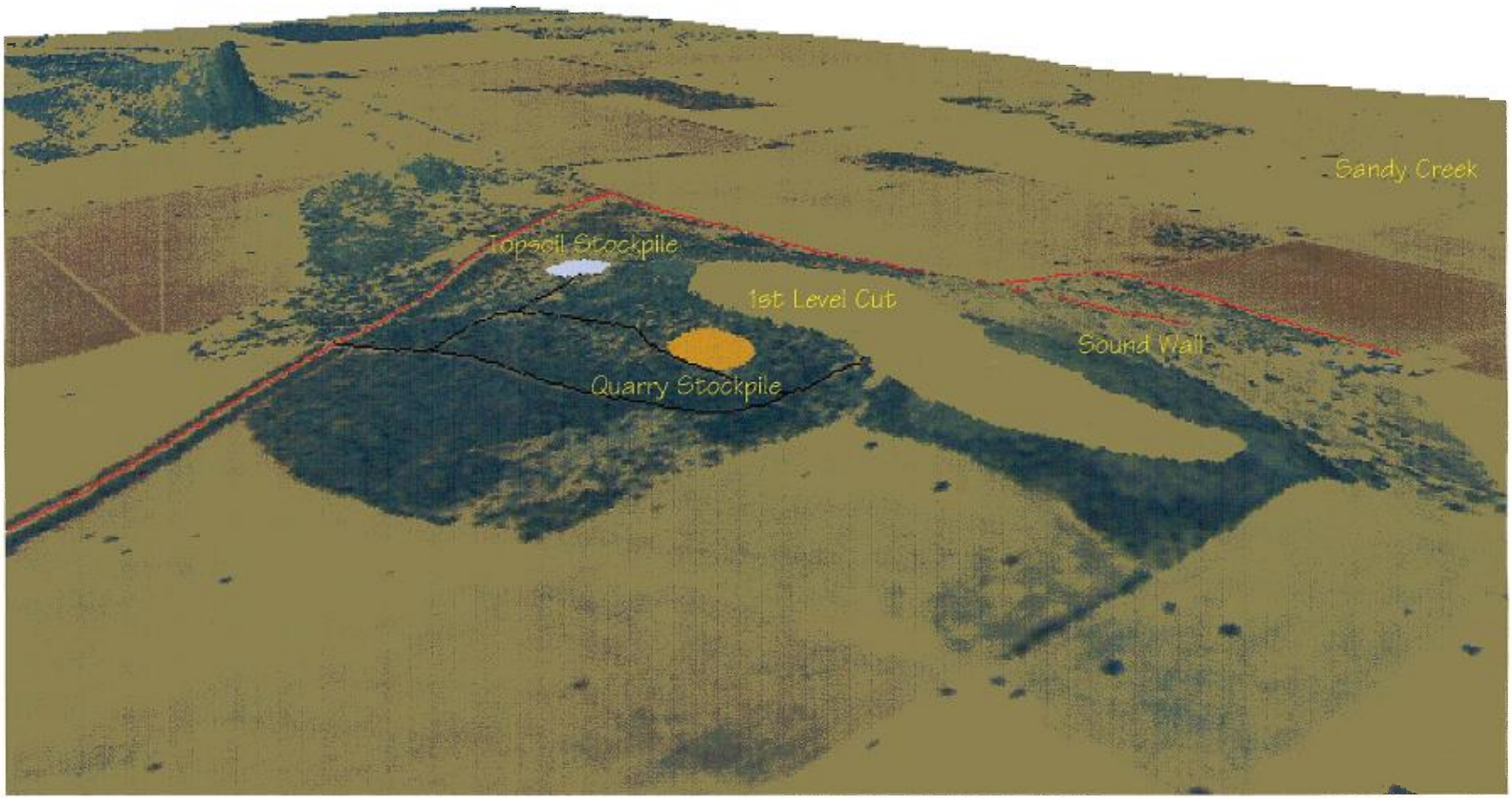
The land on the properties other than the rock outcrops was cleared early in the development of the region, and the entire property has been grazed. All of Blocks 4 and 23, and much of Block 31 is cropped (Figs 5, 6). The rock at Tin Pot Hill was initially commercially quarried over 20 years ago.

The regional patterns of land use are illustrated in Figs. 4 and 5. The flat and undulating plains have been cleared, and most of the 'intact' native vegetation is now associated with rock outcrops. The regional land use is based on sheep and dryland farming of wheat. The 525mm average annual rainfall would provide adequate water for wheat if falls were reliable. However, the 388mm median annual rainfall indicates a high degree of variability between years, where this creates wide fluctuations in wheat yields. The variability in rainfall also makes difficult the maintenance of appropriate stocking rates.

Regeneration of woody native vegetation has occurred on parts of Blocks 32 and 31 despite the grazing. This is mainly composed of Callitris, and the size classes of trees indicate several occurrences of episodic recruitment. The stem density of Callitris is very high in some areas, and effectively prevents grazing and timber production. Tree thinning, either natural or through management, is needed to develop a community that resembles the prior native vegetation.

The deep sandy soils in regrowth areas can develop a good cover of winter annual grasses where the density of trees is low, but biomass production by perennial grasses is limited.

Figure 5: 3 Dimensional view of the quarry following extraction to the 205m contour



3 Dimensional view of Glen Isla Quarry
following extraction to the 205m contour
Prepared for HRD Ready Mix, Leeton NSW
by Natural Resource Intelligence Pty Ltd (NRI)
July 2003, using TNTmips (GIS).

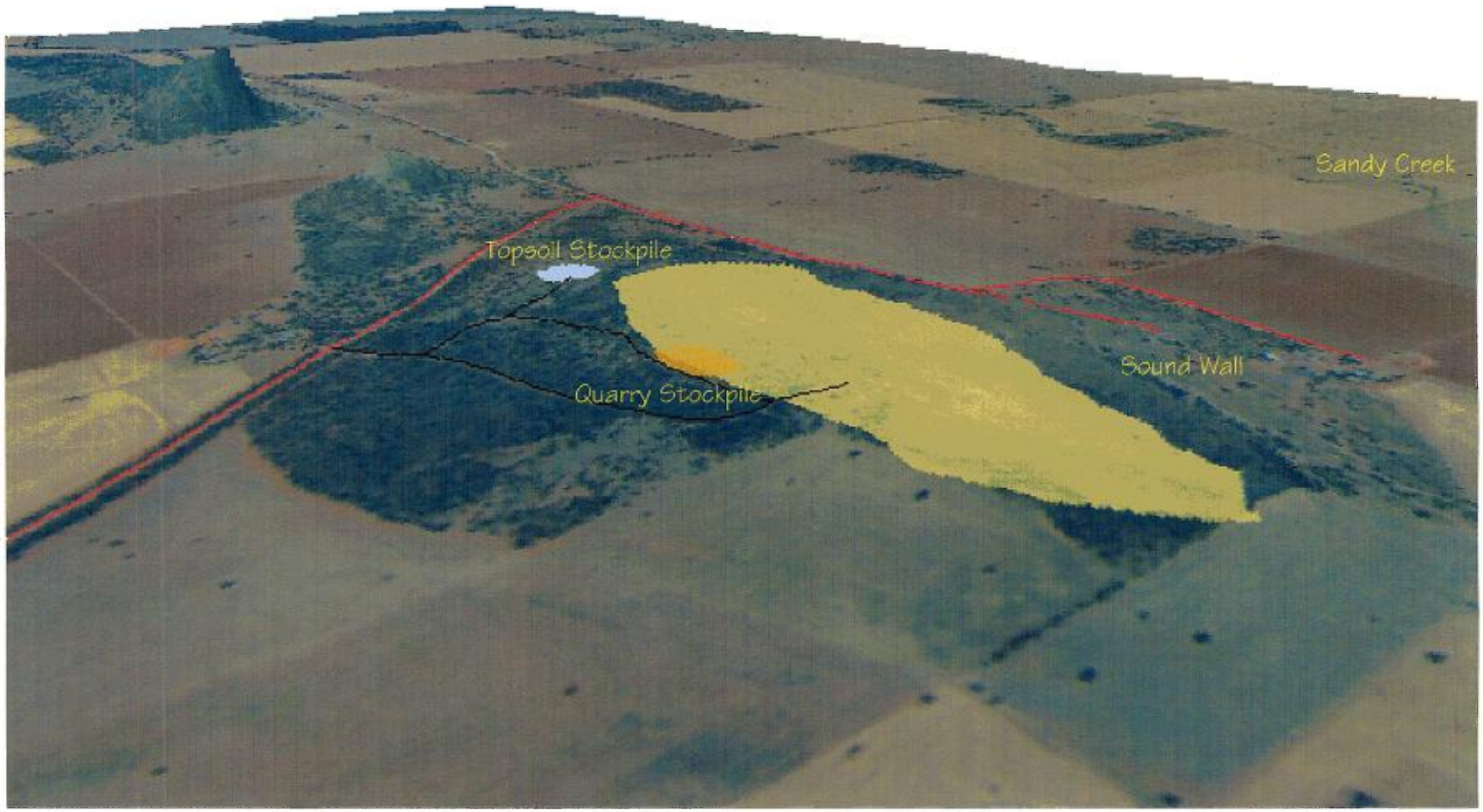
Scale 1 : 3 000

View Direction: North East
Look Angle: -13 degrees
Vertical Exaggeration: 3x

Established Roads
Proposed Roads

natural
RESOURCE INTELLIGENCE

Figure 6: 3 Dimensional view of the quarry following extraction to the 213m contour



0 50 100 150 200 250 meters

Scale 1 : 3 000

3 Dimensional view of Glen Isla Quarry
following extraction to the 213m contour
Prepared for HRD Ready Mix, Leeton NSW
by Natural Resource Intelligence Pty Ltd (NRI)
July 2003, using TNTmips (GIS).

View Direction: North East
Look Angle: -13 degrees
Vertical Exaggeration: 3x

N

Established Roads
Proposed Roads

natural
RESOURCE INTELLIGENCE

The mix of perennial and annual grasses is more favourable for grazing on the rock outcrop, but these clayey soils currently support high populations of weeds such as thistles. The areas of native vegetation have very limited production potential for grazing in their current state.

Impacts associated with the current land use include the introduction of feral animals such as foxes and rabbits, and the maintenance of weeds. A high proportion of species in the herbaceous layer are introduced. These impacts are ongoing.

IDENTIFICATION AND PRIORITISATION OF ISSUES

Overview of the Methodology

The process for the initial EIS commenced with discussions with Council where public consultation was identified as the prime requirement. An issues paper was produced and circulated to all stakeholders with a notification of a meeting at the site. The stakeholders invited to the meeting were:

- Local residents
- Council
- Local Aboriginal Council
- Department of Land and Water Conservation (DLWC)
- Road and Traffic Authority
- Parks and Wildlife Service
- Environment Protection Agency
- Department of Urban Affairs and Planning

The EIS for the initial development proposal of 10,000 tons per year was approved.

The extraction rate for the initial proposal meant that it did not represent an integrated development. However, the proposal to increase the extraction rate to 100,000 tons per annum makes it an integrated development and therefore subject to the development of a new EIS.

The requirement for a new EIS meant repeating the prior process but with new guidelines from the Director General of DUAP and the EPA. A new planning focus meeting was therefore held on the site with all stakeholders and interested parties being invited. Key participants being the EPA, local residents, and the Bland and Narrandera Shires (Annex 1). While the quarry is located in Bland Shire most of the transport corridor between the quarry and Leeton lies in the Narrandera Shire.

Outcomes of the Process

Initial Planning Focus Meeting

The issue of concern for local residents related to transport, with safety and damage to roads being raised. While transport constituted the prime concern of local residents, the constraints provided in the Issues Paper addressed requirements. The Issues Paper also met

requirements of the Road and Traffic Authority (RTA), whereby any significant change to operations would be referenced to the RTA for consideration.

The other issues raised by State Agencies at the issues meeting mainly related to the impact of noise/vibration. No issues were raised associated with conservation of biota and culture, but designs were requested for works for soil and water conservation, and site restoration. Council requested production of an EIS to be submitted with a Development Application (DA).

The issues raised by State Departments with the initial EIS included requirements for species lists, consideration of vulnerable and endangered species recorded within a 40km radius, an archaeological investigation, and a requirement to contain the noise at the nearest residence to 5db above ambient.

2001 Planning Focus Meeting

The specific requirements identified by the EPA are:

- General information about the proposal
- Impacts on surface and groundwater
- Wastewater treatment
- Air quality issues
- Noise and blasting
- Rehabilitation and environmental monitoring
- Broader environmental issues

The key concern of local residents and stakeholders raised at the planning focus group meeting was transport safety but dust, noise and vibration were also identified as being of concern. Vibration was of particular concern to the residents of the nearest dwelling at 'The Homestead'. A summary of the outcomes is given in Annex 1.

Response

These issues have been addressed by the conduct of detailed studies annexed to the body of the EIS as well as through mitigations identified in the report. While transport is addressed in these studies the final recommendations are based on extended consultation with the Narrandera Shire where the Shire had ongoing consultation with local residents and communication with Bland Shire.

ENVIRONMENTAL ISSUES

Traffic and Roads

The NSW Roads & Traffic Authority identified a requirement a traffic impact statement covering:

- Type of vehicles to be used for haulage,
- Proposed haulage routes,
- Current traffic volumes on all roads affected, including traffic on crossroads to the proposed routes,
- Affect of turning movements on through traffic,
- School bus routes affected by proposed haulage route, including number of buses and bus stop locations,
- Impact on the Barellan Township,
- Hours of operation.

An initial traffic Impact Study for the Glenisla Quarry Development was undertaken by Sinclair Knight Merz. While this address all issues raised by the RTA, this was superseded by the outcomes of discussions with residents and Shire Councils.

The final transport route to Leeton was identified by the Narrandera Shire Engineer after extensive consideration and consultation. The proposed transport route heads southwest from the quarry along the South Yalgogrin Road, then along Barellan-Sandy Creek Road, Burley Griffin Way, then the Narrandera-Barellan-Colinroobie Road. This route is identified on Figure 1.

The access from the property to the shire road has good visibility, and the traffic density is currently very low. The access points to highways similarly have good visibility.

The construction standards for the roads vary, but some have essentially been constructed by forming the soil to provide drainage, and surfacing with imported gravel. The road surfaces can support heavy loads when dry, as demonstrated by the transport of grain to regional centers. However, the bearing capacity of the underlying soil decreases at high moisture contents and the thin gravel surface has little capacity to distribute loads. While the loss of bearing capacity is much less with sandy soils than with clays, these roads are generally unsuitable for heavy haulage when wet. While the road construction standards are progressively being addressed by the Shire, transport of material from the quarry will cease when wet conditions would result in undue damage to shire roads.

Use of the material from the quarry for road construction and maintenance would increase the transport requirement. As such use depends upon regional development activities and the successful tendering for contracts, it is difficult to predict, but it would be expected that additional material would be used locally. Transport routes for additional material would depend on the destination, and would be determined in consultation with the Bland and Narrandera Shires and the Roads and Traffic Authority.

Safety

Operations will be restricted to daylight hours using 30 ton articulated trucks loaded 3 ton below their capacity. Consideration of the noise from transport activities indicates that the environmental requirements are met.

Concerns were expressed about safety with school busses and during the grain harvest. The school buss travels for 6km of the identified route along Sandy Creek Road without stopping. Around 4km of this distance is sealed. Truck drivers will be directed to ensure that they comply with all safety requirements including the need for reduced speeds in the vicinity of school busses.

The selected route is designated for heavy haulage and has a low density of traffic even during grain harvest. The main issue arises with the movement of agricultural machinery due to slow speeds and wide widths. Truck drivers will be advised to show the courtesy expected in all circumstances to ensure safety for all road users.

Alternate Routes

The haulage route identified above addresses requirements for transport to Leeton and Griffith. It does not address transport to other centres as would arise with the use of the material for road construction. Such requirements would be addressed on a case by case basis following referral to the Shires concerned and the Road and Traffic Authority.

Soils and Geological

Tin Pot Hill represents an small outcrop of acid volcanic rock formed in the middle Silurian surrounded by undulating plains. A number of such outcrops occur in the general area, and the airborne magnetic information indicates that the hill is a surface expression of a large and deep igneous mass. The rock at Tin Pot Hill is not delineated in the Geology Map, but the material is the same as the adjacent Kangaroo Hill which is described in the geology map as porphyry and rhyolite largely obscured by residual and colluvial deposits.

A detailed description of the material is given in the section on the characteristics of the resource. The rock is more closely described as a finely devitrified acid welded tuff, which equates with the rhyolite described in the geology map. The volcanic rock is highly resistant to weathering, and has apparently contributed little to the development of the surrounding soils. It weathers to produce a kalonitic clay, but this material has limited occurrence at the site. Soils on the outcrop are shallow and skeletal, characterised mainly by the accumulation of organic matter in the surface. This accumulation is appreciable indicating that grassland is the natural vegetation for the rock outcrop.

The land surrounding Tin Pot Hill is mapped as dune deposits of red and brown clayey sand, loam, lateritic soils, and irregular deposits of aeolian sand formed in the middle Quaternary. Development of soils around the rock is associated with these aeolian deposits. Accumulation of the soil material has been associated with extreme periods of wind erosion, with the rock outcrop influencing the local patterns of deposition. The associated winds have been westerlies.

The sands are old and likely derive from the last ice age, but they exhibit very little profile differentiation. The soils would generally be characterised as reddish, deep, uniform sands.

The red colour indicates the presence of iron oxides, and a highly oxidised profile. The soils are very free draining but are not highly leached because of the low rainfall.

Soils on the outcrop are very shallow and skeletal, with soil mainly accumulating in local depressions. The deepest profile observed of around 30cm deep had marked accumulation of organic matter in the surface 10cm (clay-loam texture), and pale clayey sand at depth, but without clear differentiation between the A and B horizons. The clay appears to be kalonite, and is poorly structured in the absence of organic matter. The subsoil becomes strongly cemented when dry despite the high sand content.

Erosion

Erosion of soil arises where the friction from flow exceeds the cohesive strength of the soil, and therefore depends on the soil properties as well as flow velocity and turbulence of the water. Sandy soils have little cohesive strength and are therefore readily displaced, but this displacement usually fills small gullies and surface irregularities through local redistribution. The resulting smooth surface reduces turbulence, and also reduces velocities by spreading the flow. These effects are addressed further under the heading Water.

The response of clayey surface soils to surface water flows is that:

- rain drops suspend clay particles in the water flow where they directly impact the soil (no vegetative cover), and
- the magnitude of any channel tends to increase with time as the eroded material becomes suspended in the flow and hence is transported from the site.

Erosion is best prevented by maintaining a vegetative cover, but works are required where channels have been formed. The works should be designed to spread water flows, thereby decreasing the velocity and turbulence of flows. Mechanisms vary from mechanical reshaping of the surface accompanied by revegetation, the use of straw bales and other barriers, and the spreading of coarse material that is permeable to water but not subject to erosion (coarse sand and gravel).

Given the sandy nature of the soils in the work area on Tin Pot Hill, the general requirements are to limit the development of impermeable areas that produce a high yield of water, and to avoid the construction of drains that channel water. Work areas should be 'hardened' using material from the quarry, where this will be permeable to water. This use of a porous gravel surface additionally helps maintain the permeability of the underlying soil. Moreover, water should be allowed to flow directly off semi-permeable surfaces rather than being channelled along drains. This construction mode has been used in sand dunes in high rainfall areas of coastal Queensland where the viable road construction techniques direct water flows from the road into the surrounding native vegetation rather than along formed drains.

While the prime requirement is to avoid the concentration of water flows, mechanisms are required to dispose of the water without creating erosion as the concentration of water flows is often inevitable with construction activities. The requirement to reduce flow velocities and turbulence in drains is best accomplished using stilling ponds. Stilling ponds can be produced by tailing the end of drains up-slope. The pond catches any sediment, while the broad outlet from the pond perimeter reduces flow velocities and turbulence. Water remaining in the pond after rainfall is lost through percolation and evaporation, where loss through percolation is rapid in sandy soils.

Engineers tend not to use stilling ponds for roads as their prime objective is to drain the water away from the road. Their currently preferred mechanism involves the production of barriers to flow (either straw bales or plastic strips), where these produce a minor stilling pond upstream of the barrier but increase the turbulence below. That is, bales and other such barriers have some benefit in reducing velocities, but their effect is limited because of the increase in turbulence and the failure to disperse (spread) the flow.

Where drains are necessary, as with runoff drains along roads, the drain should be short and the tail of the drain should point upslope. This form of construction reduces flow velocities, and promotes deposition of suspended material. Side drains should not be constructed.

Concentrated water flows that arise with pipes from roofs can also be terminated so as to disperse the water using stilling ponds, or by connection to agricultural drainage pipes.

Sandy soils are susceptible to wind erosion, as evidenced by the aeolian origin of the surficial material in the region. Maintenance of the tree cover minimises the potential for further erosion by reducing the velocity of the wind at the soil surface. The risk of wind erosion is associated with the surrounding cropping and grazing lands because of the removal of the vegetative cover by grazing and disturbance by ploughing. The loamy soils on the rock outcrop are not susceptible to wind erosion.

Water

The climate of the region is semiarid, with rainfall roughly evenly spread across months. However, as potential evaporation is strongly seasonal and is much greater than rainfall, water is potentially limiting to plant growth over most of late spring, summer, and early autumn. In consequence, any ground water recharge potentially only occurs over winter, and then only in seasons with well above average rainfall.

Surface Flows

The low intensity of winter rainfall reduces the potential for runoff. Conversely, summer rainfalls tend to have moderate to high intensities, increasing the likelihood of surface water flows. Events of high runoff that have the potential to cause soil erosion are therefore associated with sporadic high intensity falls over summer.

Tin Pot Hill has locally high relief within a very large catchment that drains through Sandy Creek. Water flows in all directions from the hill, but any (all) surface water flows would eventually flow into Sandy Creek. Flows in this creek are highly intermittent and of low volume and velocity.

The specific yield (ratio of runoff to rainfall) of water from the rock outcrop would be high, and could approach 80%. Conversely, the specific yield for deep sands surrounding the hill would be exceedingly low, and could be less than 1%. However, runoff from the hill would flow over the surrounding sands. The effects of surrounding soils and the episodic nature of rainfall make difficult the estimation of flows into sandy creek from the quarry site. It would be expected, however, that runoff from Tin Pot Hill rarely contributes to flows in Sandy Creek. Production of appreciable runoff would require very intense rainfalls, or the production of saturated soils through prolonged rainfall, and would therefore be associated with extreme events.

The size of the Sandy Creek catchment is difficult to determine because of the landscape formation, but would exceed 400km^2. The Sandy Creek channel is very small for this catchment size, and the tortuous shape is associated with low flow velocities. Termination of Sandy Creek around 17km west of Tin Pot Hill indicates that the land around Tin Pot Hill contributes little to flows. It appears that flows mainly derive from the hills to the east, and are generally associated with extended periods of low intensity rainfall (winter) rather than high intensity storm events. These considerations, and the small area of Tin Pot Hill, indicate that any contribution that the hill could make to flows in Sandy Creek would be insignificant. The area around Tin Pot Hill appears to be a sink rather than a source of surface water flows.

The difference between this conclusion and the suggestion that high intensity rains produce most surface water flow relates to consideration of a catchment as opposed to a site. Winter rains tend to be widespread while summer storms are generally localised. Locally, summer storms are most important in generating surface runoff, but winter rainfall is most significant in generating flows from across a large catchment. Winter rainfall could reach the streams as subsurface as well as surface flows.

The significant issues for the quarry operation are the potential occurrence of saturated soils in winter, and the possibility of erosion associated with high intensity rainfalls. Shallow areas of sandy soils will undoubtedly become saturated, but this is unlikely to affect vehicle trafficability because of the sandy soil texture and surface slope. Moreover, areas trafficked by vehicles will be hardened through use of quarry material.

Soil Erosion by Water

The development site is 1.5 km from Sandy Creek and is surrounded by sandy soils, where Sandy Creek is the only incised drainage line in the region. The minimum buffer of native vegetation around the work areas is 100m, when overseas studies indicate that a width of 30m provides an effective riparian buffer. The existing buffer of native vegetation, combined with the 1km of paddock between the quarry and the creek, precludes the quarry from having any measurable or significant effect on the stream.

Local redistribution of soil by water is the only potential erosion impact with the proposed development. The mitigation will involve:

- Surfacing of roads and work areas with material from the quarry.
- Avoiding the construction of drains that channel water.
- Where drains are necessary, tailing of the end of the drain upslope to produce a stilling pond.
- Terminating any drainage pipes so as to spread the water.

While engineering procedures can be identified that are designed to control erosion, the most effective procedure with sandy soils is to minimise changes to the existing soil surface as this spreads water flows and thereby prevents erosion. Should erosion occur at any locations, the requirement is to disperse flows through use of stilling ponds produced by correctly formed drains, or hay bales. That is, the final protection against erosion is through monitoring and implement of corrective management where issues arise.

Ground Water

The quarry site, which includes the rock outcrop and surrounding areas, would not have ground water because of the permeability of the sand, and the extent and impermeability of

the volcanic material. A groundwater aquifer within the rock is highly improbable because of the low fracturing of the rock, its position in the landscape (elevation), and the size of the igneous mass. A non-linear conduit (curved pipe) would have to extend through solid rock for over 10km for a groundwater system to exist within the material to be quarried.

The permeability of the sandy soils surrounding the hill likely results in water from the hill contributing to a groundwater system through lateral subsurface flows. The patterns of such flows cannot readily be defined, as their direction need not relate to the surface contours. Also, percolation that moves laterally could be intercepted by Sandy Creek, and hence not contribute to a groundwater system.

Detailed knowledge of subsurface structure would be required to determine the likely patterns of subsurface flow. However, conduct of detailed studies is not warranted as development of the quarry would not significantly change the existing pattern of groundwater recharge and movement. Blasting would not change the permeability of the rock because of the size of the rock mass, and contributions from the rock outcrop would remain equivalent because of the shallow soils and low vegetative cover. The proposed development would not alter the existing pattern of groundwater recharge, particularly given the minimal clearing of existing woody vegetation.

An increase in recharge to regional ground water systems would be expected to have occurred in association with the extensive clearing of woody vegetation in the areas surrounding the quarry. The significance of such an increase varies depending on the characteristics of the system. It is beneficial and often promoted in non-saline systems, but is detrimental where the additional recharge mobilises salt and brings it to the soil surface. Salinisation is not an issue locally despite the widespread clearing, as the sandy soils effectively have no ability to contribute salt. Development at the site does not have any potential to affect ground water, soil salinisation, or waterlogging.

Water Supplies

Supply of potable water is to be provided by tanks fed from roofs. Any need for water for quarry operations will be met from existing property dams. A need may arise for fire control, but is not expected for dust suppression.

The property dams are identified in Fig. 2 by the square symbols. The dam on the property containing Tin Pot Hill is mainly fed from the road side drain, and the other dam similarly receives runoff from the road. This collection from the road increases the water yield to the dam and reduces sediment flow into the creek, and is therefore beneficial to the environment and the property owner. However, the accelerated rate of sedirnent accumulation arising through the dams acting as stilling ponds increases the need for cleaning.

Water Pollution

Sandy soils can create a potential for the pollution of groundwater because of their permeability, however, the only potential sources of pollution would be fuel and oil and effluent from an amenities block. Fuel pollution is prevented through appropriate procedures such as bunding storages, conducting servicing in constructed facilities, and close supervision of refueling of plant to prevent spillage.

Effluent from the amenities block will be treated using a septic system. Studies indicate that septic systems do not have a significant environmental effect at the density that exists within

the region. The effectiveness of the septic system will be aided by the sandy soil and native vegetation at the site.

The unweathered rock has essentially no clay, hence there is no colloidal material. Some clay can become suspended from disturbed surface soil surrounding the quarry but this will rapidly be incorporated into the surrounding sandy soils. Any suspended solids, such as organic matter, will be deposited in the surrounding intact vegetation. The solubility of the material is too low to significantly affect the pH of surrounding soils.

Water Treatment

There is a general requirement to identify clean and dirty water systems, and erosion controls to treat disturbed areas and contaminated runoff. None of the water arising from the development will be contaminated. The only introduced sources of contamination are petrol, oils and lubricants (POL), and effluent from the septic. As all POL is to be bunded, the high evaporation rate ensures this will not be a source of contamination.

Effluent from septic systems has the potential for contamination through overland flow, but the high potential evaporation and sandy soils make this highly unlikely. Indeed, the environment is particularly suited to the use of septic systems.

The assessment of contamination, like weeds, can depend on the land use. Suspended clays and organic acids do not represent contamination for natural systems, but are undesirable in water supplies. As the site does not, and essentially cannot contribute to any water supply, any movement of natural materials cannot produce contamination.

Sand filters provide one of the most effective means of removing colloids, particulates, and contaminates from water. Sand is used in commercial filters, and natural sand dune systems have been used overseas to cleanup water supplies. Extensive sand masses are a natural equivalent to artificial wetlands in providing a means of cleaning water. The requirement at the quarry is therefore to ensure that any flows from the site spread across the surrounding sand to ensure maximum percolation. That is, an artificial means of cleaning any runoff is not required because the natural system provides a more effective means than any engineering solution.

Monitoring will be undertaken to check the effectiveness of control procedures, but the lack of defined patterns of surface or groundwater flows limits the availability of procedures. Surface flows will only occur for brief periods associated with high rainfalls, and flows will be shallow and dispersed (overland flow), and are unlikely to connect with the drainage in Sandy Creek. The monitoring will therefore identify:

- channeling associated with the concentration of water flows
- surficial deposition of clay and other particulates associated with the movement of sediments.

Should either characteristic be observed, remedial action will be undertaken to reduce the source of sediment and/or, disperse the flow of water.

Air Quality

The operation has the potential to create dust, with the main sources, and approximate relative contributions are identified in Table 3. The contributions from the different sources vary with the nature and location of the quarry operation, but the values in Table 3 identify

the relative significance of the sources. The significance of an activity primarily relates to the frequency of its occurrence, the size of the contributing area, and the potential to create dust.

The relative contributions for different dust sources identified in Table 3 relates as much to the ease and effort expended in dust control as to the potential for dust generation. Crushing and screening, for example, have a high potential for dust generation, but modern equipment is designed to achieve a high level of dust suppression to address health and safety requirements. Point dust sources can readily be addressed. The main difficulties for control relate to extensive sources (roads and bare areas). These sources of dust are addressed through site development and management.

The allowable increases in dust above existing levels vary with the background levels and the population level. For rural areas, the maximum levels of increase in existing dust are 2, 2, and 1 gram/metre square/month for background levels of 2, 3, and 4 gram/metre square/month respectively. The permissible increase for the proposed development site would be 2 gram/metre square/month.

Table 3. Sources of dust from open mining operations, and approximate relative contribution (%).

Bare Ground	44
Truck Haulage	40
Processing	8
Loading	4
Blasting	2
Dumping	2

Dust Generation from Quarry Operations

Dust modelling was undertaken using the AUSPLUME 5.4 model on sample data obtained at the site during operation of the crushing plant. Dust samples were taken at various points around the site during the operation of the crusher to reflect:

- background levels
- high concentrations at the crusher
- concentrations at 10m and 20m from the crusher

Each sample was taken over a defined time period to allow determination of emission / deposition rates.

Samples were weighed and the particle size distributions determined using laboratory analysis. Multiplying the size fractions by the density of the material allows calculation of the mass fractions of different sizes of particles for use in the model. The density of the rock type determined from the literature is 2.6 g/cm^3.

The particle size and mass fraction results are given in Table 4. Most of the dust mass is associated with large particles which are deposited close to the source.

The AUSPLUME model was run using meteorological records for Griffith supplied by the Bureau of Meteorology and a terrain file generated from digital elevation data identified

above. The closest neighbouring homesteads, specifically 'The Homestead', were chosen as specific receptors. Griffith is the most appropriate meteorological station for the study site.

The distribution of the modeled dust plume based on highest concentration at each receptor point is illustrated in Figure 8. At the worst case outcome the dust is not predicted to affect the nearest dwelling. The complete model specifications and table of worst 100 modeled results are given in Annex 6.

The modeling results show that dust is centred at the site and exhibits little spread. The dust produced by the quarrying operations has little effect the surrounding area and neighbouring homesteads are unaffected.

The assessment of permissible dust levels is based on:

- An average concentration of 90 micro gram per cubic metre averaged over a year
- A maximum total deposited dust level below 4 gram per square metre per month.
- A maximum increase in the deposited dust level below 2 gram per square metre per month.

The development is predicted to produce no change in dust at the closest specific receptor and therefore readily meets these requirements.

Table 4. Particle size distribution of mass fractions for dust from crushing material at the Glenisla quarry.

Particle Size (micron)	Mass Fraction
999	0.9790
848	0.0170
213	0.0010
54	0.0010
15	0.0010
4	0.0010

Dust Control

The nature of dust control measures depends on whether the source is diffuse or point located. Diffuse sources are primarily addressed through planning site development and remediation, while point sources are addressed using engineering procedures such as wind baffles and water sprays.

Climatic conditions strongly determine the spread of dust, and therefore the threat it poses to adjoining landholders. Seasonal and climatic conditions also determine the background dust levels. The general constraints are identified under climate, where 'naturally occurring' dust is most prevalent in early summer and autumn, and is generally associated with southwesterly winds. Dust is therefore of most consequence for the 'The Homestead', noting however, that winds from the southwest will direct dust away from the residence.

Point Sources

The processing of the rock is the third most significant contributor of dust, but generally contributes less than 10% of the generated dust because the equipment is designed to control

dust. The sources of this dust include conveyors, crushers, and screens. Processing is not predicted to produce significant dust because of the equipment design, and because of the low dust content of the material being processed. The rock has a very low proportion of fine material that could contribute to dust (Table 2).

The remaining quarry activities account for around 7% of dust, and are roughly comparable in their contribution. Blasting can produce appreciable dust, but its contribution is low because of the infrequent occurrence. Loading and dumping have low contributions to dust because of the form of handling and the nature of material.

Diffuse Sources

Bare areas are major potential sources of dust, and the bare paddocks produce most of the dust within the region. The potential for dust generation from bare areas associated with the development will be minimised by:

- Minimising clearing.
- Maintaining the cover of woody vegetation around the site.
- Maintaining vegetative cover on the stockpile of topsoil.
- Maintaining a cover of fine aggregate on work areas.

Dust from 'bare' areas such as the topsoil stockpile will be contained through revegetation, hence the main potential for dust generation arises with work areas that cannot be stabilised through revegetation. Maintaining the surrounding cover of woody vegetation will reduce emissions from such areas, but further action will be implemented to control dust. The requirements relate particularly to areas subject to regular vehicular disturbance, such as roads.

Sand is currently being used for dust suppression by Defence on roads in military training areas in the Northern Territory, where this use follows successful implementation of this procedure in mines in South Africa. That is, the sandy soils at the proposed quarry site already provide a reasonable level of dust suppression. However, a much higher level of suppression can be obtained by surfacing the roads using dust free material from the quarry.

Particles sufficiently small to contribute to dust are washed through the crushed gravel (aggregate) and are deposited on the soil surface. The movement of vehicles then generates little if any dust. The surfacing of the roads with quarry material will effectively reduce dust to minimal levels. This mode of dust suppression will also be used on the quarry and aggregate stockpile sites.

Application of water suppresses dust, and can be applied to roads, stockpiles, and work areas. At twenty vehicles per day, the dust created during the summer time may be significant enough to warrant the use of a water truck for dust suppression.

Monitoring of Air Quality

Monitoring is required to measure performance, but results are limited by the availability of reliable baseline information. Modeling can be used to overcome some of these limitations, but only where there is detailed and reliable information on climatic variables. The alternative is to locate monitoring devices such that effects attributable to the operation can be separated from the background.

There is no standard method for determining the spatial arrangement (locating) of monitoring devices because of the number of factors affecting the results. For the development site, the prime requirements are to determine the magnitude of any increase at

the nearest residence above the regional background. This separation of sources of dust cannot be absolutely achieved without expensive equipment as it depends on relating the measurements to the wind direction and sources.

Given that the wind directions are reasonably constant over many months samplers can be strategically located to identify the likely contribution from the quarry operations. Apart from effects of wind direction, the main uncertainties with this approach arise from the proximity of the shire road. Traffic on this road is likely the major local source of dust because of the nature of the surface and the regular disturbance.

The minimum requirement is for samplers to be located on the western edge of the woody vegetation on block 32, and on the eastern property boundary due west of the nearest homestead (The Homestead). This provides an indication of contributions from the quarry for the main prevailing winds. Samplers could additionally be located close to the South Yalgogrin Road, and on the eastern boundary of Block 32 due west of the topsoil stockpile. These gauges would provide an indication of contributions from the road and topsoil stockpile respectively.

Several types of dust samplers can be used depending upon requirements. The simplest form, by way of dust deposition gauges, is appropriate for this proposal because of remoteness (power requirements), and the likelihood of the development readily meeting the legislative requirements. The legislative requirements are specified in terms (units) that are provided by deposition gauges.

Deposition gauges take the form of a funnel feeding into a bottle, where the material collecting in the bottle is weighed at regular intervals. Records are presented as grams/metre square/month.

The deposition gauges identify the material deposited by wind but do not identify the concentration of suspended particulates, where the relationship between the two varies with particle size distribution of the dust. Measurement of Total Suspended Particulates is based on filtering a known volume of air, and hence requires a continuous source of power. Measurement of Total Suspended Particulates would be undertaken during development of the quarry to identify the relative contributions from different sources. It would therefore be used to target any remedial actions.

Noise and Blasting

Noise and vibration are calculated for average conditions indicative of the environment. This generally identifies the worst case situation because of the existence of natural barriers, and the need to encompass all likely outcomes. The main topographic feature that will influence the noise and vibration in adjacent dwellings is Tin Pot Hill. The nearest dwelling (The Homestead) is located to the east of the hill over 500m from the quarry face, and requirements are evaluated relative to this residence. The next closest occupied dwelling (Woodlands) is located 1 km to the south

Noise from Machinery

A noise and transportation impact assessment was undertaken by Richard Heggie and Associates (Annex 5). This identifies the legislative and operational requirements, and models the noise from the machinery associated with the quarrying operations for defined conditions. Table 5 summarises the requirements and outcomes of the modeling.

The modeling indicates that the proposed development readily meets the noise requirements under a range of environmental conditions.

Traffic Noise

Consideration of the frequency of vehicles and the proximity of dwellings indicates that traffic noise is very low compared with legislative requirements (Annex 5).

Table 5. Summary of requirements and outcomes of modelling LA10 noise emissions.

			Daytime Requirement (dBA)		
	Acceptable	Maximum	Calm Conditions	2m/s wind towards residence	2^0C/100m temperature inversion
Rural	45	50			
The Homestead			26	28	28
Woodlands			36	40	39
Glenburnie			28	32	32

Overpressure and Vibration from Blasting

The Environmental Protection Authority (EPA) guidelines allow a maximum overpressure of 115 dB (linear), and a maximum ground vibration of 5 mm/sec in the dwellings adjacent to mines. Experience indicates that ground vibration for mines and quarries can generally be maintained below 1mm/s. These EPA guidelines will be superseded by those developed by the Australia New Zealand Environment and Conservation Council (ANZECC), but the codes are essentially identical.

Estimates of ground vibration levels based on the effective charge mass per delay for different types of blasting operations are provided by Standards Australia.

Definitions

Airblast represents the atmospheric transmission of the pressure wave from the explosion, which constitutes the greatest cause of complaints from explosions. The human response to sporadic noise differs to that for continuous noise, with loud sporadic noise being perceived as highly undesirable (causes much greater nuisance).

Ground vibration is complex in its form and effects, but Peak Particle Velocity is commonly used as the indicator for damage. Studies and experience suggest that 'conventional' blasting at normal distances is unlikely to create ground vibrations of a magnitude that causes damage. This situation reflects both the level of charge used, and the ability to reduce vibration through the sequenced detonation of separate charges. Ground vibration depends on the maximum charge weight per delay (the Maximum Instantaneous Charge, or MIC) and not the total charge provided the delay interval is more than 8 milliseconds.

The recommended maximum peak particle velocity for houses and low-rise residential buildings is 10 mm/s, but a threshold of 5 mm/s is used for most blast designs.

Ground Vibration

Predictions can be obtained from knowledge of the propagative characteristics of the material and the charge size and configuration. With blasting a free face in a hard rock quarry the following attenuation equation for Peak Particle Velocity applies:

$$V = 500 \left(\frac{R}{Q^{1/2}}\right)^{-1.6}$$

Where

V	=	ground vibration as peak particle velocity (mm/s)
R	=	distance between charge and point of measurement (m)
Q	=	effective charge-mass per delay or MIC (kg)

Table 6 summarises vibration information for different charges and distances.

The estimated MIC is 790kg for a 500m distance to the nearest dwelling, at a ground vibration threshold of 5 mm/s. This greatly exceeds the MIC that would be used, hence ground vibration is not a practical constraint.

Table 6. MIC for a Free Face – Hard Rock Quarry

Vibration (PPV) (mm/s)	**Estimated Maximum Charge Per Delay (MIC) (kg)**									
	Distance (m)									
	5	**10**	**20**	**50**	**100**	**200**	**300**	**500**	**800**	**1000**
2	.025	.100	0.4	2.5	10	40	90	**250**	650	1000
5	.080	.320	1.3	7.9	32	125	285	**790**	2000	3150
10	.190	.760	3.0	18.9	76	300	680	1900	4850	7550
25	.600	2.40	9.5	59.2	235	950	2150	5900	15150	23700

Airblast Overpressure

The airblast overpressure depends upon whether the charge is confined or unconfined as well as the magnitude of the charge and the timing of its detonation. Routine blasting in quarries involves confined blastholes, where these do not generate excessive airblast overpressures. The formula for a fully confined blasthole is:

$$P = 3.3 \times 10^3 (Q^{1/3}/R)^{1.2}$$

Where P = airblast level (Pa)
Q = mass of charge detonated (kg)
R = distance from the charge (m).

The airblast overpressure (P) can be converted to dB using the formula:

$$L_p = 20\log_{10}(P/P_o)$$

Where L_p = the airblast level expressed (dB)
P = the airblast overpressure expressed (Pa)
P_o = the reference pressure (20×10^{-6} Pa)

The maximum allowable level for human discomfort under the EPA guidelines is 115 dB. At 500m this suggests a MIC of 85 kg, however a MIC of 100 kg will only result in an airblast of 115.57 dB.

Despite the confined blasthole, the airblast overpressure is more limiting than ground vibration. Even so, this 80kg limitation to the MIC is not operationally limiting because the sequential detonation of charges allows achievement of the required blast size without the generation of excessive noise or vibration. That is, blasting is designed to minimise noise and vibration, where this is directed by the NSW Department of Mineral Resources.

The MIC that will comply with the EPA and ANZECC guidelines is around 80kg. The contours produced by a 100 kg MIC blast indicate that the nearest dwellings are not exposed to airblast in excess of the allowed limits (Fig. 7).

Management strategies for noise control

Blasting will be conducted by a licensed operator under NSW Department of Mineral Resources supervision, and should occur infrequently during daylight hours (Maximum of once every two weeks). Blast operators are licensed, and endeavour to make ground vibration and airblast pressure as low a level as possible to reduce cause for discomfort and complaint. The contractor will monitor operations to ensure that the blasting meets environmental requirements.

The factors affecting outcomes are summarised in Table 7. The solution that will be applied in practice is to use a MIC of less than 80 kg, but to use multiple charges separated by more than 8 milliseconds. This approach can achieve economies in operation as well as reductions in the levels and frequency of blast noise and vibration. A single blast each year may best meet requirements, but this depends on the size of the available work face.

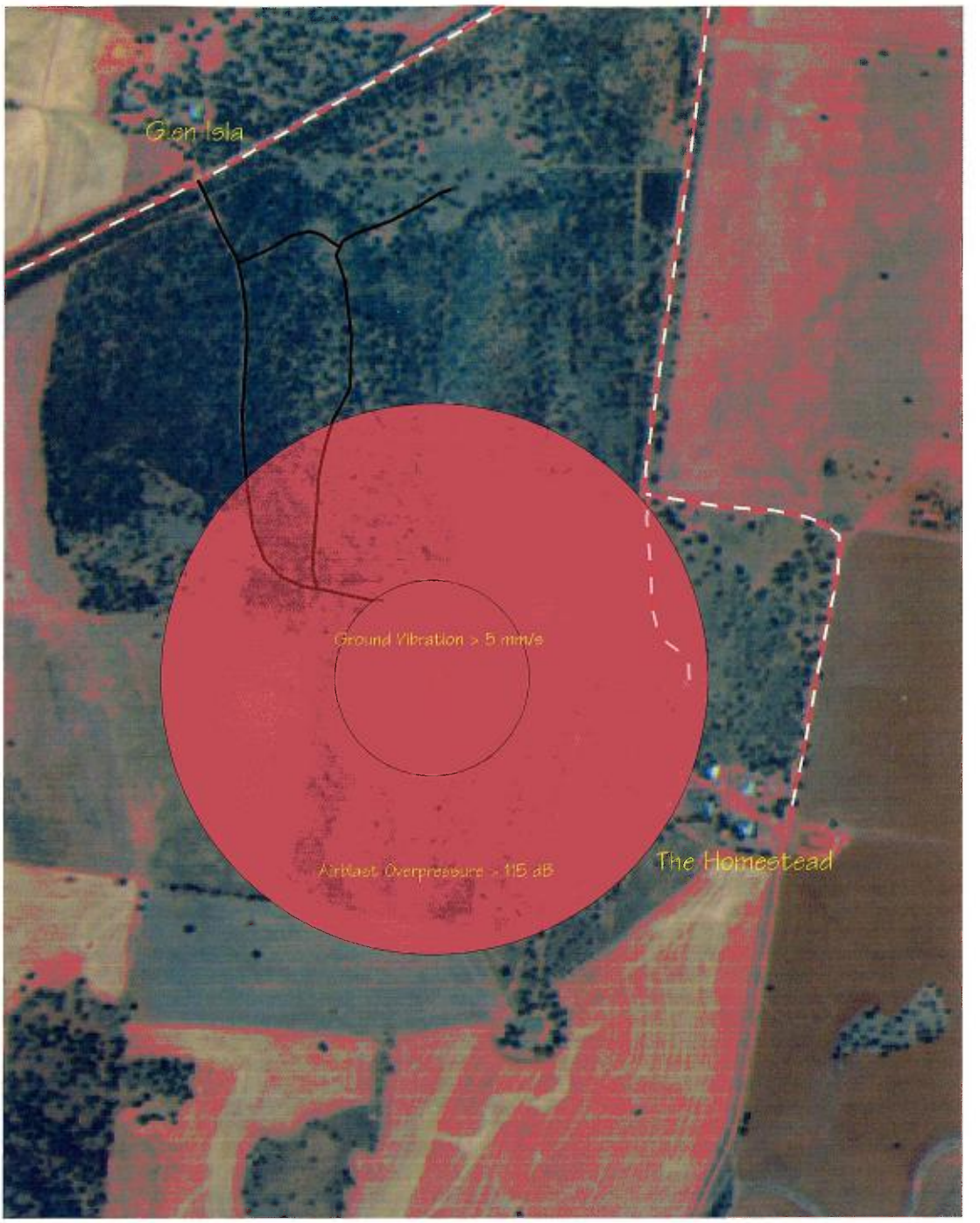
Outcomes of the Initial Blast

The air blast pressures from the first production blast were higher than expected while still within safe limits. This arose because of assumptions about the propagation characteristics of the rock made when calculating charges. This knowledge will allow use of appropriate charges in subsequent blasts to ensure that vibration and blast pressures are well under the specified limits. Subsequent blasting will take account of this experience and reduce the impacts to well below the specified thresholds.

Table 7. Ground Vibration and Airblast Controls

	Ground Vibration			Airblast		
	Significant	Moderate	Insignificant	Significant	Moderate	Insignificant
Within Operator Control						
Charge Mass per Delay (MIC)	X			X		
Delay Interval	X			X		
Burden and spacing		X		X		
Stemming amount			X	X		
Stemming Type			X	X		
Charge length and diameter			X		X	
Angle of blasthole			X			X
Direction of initiation		X		X		
Charge Mass per blast			X			X
Charge depth			X	X		
Covering of detonating cord			X	X		
Charge confinement	X			X		
Blasthole deviation	X			X		
Not under Operator Control						
General Surface			X		X	
Type and depth of overburden	X			X		
Wind and weather conditions			X	X		

Figure 7: Contours for Airblast and Ground Vibration



Scale 1 : 12 000

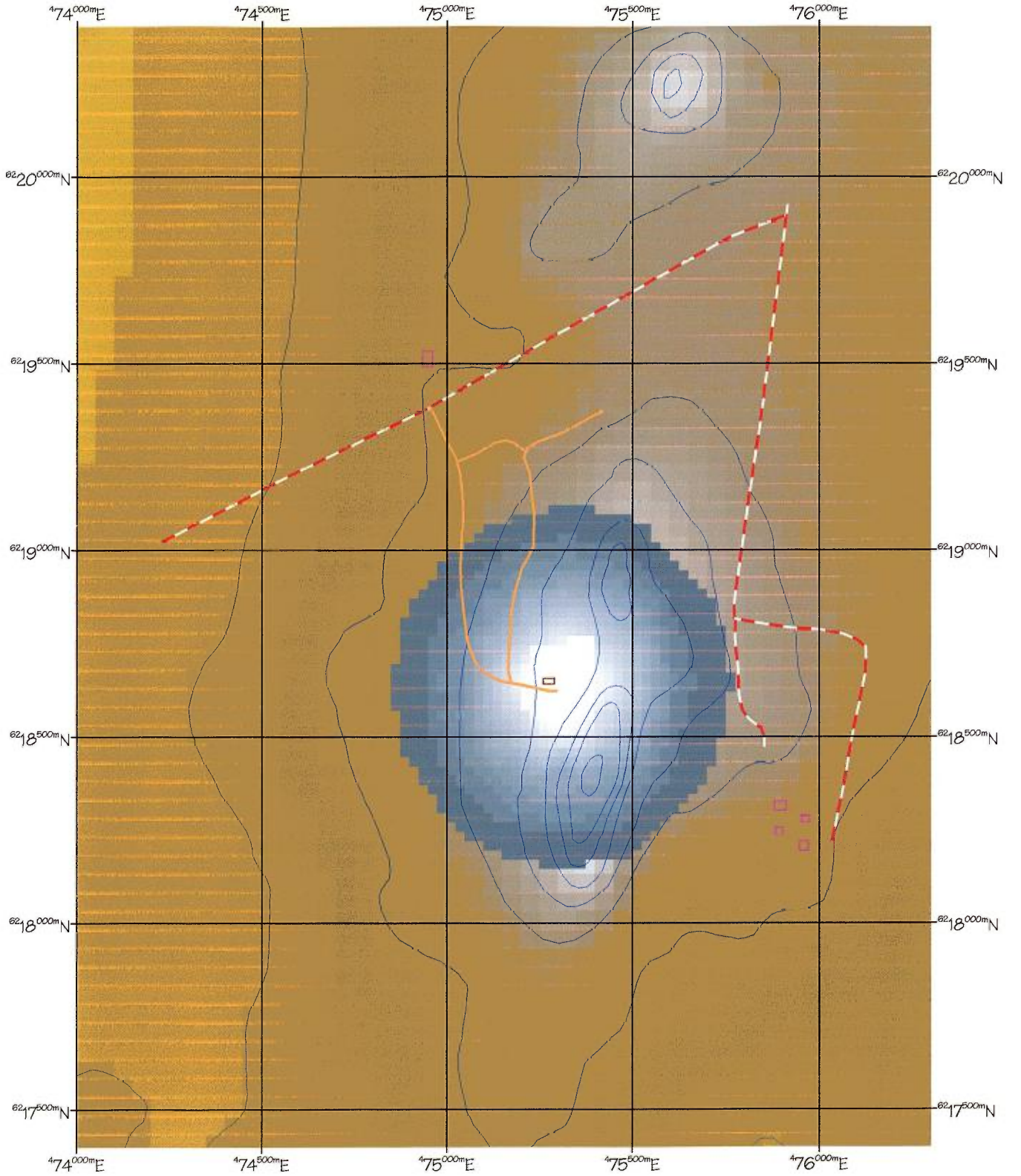
Assumes a Maximum Instantaneous Charge (MIC) of 100 kg
Contours Conform to EPA, ANZECC and Standards Australia Guidelines
and are derived from Standard AS 2187.2-1993
and ICI Australia Explosives Blasting Guide
Contours represent a scenario where there are
no trees and only flat ground between the blast and the residences.
The location of the Glen Isla quarry and surrounding vegetation
suggests a 100 kg MIC limit may be conservative.

N

Airblast Overpressure and Ground Vibration Zones
Prepared for HRD Ready Mix, Leeton NSW
by Natural Resource Intelligence Pty Ltd (NRI)
July 2003, using TNTmips (GIS).

natural
RESOURCE INTELLIGENCE

Figure 8: Map of Dust Modelling Results



Lowest concentration

Dust:

Highest concentration

Lower elevation

DEM:

Higher elevation

Homesteads
Site Office
Contours
Quarry Roads
Public Roads

N

Scale 1:15000

0 0.5 1 km

Universal Transverse Mercator: AGD 66 Datum

Map of extent of dust deposition as modelled by Ausplume 5.4 dispersion model, based on continuous crushing. Map prepared by Natural Resource Intelligence Pty Ltd (NRI), using TNTmips (GIS), May 2003.

natural RESOURCE INTELLIGENCE

Flora

A vegetation survey was conducted in November 1999, and the results are detailed in Annex 2. The vegetation was divided into communities after inspecting the range of slopes, aspects and disturbance. Detailed floristic and structural information was then collected in a number of 20x20 metre quadrats located to sample the environmental variation within communities. All vascular plant species present were recorded and rated for abundance, and information was collected on vegetation structure and disturbance.

Three species listed on the Threatened Species Conservation (TSC) Act (1995) were identified by NSW National Parks and Wildlife Service (NPWS) as possibly occurring in the area. Particular effort was made to search for these species or their habitats, and '8-part tests of significance' were conducted where appropriate.

Two communities were identified where each had been subject to extensive clearing and grazing. A total of 165 taxa (species and subspecies) from 54 families were recorded within the communities, with 130 species being native and 35 (21%) exotic. The prominent families were:

- Poaceae (grasses), 37 taxa, 10 exotic.
- Asteraceae (daisies), 25 species, 9 exotic.
- Fabaceae - Faboideae (peas), 11 species, 7 exotic.
- Chenopodiaceae (salt bushes, blue bushes), 7 species, none exotic.

Vegetation Communities

No regional vegetation mapping exists for the site, and the closest and most recent is that of Sivertsen and Metcalfe (1995) for the Forbes and Cargelligo 1:250,000 map sheets. This mapping begins 19 kilometres to the north and includes similar landscapes and geologies to Tin Pot Hill.

Two vegetation communities identified by Sivertsen and Metcalfe were recognised at the site, but each contained considerable variation due to past clearing and grazing.

1. Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)

This community occurs on all the hills in the area. The structure varies and includes grassland, sparse shrubland, low open woodland, low woodland, and dense woodland composed of White Cypress (*Callitris glaucophylla*) regrowth. The areas of low woodland are small and dominated by Currawang (*Acacia doratoxylon*). More commonly the mature trees are widely scattered, forming a low open woodland of Currawang, Dwyer's Red Gum (*Eucalyptus dwyeri*) and White Cypress.

Patches of Fern-leaf Hopbush (*Dodonaea boronifolia*) and Hill Indigo (*Indigofera australis*) with Irongrass (*Lomandra patens*) are found on the steeper rocky slopes. The ground layer is dominated by Hill Raspwort (Gonocarpus elatus) and native grasses including Ringed Wallaby-grass (*Austrodanthonia caespitosa*), Small-flowered Wallaby-grass (*Austrodanthonia setacea*), Speargrasses (*Austrostipa densiflora* and *A. scabra* subsp *scabra*), Jericho Wiregrass (*Aristida jerichoensis* var. *jerichoensis*), Tall Wheatgrass (*Elymus scaber var. scaber)* and Mulga Mitchell Grass (*Thyridolepis mitchelliana*). Other

common native forbs include Tall Bluebell (*Wahlenbergia stricta* subsp. *alterna*) Yellow Rush-lily (*Tricoryne elatior*) and Nodding Chocolate Lily (*Dichopogon fimbriatus*).

Annual exotic grasses and forbs are common; these include Wild Oats (*Avena fatua*), Smooth Catsear (*Hypochaeris glabra*), False Hair-grass (*Pentaschistis airoides*) and Squirrel Tail Fescue (*Vulpia bromoides*).

Most of this community represents regrowth following clearing, and all has been intensively grazed. Grazing by rabbits is still occurring on the hill and its surrounds.

Application of the characterisation of communities by Sivertsen and Metcalfe does not discriminate between the communities on the volcanic outcrop and the surrounding footslopes. This is appropriate for some purposes, but fails to distinguish between the population dynamics of the two areas. Many species are common to the two locations, but the shallow soils on the outcrop results in suppression of woody vegetation through drought. The hill has evidently periodically supported a reasonable cover of shrubby vegetation but is now largely grassland. The main impact of the quarry is on the rock outcrop.

2. White Cypress - Poplar Box woodlands (footslopes and plains)

This is equivalent to the Open Pine and Box Woodlands (F2) and Pine and Box Woodlands (F3) of Sivertsen and Metcalfe (1995). The structure is scattered mature trees forming an open woodland with understorey of either dense patches of Cypress regrowth of different ages, or open grassy patches. The dominant tree is White Cypress with scattered mature eucalypts, most commonly Poplar or Bimble Box (*Eucalyptus populnea* subsp. *bimbil*) and less frequently Grey Box (*E. microcarpa*), Inland Red Box (*E. intertexta*) or Dwyer's Red Gum (*E. dwyeri*) closer to the hill. Occasional Buloke (*Allocasuarina leuhmannii*) occur.

The understorey is largely dominated by dense Cypress regrowth with a sparse grass cover of Wallaby Grasses (*Austrodanthonia caespitosa, A. auriculata* and *A. setacea*), Speargrass (*Austrostipa scabra* subsp. *scabra*) and the exotic annuals False Hairgrass (*Pentaschistis airoides)*, Squirrel Tail Fescue (*Vulpia bromoides*) and Smooth Catsear (*Hypochaeris glabra*). Where Cypress regrowth is absent, the understorey is open and grassy with a range of shrubs and small trees including Wilga (*Geijera parviflora*), Green Wattle (*Acacia deanei* subsp. *deanei*), Miljee (*A. oswaldii*), Needlewood (*Hakea tephrosperma*) and Weeping Pittosporum (*Pittosporum phylliraeoides*).

The common grasses are the same throughout the community but native forbs are more common in areas of sparse callitris, and include Tall Bluebell (*Wahlenbergia stricta* subsp. *alterna*), River Bluebell (*W. fluminalis*), Climbing Saltbush (*Einadia nutans* subsp. *nutans*), a Bluebush (*Maireana humillima*), Golden Everlasting (*Bracteantha bracteata*) and Pygmy Sunray (*Triptilodiscus pygmaeus*).

This community occurs on the plains surrounding Tin Pot Hill. On the eastern side of the hill, Cypress regrowth is slightly less than on the western side resulting in a more open Box woodland. Occasional patches of Kangaroo Grass (*Themeda australis*) occur along the eastern edge of the site.

This community represents regrowth following clearing, and has been intensively grazed by livestock. The most recent disturbances include the felling of callitris for fence posts and grazing.

Significant Species

Threatened species

The NSW NPWS identified three species listed on the TSC Act which had been recorded within a 30 km radius of the proposed development site, a Leek Orchid (*Prasophyllum fuscum*), Spiny Peppercress (*Lepidium aschersonii*) and another Peppercress (*L. hyssopifolium*). None of these species were found during the survey and are unlikely to occur based on their environmental requirements.

Prasophyllum fuscum is now thought to be restricted to either just the Blue Mountains or the Wingecaribee Swamp in the Southern Tablelands. The *Prasophyllum* that occurs on the western slopes and plains, *P. campestre*, is widespread in grassy Cypress woodlands and on low rocky hills. *P. campestre* is common and widespread and not a threatened species.

Spiny Peppercress (*Lepidium aschersonii*) is a perennial herb of disjunct distribution in the north-east of the western plains and the central western slopes of NSW, and the volcanic western plains of Victoria. It grows in heavy black or grey loamy clays, commonly around salt pans or lakes or in waterlogged soils. The soils on the western footslopes of Tin Pot Hill site deep uniform sands of aeolian origin. The volcanic rock of Tin Pot Hill is highly resistant to weathering and consequently soils are very shallow. *Lepidium aschersonii* was not found during the survey, nor was any suitable soil type for the species found on the site.

Lepidium hyssopifolium is a perennial herb listed as nationally Endangered in the Commonwealth Endangered Species Protection Act (1992), and also as Endangered in the NSW TSC Act. It is rarely recorded, with only a few specimens known from widely scattered locations in New South Wales, South Australia, Victoria and Tasmania. The species was not found during the survey and its occurrence at the quarry site is unlikely as, based upon current information, *L. hyssopifolium* occurs most commonly on heavy dark fertile soils.

ROTAP

Irongrass (*Lomandra patens*) is listed on the Rare or Threatened Australian Plant (ROTAP) list (Briggs and Leigh 1996) but not the TSC Act. It is classified as 3RCa which indicates that it is a rare plant with a range of more than 100 km, and that at least 1000 plants are found within one or more conservation reserves. It grows on rocky hillsides and is found across western New South Wales from Wellington to Mootwingee. A rather uncommon species, although it can be locally abundant, it is known from several rocky outcrops near Tin Pot Hill including the Cocoparra National Park.

The ROTAP list was previously used by the Commonwealth as the guide to conservation requirements. This has been replaced by the species lists prepared to address the requirements of the EPBC Act. The categories listed under the EPBC Act are:

- Extinct
- Extinct in the Wild
- Critically Endangered
- Endangered
- Vulnerable
- Conservation dependent

Lomandra patens is not on any of these lists and hence is not subject to requirements under the EPBC Act.

Lomandra patens is found on the steepest areas of rock outcrop on Tin Pot Hill and the unnamed hill to the north of the road on Block 31. The species is uncommon but widespread across NSW, and likely occurs on the many outcrops of the same volcanic material to Tin Pot Hill that occur to the north. Quarrying the hill will directly impact the local population as locally the outcrops appear to provide the only suitable habitat.

The significance of the occurrence has been evaluated using an 8 part test, where this has been added to the flora study (Annex 2a) for presentation. Loss of the population at one of these sites would not be critical to the survival of the species, but maintenance of the populations would be desirable. This can be achieved by retention of rock outcrop and weathered volcanic material noting, however, that germination of lomandras appears highly irregular.

Regionally rare or restricted

The Mid-Lachlan Regional Vegetation Management Plan (RVMP) covers the Bland Shire and includes Tin Pot Hill. This plan lists plant species with a rare or restricted distribution in the Mid-Lachlan region regardless of their occurrence elsewhere.

The Slender-leaf Mistletoe (*Amyema linophyllum* subsp. *orientale*) is listed as locally rare, where this is parasitic on Buloke (*Allocasuarina leuhmanii*). While occassional individuals of Buloke occur in the White Cypress - Poplar Box woodlands they are located close to the South Yalgogrin Road distant from the rocky hills, and are unlikely to be impacted by the development.

Significant Vegetation Communities

The Mid-Lachlan RVMP lists vegetation communities regarded as threatened at the regional or State level, and these 'Priority Plant Communities' are subject to development consent. Poplar Box Woodland is a listed priority community, as it is considered to be highly fragmented and not conserved.

The Poplar Box Woodlands described in the RVMP differ to the White Cypress - Poplar Box community at Tin Pot Hill, in that Poplar Box is the dominant species with White Cypress as an associate. The community at Tin Pot Hill is better described in the RVMP as a White Cypress Woodland, where White Cypress is the dominant species and eucalypts are associated where White Cyprus is not listed as a priority.

Conservation of the *Eucalyptus* trees within the White Cypress - Poplar Box woodland could be warranted as this provides the basis for subsequent development of eucalypt woodland. However, the likely course of development of vegetation on the site is difficult to predict as it depends upon natural factors such as fire and drought as well as existing land uses such as grazing.

The proposed development will have greatest impact the Dwyer's Redgum - White Cypress - Currawang low open woodland on the hills, particularly on the grassland and low shrubland associated with the rock outcrop. Some species are found only in this community, most notably Irongrass (*Lomandra patens*), and also Fern-leaf Hopbush (*Dodonaea boroniifolia*) and one specimen of Drooping Sheoke (*Allocasuarina verticillata*). However, this is not listed as a priority community in the RVMP as it is well represented to the north. Also, restricting mining to one hill retains a significant proportion of the local population.

The Bland Local Environmental Plan (1993) identifies three areas of remnant vegetation regarded as environmentally sensitive within a four-kilometer radius of the proposed quarry to the west-southwest, north, and southeast. These sites are remote from the quarry, and the quarrying and transport operations will not impact on these areas.

EPBC Act

Referral under the Environmental Protection and Biodiversity Conservation (EPBC) Act is required where a development proposal may have a significant impact species and/or communities listed under the Act. None of the species or communities impacted by the proposed development are listed under the EPBC Act hence there is no requirement for referral.

Fauna

Fauna that could be expected to occur in the general area of the proposed development (within 1km approx.) were identified from the literature. Field observations were undertaken to ensure appropriate identification of the habitats, and to identify relationships with other communities in the landscape. Observations were made of species that could readily be recorded during the day, but no trapping or spotlighting was undertaken.

The detailed results are presented in Annex 3. These have been stratified for the habitats according to:

- Fauna that occur or may occur in 'hill' habitats: Dwyer's Red Gum – Pine Woodland. [Equivalent to Sivertsen and Metcalfe (1995)* Habitat Type H1]
- Fauna that occur or may occur in 'footslope' habitats: Pine and Box Woodlands [Equivalent to Sivertsen and Metcalfe (1995) Habitat Types F2 and F3]
- Fauna recorded or indicated from dung, scats or prints to be in the area on a site inspection 0900 – 1400 hrs 24th November 1999.

The information recorded for each species was:

(X) Considered likely to occur in nominated habitat.

(-) Considered unlikely to occur in nominated habitat, but likely to occur in the general area depending, in many instances, on seasonal conditions.

(?) Uncertain as to whether the species may occur in the general area and/or utilise the nominated habitat.

Fauna listed in The Threatened Species Conservation Act (1995) are shown in bold. An '8-Part test', as required under S.5A of the *EPA Act 1979*, is given for those species indicated from the literature as likely to use 'hill' habitats in the region of the proposed development.

Table 8. Number of species likely to occur within the hill and footslope habitats. The number of species listed in The Threatened Species Conservation Act (1995) is given in bold.

	Hill Habitat	Footslope Habitat	Introduced Species
Amphibians & Reptiles	42	41 **(1)**	
Birds	85 **(3)**	110 **(4)**	

Effects on Threatened Species, Populations or Communities, or their Habitats

Malleefowl *Leipoa ocellata*

Malleefowl are sedentary and territorial, and prefer tall, dense and floristically dense mallee. The area affected by the proposed development comprises an exposed knoll of rock outcropping with areas of clay overlying the rock to the west and south. The vegetation comprises mostly White Cypress Pine *Callitris glaucophylla*, which is inappropriate habitat for the Malleefowl. Also, the combined effects of the grazing by rabbits and sheep, and of the presence of foxes severely constrains the usefulness of the site as habitat for Malleefowl.

As a result of the proposed development:

- It is not possible that the life cycle of the Malleefowl would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat, no area of known habitat of this species utilising this site will be modified or removed.
- No areas of known habitat of the Malleefowl will become isolated from currently interconnecting or proximate areas.
- The Malleefowl habitat is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Malleefowl will not be affected.

The conclusion is that the proposed development is unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Malleefowl.

Grey Falcon *Falco hypoleucos*

Little is known about the Grey Falcon. It is principally a species of the arid inland of temperate and tropical Australia and generally occurs on the plains of drainage systems of the arid zone with lightly timbered (eucalypt) watercourses. It is mostly known to nest in tall eucalypts near a watercourse. It feeds mostly on birds, particularly parrots and pigeons (Marchant and Higgins 1993). On this information the habitat of the area of the proposed development, a rocky knoll supporting overstorey vegetation of predominantly White Cypress Pine is thus indicated to be unsuitable for the Grey Falcon.

The proposed development is near the geographic eastern limit of the Grey Falcons' distribution which is extensive over remote areas of arid Australia. Much of its range is largely unaffected by human related activities such as pastoralism thus its habitat may serve as a conservation reserve. Conservation reserves in which the species has been recorded include Yathong NR, Round Hill NR, and Warrumbungle NP.

As a result of the proposed development:

- It is not possible for the life cycle of the Grey Falcon to be disrupted such that a viable population of this species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding, no area of known habitat of this species is likely to be modified or removed.

- No areas of known habitat of the Grey Falcon will become isolated from currently interconnecting or proximate areas.
- The Grey Falcon is probably adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Grey Falcon will not be affected.

The proposed development is highly unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Grey Falcon.

Regent Honeyeater *Xanthomyza phrygia*

The distribution of the Regent Honeyeater is given as south-eastern South Australia, Victoria, eastern New South Wales and south-eastern Queensland with a current core distribution of northern central and east coastal Victoria, eastern New South Wales and, inland, south-eastern Queensland. The proposed development is approximately on the western boundary of the Regent Honeyeater's distribution in eastern New South Wales but outside the indicated current core distribution.

The species characteristically is associated with White Box *E. albens*, Yellow Box *E. melliodora* and Ironbark *E. sideroxylon* woodlands. These woodlands occur on the more fertile soils and hence have been subject to extensive clearing. The Regent Honeyeater favours areas of heavily flowering eucalypts, feeding on nectar and insects. Whilst the Regent Honeyeater may thus occur within the general area of the proposed development the habitat of the site and of the immediately surrounding area of predominantly White Cypress Pine *Callitris glaucophylla,* is unlikely to be utilised by this species.

Movements of the Regent Honeyeater are considered irruptive and migratory, shifting north in autumn and winter and south in spring (Schodde and Tidemann 1986). This suggests that any birds possibly from time to time occurring in the general region of the subject site may be part of the broader population of this species.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Regent Honeyeater would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding, it is highly unlikely that any area of habitat utilised by this species will be modified or removed.
- No areas of known habitat of the Regent Honeyeater will become isolated from currently interconnecting or proximate areas.
- The Regent Honeyeater is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Regent Honeyeater will not be affected.

The proposed development is unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Regent Honeyeater.

Painted Honeyeater *Grantiella picta*

The Painted Honeyeater is distributed over most of inland eastern Australia including central Queensland and eastern Northern Territory. It is highly nomadic and feeds on nectar and fruit of mistletoe and on insects. The vegetation at the proposed development site comprises a light overstorey of mostly White Cypress Pine *Callitris glaucophylla* with no mistletoe in the trees on the site itself and only scattered specimens of *Amyema linophyllum* in trees of the surrounding woodland. It is therefore unlikely that the Painted Honeyeater occurs in the area or may utilise area of the subject site itself.

The extent of the local population of the Painted Honeyeater is not known. General information indicates that development location is well within the southern limit of the Painted Honeyeaters' distribution in eastern Australia.. Since this species is highly nomadic, any individuals that might occur in the area of the proposed development would be considered as part of a broad regional population of this species.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Painted Honeyeater might be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and breeding, it is highly unlikely that habitat of this species will be modified or removed.
- No areas of known habitat of the Painted Honeyeater are likely to become isolated from currently interconnecting or proximate areas.
- The Painted Honeyeater is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Painted Honeyeater is highly unlikely to be affected.

In view of the information given in the above sections of this assessment no impact from the proposed development is likely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Painted Honeyeater.

Gilbert's Whistler *Pachycephala inornata*

Gilbert's Whistler is distributed across most of southern Australia west of the Great Dividing Range, and mainly inhabits understorey shrubs in lightly timbered country where it forages for arthropods. The occurrence of patches a dense shrub layer of *Acacia*, predominantly *A. doratoxylon* and *A. oswaldii* at the proposed development site makes it possible that the Gilbert's Whistler may occur in the area.

Individuals are thought to be generally sedentary but the extent of any local populations is unknown. The proposed development appears near the eastern limit of the Gilbert's Whistlers' distribution. East of this location the native vegetation grades to mostly box and/or ironbark woodland whereas the preferred habitat for Gilbert's Whistler's is for the shrub woodlands to the west. While the species is known from the general region, and may occur in the general area of the subject site, it is highly unlikely to utilise habitat of the area to be impacted on account of its habitat preferences.

As a result of the proposed development:

- It is not possible for the life cycle of the Gilbert's Whistler to be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and breeding, no area of known habitat of this species utilising this site is likely to be modified or removed.
- No areas of known habitat of the Gilbert's Whistler will become isolated from currently interconnecting or proximate areas.
- The Gilbert's Whistler is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Gilbert's Whistler will not be affected.

The proposed development is unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Gilbert's Whistler.

Superb Parrot *Polytelis swainsonii*

The Superb Parrot occurs mostly in northern, central Victoria and New South Wales, breeding along the watercourses of the Murray, Edward, Murrumbidgee and Lachlan Rivers and the woodlands of the western slopes of the Great Dividing Range between Canberra, Cowra, Temora and Gundagai. The nesting trees are usually large, up to 50 metres, with nesting hollows mostly within the height range of 10-20 metres. The tree species in which it has been recorded nesting include River Red Gum *E. camaldulensis*, Blakely's Red *Gum E. Blakelyi*, Narrow-leaved Box *E. microcarpa* and Inland Red Box *E. intertexta*. The Superb Parrots' diet is varied, comprising a broad range of seeds of grasses, herbaceous plants, berries, nectar, flowers and insects. Whilst the Superb Parrot occurs within the general area of the subject development the habitat of the site and of the immediately surrounding area of predominantly White Cypress Pine *Callitris glaucophylla,* is not a habitat likely to be utilised by this species.

Inspection of the distributional information on this species indicates that the proposed development is approximately at the geographic centre the Superb Parrot's distribution in mainland Australia.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Superb Parrot would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Superb Parrot, it is highly unlikely that any area of habitat utilised by this species will be modified or removed.
- No areas of known habitat of the Superb Parrot will become isolated from currently interconnecting or proximate areas.
- The Superb Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Superb Parrot will not be affected.

In view of the above information the proposed development is highly unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Superb Parrot.

Swift Parrot *Lathamus discolour*

The Swift Parrot breeds in Tasmania between October and March, migrating to the south-eastern mainland from April to September. On the southeastern mainland flocks of the Swift Parrot concentrate where eucalypts are flowering profusely and there is an abundance of lerps, manna and insects. The Swift Parrot is recorded using a broad range of eucalypts for foraging in south-eastern mainland Australia including mainly species such as Blue Gum *E. globulus*, Swamp Gum *E. ovata*, Yellow Box *E. melliodora*, White Box, *E. albens* and Red Ironbark *E. tricarpa*. In relation to the development site, it has been recorded utilising Narrow-leaved Box *E. microcarpa* but not Dwyer's Red Gum. Narrow-leaved Box occurs within the general area not on the development site. The habitat of the subject site is therefore inappropriate for, and highly unlikely to be used by, the Swift Parrot.

The Swift Parrot is a migratory species likely to occur seasonally and irregularly in the general region. Any birds occurring in the area of the subject development can probably be considered to form portion of the Australian population of this species. The location of the proposed development is approximately centered in the geographic distribution of the Swift Parrot's in mainland Australia.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Swift Parrot may be disrupted such that a viable population of the species may be placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Swift Parrot, no area of known habitat of this species utilising this site is likely to be modified or removed.
- No areas of known habitat of the Swift Parrot will become isolated from currently interconnecting or proximate areas.
- The Swift Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Swift Parrot will not be affected.

It is highly unlikely that the proposed development may have the potential to threaten the survival or evolutionary development of the regional or local population of the Swift Parrot.

Turquoise Parrot *Noephema pulchella*

The Turquoise Parrot's preferred habitats are woodlands and open forests with a ground cover of grasses or sometimes a low understorey of shrubs. There is usually a variety of eucalypts including White Box *E. albens*, Blakeley's Red Gum *E. blakeleyi* Yellow Box and *E. melliodora* and Red Box, *E. polyanthemos*. The species also occurs in savanna woodland and riparian woodlands and forests including those on alluvial flats with stands of River Red Gum *E. camaldulensis* and Swamp *Gum E. camphora*. These characteristics of habitat are indicative of a strong preference by the Turquoise Parrot for habitats of high quality soils – habitats that since settlement have been sought for pastoral and agricultural development and therefore have been extensively cleared.

Little is known of the movements of the Turquoise Parrot although the species has an extensive distribution in eastern New South Wales and southeastern Queensland. Groups or small flocks are thought to be relatively sedentary. It has been recorded in the Cocoparra NP and therefore may occur in the area of the proposed development site. The location of the

proposed development is well within the southern boundary of the Turquoise Parrot's distribution in south-eastern Australia.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Turquoise Parrot would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat, it is highly unlikely that any habitat likely to be used by this species will be modified or removed.
- No areas of known habitat of the Turquoise Parrot will become isolated from currently interconnecting or proximate areas.
- The Turquoise Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Turquoise Parrot will not be affected.

No impact from the proposed development is likely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Turquoise Parrot.

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

Very little is known about the Yellow-bellied Sheathtail-bat. It is widely distributed, occurring over most of eastern and northern Australia. It is a fast, high flying bat, typically feeding above the canopy of forests and woodlands and few specimens of this species have been collected (Richards 1998). This species' rarity may thus be more apparent than real. In central coastal Queensland a survey of a broad range of environments using bat-detectors found this species to predominantly utilise the more densely forested habitats. On this information the habitat characteristics of the area of the proposed development is likely to be little, if at all, potential use to Yellow-bellied Sheathtail-bat.

The Yellow-bellied Sheathtail-bat has an extensive distribution, approximately two thirds of the Australian continent. The location of the proposed development is well within the Yellow-bellied Sheathtail-bats' distribution in eastern Australia.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Yellow-bellied Sheathtail-bat would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Yellow-bellied Sheathtail-bat, it is highly unlikely that habitat of likely use to this species will be modified or removed.
- No areas of known habitat of the Yellow-bellied Sheathtail-bat will become isolated from currently interconnecting or proximate areas.
- The Yellow-bellied Sheathtail-bat is probably adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Yellow-bellied Sheathtail-bat will not be affected.

It is highly unlikely that the proposed development has the potential to threaten the survival or evolutionary development of the regional or local population of the Yellow-bellied Sheathtail-bat.

Greater Long-eared Bat *Nyctophilus timoriensis*

Very little is known about the Greater Long-eared Bat, and the taxonomy of the species is currently uncertain. The broad distribution comprises southern central Queensland, central western New South Wales, northwestern Victoria and south Australia. It utilises a broad range of habitats including tall forests, River Red Gum forests, box/ironbark/*Callitris* open forests and woodland and mallee. The species is thought to forage for arthropods gleaned from substrates. The rocky knoll supporting overstorey vegetation of predominantly White Cypress Pine providing few if any tree hollows is thus likely to be little, if at all, utilised by the Greater Long-eared Bat.

The location of the proposed development is well within the Greater Long-eared Bats' distribution in eastern Australia.

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Greater Long-eared Bat would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Greater Long-eared Bat, it is highly unlikely that habitat of likely use to this species will be modified or removed.
- No areas of known habitat of the Greater Long-eared Bat will become isolated from currently interconnecting or proximate areas.
- The Greater Long-eared Bat is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Greater Long-eared Bat will not be affected.

It is highly unlikely that the proposed development may have the potential to threaten the survival or evolutionary development of the regional or local population of the Greater Long-eared Bat.

EPBC Act

Referral under the Environmental Protection and Biodiversity Conservation (EPBC) Act is required where a development proposal may have a significant impact species listed under the Act. Species identified as potentially being affected that are listed under the EPBC Act are:

- Endangered: Swift Parrot
- Vulnerable: Malleefowl, Superb Parrot, Greater Long-eared Bat

Application of the 8 part test identifies that the proposed development would not significantly impact on these species hence referral under the EPBC Act is not required. The lack of impact mainly arises because the rock outcrop does not represent suitable habitat for these species.

Greenhouse Gasses

The EBPC Act requires consideration of the production of greenhouse gasses when addressing the environmental impact of development proposals.

The proposal involves the production of greenhouse gasses associated with blasting, crushing and transport of the material. The main gas produced is carbon dioxide (CO_2) and is mainly associated with the burning of fossil fuels. Transport represents the main consumer of energy and hence the main source of CO_2.

The amount of greenhouse gas produced by the blasting and crushing of the rock is the same as for any such development in the region. The amount of greenhouse gas produced through transport should be less than if the quarry was not developed due to the reduced transport distances. Transport distance as well as safety was taken into account in the selection of the preferred transport route.

Other potential sources of greenhouse gases are essentially restricted to the clearing of woody vegetation. As little woody vegetation is to be cleared the potential effects of such clearing are insignificant. As the site is to be revegetated on cessation of the quarrying activities the net effect on greenhouse gases should effectively be zero.

SOCIAL ISSUES

Social

The main local land use is extensive dry-land agriculture involving cropping and grazing, resulting in a low population density. As with extensive agricultural areas elsewhere, the population density has been declining. The development of the quarry operation would therefore have social and economic benefits.

Regional economic benefits should derive from the local availability of material for road construction and maintenance as well as the additional employment. Costs are closely linked with transport distances, and the proposed quarry is distant from existing sources of material. The competitive availability of aggregate also has benefits as charges are generally higher where monopolies exist. These costs are of consequence to local shires as well as businesses.

The potential social disadvantages of the quarry relate to the on site activities and transport. Potential impacts of transport are limited by the existing low traffic density, the low frequency of truck movements from the quarry, and the exclusion of haulage under wet conditions.

Potential on site impacts relate to noise, dust, and vibration, and therefore depend strongly on the proximity of dwellings. The closest dwelling (The Homestead) is located 0.5 km east of the quarry, and is separated from the work area by the hill. The occupants of this dwelling were consulted at the initiation of the proposal.

The next closest dwelling (Woodlands) is located 1 km to the south of the southern end of Tin Pot Hill. The residence on Block 31 (Glenisla) is around 1 km from the historic quarry site. The residence Glenburnie would be around 1.5 km northeast from any quarrying conducted on Block 31.

The distances between the quarry and residences result in the operation meeting all environmental requirements for noise and vibration, where this will avoid adverse social impact. However, as small changes can be considered a nuisance in a quiet rural environment, the following procedures will be used to further reduce possible effects.

- The use of explosives, conducted under the control of the Department of Mineral Resources, will be designed to minimise noise and vibration.
- Neighbours will be notified of blasting operations.
- The quarry will only operate during daylight hours.
- A sound barrier will be maintained between the work site and the closest dwellings.
- The woody vegetation will be maintained around the quarry site.
- Quarry material will be used for dust suppression on work areas and tracks.
- Water trucks will be used to suppress dust when needed.

Health and Safety

The main on-site safety issues relate to blasting and operation of the equipment, where these are covered by State requirements. Operators undertaking hazardous activities must be licensed, hence blasting will be undertaken by a contractor under control of the NSW Department of Mineral Resources. Safety issues associated with the operation of the equipment will be met by the employment of two personnel.

The off-site safety issue relates to transport. This is addressed by route selection, and the cessation of transport when local roads are wet, and by operating during daylight hours.

Health issues are restricted to personnel operating the equipment and relate to noise and dust. All State occupational health and safety requirements will be met by operating the equipment according to manufacturer specification, and the use of personal protective equipment. Dust levels will be maintained such that dust is not damaging to human health, hence the main requirement is for hearing protection for work in close proximity to some of the equipment.

Heritage

Aboriginal heritage was addressed through conduct of a survey by a representative of the local Aboriginal Council. This survey did not identify any specific features of cultural significance to the Aboriginal people (Annex 4).

The hill provides a feature of high relief in a generally flat terrain, and hence would have been used to advantage by Aboriginal people. The hard rock may also have been used for the construction of tools. However, the limited availability of water in the area would have greatly restricted its use. The hill contains no evidence of storage of water in rock wells, natural or anthropogenic, and the adjacent Sandy Creek has highly intermittent flow.

There are no known heritage issues associated with white settlement. The area is densely settled considering the low rainfall and current productivity of the land use, and the local homesteads represent reasonably recent developments. None of the properties identified in this proposal contain features, buildings, or artifacts that would be considered to have cultural significance.

Visual Amenity

Every hill is a distinct feature in flat terrain, and hence has visual significance. However, the low elevation of Tin Pot Hill, and the grassy vegetative cover limit this significance. The current distinctiveness of the hill arises as much from the surrounding woody vegetation as from the rock outcrop.

While visual appeal is highly subjective, elements can be identified within a landscape that make it aesthetically pleasing. A mosaic or pattern is generally highly regarded, hence homogeneity by way of a uniform cover of grassland or woodland gives low visual appeal. However, localised impacts of scars within homogeneous areas are often regarded as displeasing. The main feature of Tin Pot Hill that currently contributes to visual aesthetics is the occurrence of a block of woody vegetation within a landscape that has been largely cleared for agriculture.

The two aspects of the development that could reduce visual appeal are the removal of the hill, and the generation of a scar within an area of woody vegetation. As the quarry operation effectively involves the removal of the most visible portion of the hill, the mitigation is to further develop the woody vegetation, and to leave a low ridge of material. This ridge will be visually insignificant from the main road, but will be significant when viewed from the nearest local residence. The proposed development will have visual impact but this will be minimised and eventually only apparent to those with prior knowledge of the area.

The rehabilitation of the quarry will prevent the mined area appearing as a scar on the landscape noting, however, that the natural grassland on the rock within an extensive area of woody vegetation originally produced an appearance of a 'scar'. Any perception that this grassland is more desirable than grassland in areas of cleared woody vegetation is cultural, and would differ between conservationists and graziers.

Intergenerational Equity

Issues of intergenerational equity relate to the cost / benefit of the proposal to future generations. Does it deprive future generations of a potential opportunity or does it benefit them through improving the foundation for their activities?

Material from the quarry will be used for the development of infrastructure and buildings in the region. It will therefore help develop the regional infrastructure and economy and thereby provide benefit to future generations.

The mining of the hill is and extractive activity and hence is essentially irreversible. It therefore deprives future generations of conducting the same activity. The significance of this loss of opportunity is unlikely to be high due to the occurrence of similar hills in the vicinity and the occurrence of much larger outcrops of the rock to the north. Future generations will have the opportunity to conduct the same type of operation should they choose.

The overall conclusion is the proposal benefits future generations and does not impose a significant loss of opportunity.

Environmental Values

There is currently no simple system that provides a clear, whole of life valuation of the environment that can be compared with monetary gains. This assessment must therefore be based on the current perceptions held by the community as to the environmental values of the site and how they may be affected by the proposal.

The assessment of the environmental value of the site in its current form and condition depends on perceptions. To some any existing native woody vegetation has high value while others see such woody regrowth a loss of productive opportunity. A balanced assessment of the vegetation on and around Tin Pot Hill is that the native vegetation has environmental value but is degraded by the weed like infestation by Callitris and the high proportion of weeds occurring in the grassland on the hill. The existing vegetation has value but is highly degraded compared with the natural or intact state.

The development proposal will have little affect on the native vegetation on the site and will therefore have little effect on environmental values. The only potential for a change to values arises from the effective removal of most of the hill where this impacts on visual amenity and the form of the vegetative cover. The issue of visual amenity is addressed above where it is concluded that the visual impact of the proposed development will be minimal and eventually only apparent to those with prior knowledge of the area.

The issue of vegetative cover is also addressed under visual amenity noting that rehabilitation of the quarry will prevent the mined area appearing as a scar on the landscape. The replacement vegetation is unlikely to be identical to that which currently exists but, given the current level of weed infestation, this can have benefits. The main requirement with the rehabilitation is to prevent the development of dense monocultures of Callitris that have arisen on other parts of the site. The rehabilitation provides opportunities to maintain and improve the diversity of the native vegetation on the site.

On completion of the quarrying the environmental values of the site would not have significantly degraded and could have improved.

ANNEX 1

FILE NOTE: P.1991

ON-SITE PLANNING FOCUS MEETING – 16 NOVEMBER 2001-11-27
HRD READYMIX – TIN POT HILL, BARELLAN

Present: HRD Readymix Leeton (Colleen) and Griffith
Brian Tunstall
EPA (2)
Narrandera Shire Council (NSC) (2)
A number of local residents, including L Spencer, G Flagg, Mrs Russell

The main issue raised by the residents, and NSC was the traffic generation on unsuitable roads.

The specific concerns were:

- dust from the roads
- width of road inadequate
- damage during wet weather
- no. of routes
- safety issues in relation to dust, school buses and traffic during harvest.

Alan Lawrence, Engineer for NSC, stated their preferred route, to regional roads (refer attached map).

NSC prepared to negotiate on road upgrading with developer and BSC.

Developer indicated that they would only be considering up to about 40,000 tonnes per annum, operating on stockpiles created over a short period or for large orders.

Developer stated they would not transport vehicles during wet weather and are prepared to create a large stockpile away from harvest routes and not use trucks to quarry during harvest.

General discussion on Hamel Road upgrade, with dust suppressant measures either side of access roads to dwellings near road.

NSC see advantage in quarry to provide quality aggregate at reduced transport costs and are willing to look at road upgrading over time, especially state roads which they get funding for.

I indicated there may be some support through Section 94 Contributions.

NSC advised developer they would need B-Double access for the whole route.

Resident enquired about CSR involvement and was advised that they had nothing to do with the quarry.

Developer happy not to operate during open/closing of school periods and during school bus operations.

EPA Officer advised that the developer would need to undertake assessments to indicate that noise and vibration from blasting would meet their guidelines.

I advised Brain Tunstall to write to all agencies and NSC to seek their requirements for assessment in the EIS.

Residents appeared happy with meeting outcome.

Meeting concluded at 11.45am.

Notes taken by David Mitchell – Director Environment & Community

Annex 2

VEGETATION SURVEY OF THE PROPOSED QUARRY SITE AT TIN POT HILL, NSW

Unpublished report to
Environmental Research and Information Consortium

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December 1999

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I would like to thank David Jones at the Australian National Herbarium (ANH) for helpful discussions about orchids. I am also grateful to Dr Helen Hewson at the ANH for providing information on the distribution of the threatened *Lepidium* species. Mike Fleming, NSW National Parks and Wildlife Service at Dubbo, directed me to sources of information on the vegetation of the region.

1 INTRODUCTION

The proposed quarry at Tin Pot Hill, 25 kilometres north-west of Ardlethan will involve the destruction of all the vegetation on the existing hill plus a small amount at the base of the hill on the western side and along the access road.

In order to assess the impact of the proposed work on the native flora of the site, a vegetation survey of the hill and surrounding area was carried out in November 1999. Particular consideration was given to surveying for threatened plant species and communities, and assessing the significance of the vegetation in a regional context.

2 METHODS

Fieldwork at the Tin Pot Hill site was carried out from 16-18 November 1999. All fieldwork was carried out on foot in the areas of native vegetation in Blocks 31 and 32 of the property. Efforts were concentrated on the rocky hills, which would be the areas most affected by the quarry development. This includes Tin Pot Hill where the original quarry is located, the knoll to the north of Tin Pot Hill, and the un-named hill to the north of the road in Block 31.

After a number of initial traverses across the range of different slopes, aspects and levels of disturbance at the site, the vegetation was divided into communities. Detailed floristic and structural information was collected in a number of 20x20 metre quadrats which were located to sample the environmental variation in each of the identified communities. In each quadrat, all vascular plant species present were recorded and given a measure of cover/abundance shown in Table 1 below. This follows the standard NSW National Parks and Wildlife Service (NSW NPWS) method for vegetation surveys. Information was also collected on vegetation structure in the quadrat, and any disturbances.

Table 1 CRA cover/abundance scale

CRA abundance score	% cover / abundance
1	<5% cover, few plants
2	<5% cover, many plants
3	5-25% cover
4	26-50% cover
5	51-75% cover
6	76-100% cover

In addition, traverses were made across the site to detect species not found in the quadrats, and in particular to search for vulnerable and endangered species. At the completion of the quadrats and traverses, all species encountered were given a rating of abundance in each plant community:- abundant (A), common (C), occasional (O) or rare (R). The condition of vegetation in each community and the relationship to regional communities was assessed.

Three species listed on the Threatened Species Conservation (TSC) Act (1995) were identified by NSW NPWS as possibly occurring in the area. Particular effort was made to search for these species or their habitats, and '8-part tests of significance' were conducted where appropriate. The plant collection at the Australian National Herbarium in Canberra and experts in the relevant taxa were consulted as to the habitat requirements and likely occurrence of these threatened species at the site.

Herbarium voucher material was collected for significant species, or to confirm the identity of any species not fully identified in the field. Vouchers have been lodged at the Australian National Herbarium in Canberra with duplicates of most specimens sent to the NSW Herbarium in Sydney. Nomenclature follows that in Harden (1990-1993), except where more recent names have been formally published.

3 RESULTS

3.1 Plant Species

A total of 165 taxa (species and subspecies) from 54 families were recorded during the survey. Of these, 130 species were native and 35 exotic (21%). The families with the most species recorded were:

- Poaceae (grasses), 37 taxa (10 exotic);
- Asteraceae (daisies), 25 species (9 exotic);
- Fabaceae - Faboideae (peas), 11 species (7 exotic); and
- Chenopodiaceae (salt bushes, blue bushes), 7 (0 exotic).

A complete list of plant species with their abundance in each vegetation community is given in Appendix 1.

3.2 Vegetation Communities

No regional vegetation mapping has been carried out around Tin Pot Hill. The most recent regional vegetation mapping close to the site is that of Sivertsen and Metcalfe (1995) covering the Forbes and Cargelligo 1:250,000 map sheets. The Cargelligo mapsheet begins 19 kilometres to the north and covers similar landscapes and geologies to that of Tin Pot Hill. The vegetation classification developed by Sivertsen and Metcalfe has been used to describe the communities of the proposed quarry site.

Two vegetation communities were recognised at the site. Within each community there is considerable variation in structure due to past clearing and grazing disturbances.

1. Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)

This community is equivalent to the Dwyers Red Gum and Pine Woodlands (H1) of Sivertsen and Metcalfe (1995). It occurs on all the hills at the site; Tin Pot Hill, the knoll to the north, and the un-named hill north of the road.

Structure is variable, ranging from low woodland, to low open woodland interspersed with patches of dense White Cypress (*Callitris glaucophylla*) regrowth and areas of grassland. The areas of low woodland are small and dominated by Currawang (*Acacia doratoxylon*). More commonly the mature trees are widely scattered, forming a low open woodland of Currawang, Dwyer's Red Gum (*Eucalyptus dwyeri*) and White Cypress.

Shrubby patches of Fern-leaf Hopbush (*Dodonaea boronifolia*) and Hill Indigo (*Indigofera australis*) with Irongrass (*Lomandra patens*) are found on the steeper rocky slopes. The ground layer is dominated by Hill Raspwort (Gonocarpus elatus) and native grasses including Ringed Wallaby-grass (*Austrodanthonia caespitosa*), Small-flowered Wallaby-grass (*Austrodanthonia setacea*), Speargrasses (*Austrostipa densiflora* and *A. scabra* subsp *scabra*), Jericho Wiregrass (*Aristida jerichoensis* var. *jerichoensis*), Tall Wheatgrass (*Elymus scaber var. scaber)* and Mulga Mitchell Grass (*Thyridolepis mitchelliana*). Other common native forbs include Tall Bluebell (*Wahlenbergia stricta* subsp. *alterna*) Yellow Rush-lily (*Tricoryne elatior*) and Nodding Chocolate Lily (*Dichopogon fimbriatus*).

Annual exotic grasses and forbs are common; these include Wild Oats (*Avena fatua*), Smooth Catsear (*Hypochaeris glabra*), False Hair-grass (*Pentaschistis airoides*) and Squirrel Tail Fescue (*Vulpia bromoides*).

2. White Cypress - Poplar Box woodlands (footslopes and plains)

This community is equivalent to the Open Pine and Box Woodlands (F2) and in places, the Pine and Box Woodlands (F3) of Sivertsen and Metcalfe (1995). It is variable in structure with scattered mature trees forming an open woodland with understorey of either dense patches of Cypress regrowth of different ages, or open grassy patches. The dominant tree is White Cypress with mature eucalypts scattered throughout, most commonly Poplar or Bimble Box (*Eucalyptus populnea* subsp. *bimbil*) and less frequently Grey Box (*E. microcarpa*), Inland Red Box (*E. intertexta*) or Dwyer's Red Gum (*E. dwyeri*) closer to the hill. The occasional Buloke (*Allocasuarina leuhmannii*) can also be found in this community.

The understorey over large areas is dominated by dense Cypress regrowth which restricts the development of the ground layer to a sparse grass cover of Wallaby Grasses (*Austrodanthonia caespitosa, A. auriculata* and *A. setacea*), Speargrass (*Austrostipa scabra* subsp. *scabra*) and the exotic annuals False Hairgrass (*Pentaschistis airoides)*, Squirrel Tail Fescue (*Vulpia bromoides*) and Smooth Catsear (*Hypochaeris glabra*).

Where Cypress regrowth is absent, the understorey is open and grassy with a range of shrubs and small trees including Wilga (*Geijera parviflora*), Green Wattle (*Acacia deanei* subsp. *deanei*), Miljee (*A. oswaldii*), Needlewood (*Hakea tephrosperma*) and Weeping Pittosporum (*Pittosporum phylliraeoides*).

The common grasses are the same as those occurring under the Cypress regrowth, but native forbs are more frequent including Tall Bluebell (*Wahlenbergia stricta* subsp. *alterna*), River Bluebell (*W. fluminalis*), Climbing Saltbush (*Einadia nutans* subsp. *nutans*), a Bluebush (*Maireana humillima*), Golden Everlasting (*Bracteantha bracteata*) and Pygmy Sunray (*Triptilodiscus pygmaeus*).

This community occurs on the plains surrounding Tin Pot Hill. On the eastern side of the hill, Cypress regrowth is slightly less than on the western side resulting in a more open Box woodland. Occasional patches of Kangaroo Grass (*Themeda australis*) can be found along the eastern edge of the site.

3.3 Significant Species and Communities

3.3.1 Threatened species

The NSW NPWS identified three species listed on the TSC Act which had been recorded within a 30 km radius of the proposed development site, a Leek Orchid (*Prasophyllum fuscum*), Spiny Peppercress (*Lepidium aschersonii*) and another Peppercress (*L. hyssopifolium*). None of these species were found during the survey and details of their likely occurrence in the area are given below.

a) *Prasophyllum fuscum*

Prasophyllum fuscum was first described by Robert Brown last century from a collection made on the western plains of Sydney. For many years the name *P. fuscum* was applied to a wide range of species including the *Prasophyllum* species found on the western slopes and plains. Following recent taxonomic revisions *P. fuscum* is now thought to be restricted to either just the Blue Mountains or the Wingecaribee Swamp in the Southern Tablelands, however there is still controversy about which of these populations represents the true *P. fuscum* (Bishop 1996, David Jones pers. comm. 1999).

The *Prasophyllum* which occurs on the western slopes and plains, is *P. campestre*, the Inland Leek Orchid. It is widespread in grassy Cypress woodlands and on low rocky hills, although it may

often be missed because of its short flowering season. *P. campestre* was found scattered around the base of Tin Pot Hill in reasonable numbers. It was at the end of flowering, and it is likely that more plants occur at the site but had already finished flowering and disappeared at the time of survey.

P. campestre is common and widespread and not a threatened species. The truly threatened *P. fuscum* does not occur within several hundred kilometres of Tin Pot Hill, and is not an issue for the proposed development.

b) *Lepidium aschersonii*

Spiny Peppercress (*Lepidium aschersonii*) is a perennial herb of disjunct distribution in the north-east of the western plains and the central western slopes of NSW, and the volcanic western plains of Victoria. It is listed as Vulnerable in New South Wales It grows in heavy black or grey loamy clays, commonly around salt pans or lakes or in waterlogged soils.

The soils on the western footslopes of Tin Pot Hill site can be characterised as reddish deep uniform sands of aeolian origin. On the eastern side the particles are finer and the soils have a higher clay content, however are still of a generally sandy nature and reddish in colour. The volcanic rock of Tin Pot Hill is highly resistant to weathering and consequently soils are very shallow.

Lepidium aschersonii was not found during the survey, nor was any suitable soil type for the species found on the site. The species' requirement for heavy dark often-waterlogged soils makes its occurrence in the deep red aeolian sands of the Tin Pot Hill area highly improbable. It is considered that the proposed development will have no impact on *L. aschersonii* or its habitat.

c) *Lepidium hyssopifolium*

Lepidium hyssopifolium is a perennial herb listed as nationally Endangered in the Commonwealth Endangered Species Protection Act (1992), and also as Endangered in the NSW TSC Act.

It is rarely recorded, with only a few specimens known from widely scattered locations in New South Wales, South Australia, Victoria and Tasmania (Hewson 1982). Information on its habitat requirements is sparse. In Tasmania it has been found on dark brown clay loams in the Midlands. In South Australia it has been recorded from grey clay loams on the banks of the Murray River. In Victoria it has been reported growing in red-brown earths on the western basalt plains and it is only currently known from two localities (Entwistle 1996). In New South Wales it has been recorded from Wentworth on heavy silt on river flats, from Gostwyck near the Queensland border and from Bathurst.

There has been some taxonomic confusion about the species *Lepidium hyssopifolium* and at one stage it included *L. africanum*, *L. pseudohyssopifolium* and *L. pseudotasmanicum* (Entwistle 1996). There may still exist some records of *L. hyssopifolium* which should be more correctly named as one of these latter species.

Lepidium hyssopifolium was not found during the survey at Tin Pot Hill. Based upon current information, *L. hyssopifolium* occurs most commonly in heavy dark fertile soils. As with *L. aschersonii*, the deep red sands of the Tin Pot Hill site are probably not suitable for *L. hyssopifolium* and its occurrence at the quarry site is considered unlikely.

3.3.2 Other Significant Species

a) ROTAP

One species, Irongrass (*Lomandra patens*), is listed on the Rare or Threatened Australian Plant (ROTAP) list (Briggs and Leigh 1996) but not the TSC Act. It is classified as 3RCa which indicates that it is a rare plant with a range of more than 100 km, and that at least 1000 plants are found within one or more conservation reserves.

It grows on rocky hillsides and is found across western New South Wales from Wellington to Mootwingee (Quirico 1993). A rather uncommon species, although locally abundant in favourable situations (Cunningham *et al* 1981), it is known from several rocky outcrops near Tin Pot Hill including the Cocoparra National Park.

At the proposed quarry site *L. patens* is found on the steepest areas of rock outcrop on Tin Pot Hill and the un-named hill to the north of the road on Block 31. Quarrying either of these hills will impact directly on the population at this site as these are the only suitable habitat for the species. It is unlikely that L. patens will re-establish on the quarry site after rehabilitation as its rock outcrop habitat will have been removed.

The species is widespread across NSW (although uncommon), probably occurs in the hills to the north of Tin Pot Hill, and is conserved in the Cocoparra National Park. The loss of part of the population at this site is not considered critical to the survival of the species.

b) Regionally rare or restricted

The Mid-Lachlan Regional Vegetation Management Plan (RVMP) covers the Bland Shire and includes Tin Pot Hill. This plan lists plant species with a rare or restricted distribution in the Mid-Lachlan region, even if they may be common elsewhere.

One species present at the proposed quarry site is listed as regionally rare or significant. This is Slender-leaf Mistletoe (*Amyema linophyllum* subsp. *orientale*), which is parasitic on Buloke (*Allocasuarina leuhmanii*). Buloke occurs occasionally in the White Cypress - Poplar Box woodlands but most of it is close to the South Yalgogrin Road at some distance from the rocky hills, and is unlikely to be impacted by the development.

3.3.3 Significant Vegetation Communities

The Mid-Lachlan RVMP lists a number of vegetation communities regarded as threatened on either a regional or State level. These 'Priority Plant Communities' are to be subject to development consent.

Poplar Box Woodland is one of the priority communities listed, as it is considered to be highly fragmented and not conserved within the region. The Poplar Box Woodlands described in the RVMP are slightly different to the White Cypress - Poplar Box community at Tin Pot Hill, in that Poplar Box is the dominant species with White Cypress as an associate. The community at Tin Pot Hill is better described in the RVMP as a White Cypress Woodland, where White Cypress is the dominant species and eucalypts are associated. This community is not listed as a priority.

Despite this it could be considered that the conservation of the *Eucalyptus* species within the White Cypress - Poplar Box woodland should be a priority, particularly where these trees are mature. This includes Poplar Box, Grey Box (*E. microcarpa*) and Inland Red Box (*E. intertexta*). Retention and protection of these trees should be undertaken where at all possible during the proposed development.

The Dwyer's Redgum - White Cypress - Currawang low open woodland on the hills is not listed as a priority community in the RVMP. However the proposed development will have greatest impact on this community, possibly removing most of it from the site depending upon the extent of quarry development. Rehabilitation on the quarry site at the end of works is unlikely to establish the community as the rock outcrop habitat will have been removed.

Some species are found only in this community, most notably Irongrass (*Lomandra patens*), and also Fern-leaf Hopbush (*Dodonaea boroniifolia*) and one specimen of Drooping Sheoke (*Allocasuarina verticillata*). If either of the main hills, Tin Pot Hill or the un-named northern hill are not quarried then a proportion of the populations of these species will remain. The same community is likely to occur on Kangaroo Mountain to the north of the site, and other hills in the area with a similar geology, although these were not visited during the survey.

CONCLUSION

During the vegetation survey of the Tin Pot Hill proposed quarry site 165 plant species were recorded including one nationally rare (ROTAP) species and one regionally rare species. None of the three target Threatened species or appropriate habitat were found.

The ROTAP species, Irongrass (*Lomandra patens*) will be affected by the proposed development as it is found only on the rock outcrops. The species also occurs in hills around the quarry site (including Cocoparra National Park) and removal of part of the Tin Pot Hill population is unlikely to critically affect the species. The regionally rare species, Slender-leaf Mistletoe (*Amyema linophyllum* subsp. *orientale*), is unlikely to be affected by the development as it only grows on Buloke trees at some distance from the hills.

Two vegetation communities occur at the site; Dwyer's Redgum - White Cypress - Currawang low open woodland on the hills, and White Cypress - Poplar Box woodland to open woodland on the surrounding footslopes and plains.

The Dwyer's Redgum community will be the most impacted by the development, and may not be able to be restored once the quarry is finished. The White Cypress - Poplar Box woodlands will be much less impacted than the hill vegetation, however retention where possible of all eucalypt trees in this community is important from a regional conservation perspective.

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APPENDIX 1

Plant Species List for Tin Pot Hill Proposed Quarry Development Site

A = Abundant, C = Common, O = Occasional, R = Rare

Family/ Species *= exotic	Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)	White Cypress - Poplar Box woodlands (footslopes, plains)
Pteridophyta		
Sinopteridaceae		
Cheilanthes sieberi	C	C
Gymnosperms		
Cupressaceae		
Callitris glaucophylla	C	A
Amaranthaceae		
Alternanthera denticulata	R	R
Alternanthera sp. *A*	R	
Amaryllidaceae		
Calostemma purpurea	C	C
Anthericaceae		
Dichopogon fimbriatus	C	
Tricoryne elatior	A	O
Apiaceae		
Daucus glochidiatus		
Hydrocotyle laxiflora	O	O
Apocynaceae		
Parsonsia eucalyptophylla	O	O
Asteraceae		
Actinoble uliginosum	O	O
* *Arctotheca calendula*	O	O
Bracteantha bracteata	C	C
Bracteantha viscosa	R	
Calotis cunefolia	O	O
* *Carduus tenuifolius*	O	O
* *Carthamus lanatus*	C	C
Cassinia laevis		O
* *Centaurea melitensis*	O	O
Chrysocephalum apiculatum		O
Chrysocephalum semipapposum	O	O
* *Cirsium vulgare*		R
Cymbonotus lawsonianus		O
* *Hedypnois rhagodioloides*	R	
Hyalosperma semisterile		O
* *Hypochaeris glabra*	A	A
Isoetopsis graminifolium		O
Minuria leptophylla		O
Sigesbeckia australiensis	R	
* *Sonchus asper*	O	O
* *Sonchus oleraceus*	O	O
Triptilodiscus pygmaeus	C	C
Vittadinia cervicularis subsp. *subcervicularis*	C	C
Vittadinia dissecta var. *hirsuta*	O	O
Vittadinia gracilis	O	O

A = Abundant, C = Common, O = Occasional, R = Rare

Family/ Species *= exotic	Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)	White Cypress - Poplar Box woodlands (plains, footslopes)
Bignoniaceae		
Pandorea pandorana	O	
Boraginaceae		
* *Echium vulgare*	A	C
Caesalpinoideae		
Senna artemisioides subsp. *zygophylla*	R	O
Campanulaceae		
Wahlenbergia fluminalis		O
Wahlenbergia gracilenta	R	
Wahlenbergia luteola	R	R
Wahlenbergia stricta subsp.*alterna*	A	O
Caryophyllaceae		
* *Petrorhagia nanteuilli*	C	C
* *Silene gallica* var. *gallica*	O	O
Casuarinaceae		
Allocasuarina leuhmannii		O
Allocasuarina verticillata	R	
Chenopodiaceae		
Chenopodium desertorum subsp. *microphyllum*		O
Chenopodium melanocarpum		R
Einadia nutans subsp. *nutans*	O	C
Maireana enchylanoides		O
Maireana humillima		O
Maireana microphylla		R
Salsola kali		R
Convolvulaceae		
Convolvulus erubescens	O	
Dichondra repens		O
Evolvulus alsinoides var. *decumbens*	R	
Crassulaceae		
Crassula colorata	O	
Cyperaceae		
* *Cyperus eragrostis*	R	
Fimbristylis dichotoma	R	
Schoenus apogpon	R	
Euphorbiaceae		
Bertya cunninghamii		R
Chamaesace drummondii	R	
Phyllanthus fuernrohrii		O
Poranthera microphylla	O	
Fabaceae - Faboideae		
Glycine canescens	C	O
Glycine clandestina		
Indigofera australis	C	
* *Medicago minima*		R
Mirbelia pungens		
* *Trifolium angustifolium*	O	

A = Abundant, C = Common, O = Occasional, R = Rare

Family/ Species *= exotic	Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)	White Cypress - Poplar Box woodlands (plains, footslopes)
* *Trifolium arvense*	A	A
* *Trifolium campestre*	C	C
* *Trifolium glomeratum*	O	O
* *Trifolium hirtum*	O	
Trifolium subterraneum	R	
Fabaceae - Mimosoideaeae		
Acacia deanei subsp. *deanei*		O
Acacia decora	R	
Acacia doratoxylon	C	O
Acacia oswaldii		C
Gentianaceae		
* *Centaurium erythraea*	R	
Geraniaceae		
Erodium crinitum	O	O
Geranium retrorsum	O	
Goodeniaceae		
Brunonia australis		R
Goodenia glabra	C	C
Velleia paradoxa	C	
Haloragacaeae		
Gonocarpus elatus	A	O
Hypericaceae		
Hypericum gramineum	R	
Juncaceae		
Juncus radula	R	R
Lamiaceae		
Ajuga australis		O
* *Marrubium vulgare*		O
Lomandraceae		
Lomandra filiformis subsp. *coriacea*	O	O
Lomandra patens	C	
Loranthaceae		
Amyema linophyllum subsp. *orientale*		O
Amyema pendulum		O
Lythraceae		
Lythrum hyssopifolium	R	R
Malvaceae		
Sida corrugata	C	C
Sida cunninghamii	C	C
Myrtaceae		
Eucalyptus dwyeri	C	O
Eucalyptus intertexta		O
Eucalyptus microcarpa		C
Eucalyptus populnea subsp. *bimbil*		C

A = Abundant, C = Common, O = Occasional, R = Rare

Family/ Species *= exotic	Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)	White Cypress - Poplar Box woodlands (plains, footslopes)
Nyctaginaceae		
Boerhavia dominii	R	
Orchidaceae		
Microtis unifolia	O	O
Prasophyllum campestre	O	R
Oxalidaceae		
Oxalis perennans	O	O
Phormiaceae		
Dianella longifolia var. *longifolia*	O	
Pittosporaceae		
Pittosporum phylliraeoides		O
Poaceae		
Amphibromus macrorhinus	R	
Amphipogon caricinus var. *caricinus*	O	O
Aristida behriana	O	C
Aristida jerichoensis var. *jerichoensis*	A	A
Aristida jerichoensis var. *subspinulifera*		O
Austrodanthonia auriculata		O
Austrodanthonia caespitosa	A	A
Austrodanthonia setacea	C	C
Austrostipa bigeniculata	O	O
Austrostipa densiflora	C	C
Austrostipa gibbosa		R
Austrostipa scabra subsp. *scabra*	A	A
* *Avena fatua*	A	A
Bothriochloa macra	R	
* *Bromus diandrus*	R	
* *Bromus madritensis*	C	C
* *Bromus molliformis*	O	O
Chloris divaricata var. *divaricata*		O
Digitaria brownii	O	
Digitaria hysterichoides	O	
Elymus scaber subsp. *scaber*	C	C
Enneapogon nigricans	C	
* *Eragrostis curvula*	R	
Eragrostis elongata	R	
Eragrostis lacunaria	O	O
Eulalia aurea		O
* *Hordeum leporinum*		O
* *Lolium perenne*	O	O
Monachather paradoxa	O	O
Panicum effusum subsp. *simile*	O	O
Paspalidium gracile	O	O
* *Pentaschistis airoides*	A	A
* *Schismus barbatus*		R
Themeda australis	O	
Thyrdiolepis mitchelliana	C	C
Tripogon loliiformis		
* *Vulpia bromoides*	A	A
Polygonaceae		
Persicaria prostrata	R	
Rumex brownii		O

A = Abundant, C = Common, O = Occasional, R = Rare

Family/ Species *= exotic	Dwyer's Redgum - White Cypress - Currawang low open woodlands (hills)	White Cypress - Poplar Box woodlands (plains, footslopes)
Portulacaceae		
Calandrinia eremaea	O	O
Primulaceae		
* *Anagallis arvensis*		R
Proteaceae		
Hakea tephrosperma		O
Rhamnaceae		
Cryptandra amara var. *floribunda*		R
Rubiaceae		
Galium gaudichaudii	R	
Rutaceae		
Geijera parviflora		O
Sapindaceae		
Dodonaea boroniifolia	C	
Dodonaea viscosa subsp. *mucronata*		R
Scrophulariaceae		
* *Verbascum thaspus*	O	O
Solanaceae		
Nicotiana goodspeedii		R
Nicotiana simulans	R	
Solanum cinereum		R
* *Solanum nigrum*	R	R
Stackhousiaceae		
Stackhousia monogyna		
Sterculiaceae		
Brachychiton populnea	O	O
Thymeleaceae		
Pimilea micrantha	O	
Violaceae		
Hybanthus monopetalus	C	O
Zygophyllaceae		
Tribulus micrococcus	R	

ANNEX 2: addendum

EPA Act 1979 - S 5A Assessment - '8-Part Test'

Significant Effect on Threatened Species, Populations or Ecological Communities, or their Habitats

Irongrass (*Lomandra patens*)

S.5A of the Act states:
'For the purposes of this Act and, in particular, in the administration of sections 77, 90 and 112, the following factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats.'

This assessment has been applied to the lomandra to identify the nature and extent of potential impact even though it is not a threatened species under the Act.

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
Irongrass (*Lomandra patens*) is listed on the Rare or Threatened Australian Plant (ROTAP) list (Briggs and Leigh 1996) but not the TSC Act. It is classified as 3RCa which indicates that it is a rare plant with a range of more than 100 km, and that at least 1000 plants are found within one or more conservation reserves.

Lomandra patens grows on rocky hillsides, and is found across western New South Wales from Wellington to Mootwingee. It is rather uncommon species but can be locally abundant, it is known from several rocky outcrops near Tin Pot Hill including the Cocoparra National Park.

Extent of the local population
Lomandra patens is found on the steepest areas of rock outcrop on Tin Pot Hill and the un-named hill to the north of the road on Block 31. It is known from several rocky outcrops near Tin Pot Hill including the Cocoparra National Park.

Stages of lifecycle affected by the proposed development
Complete removal of the hill through quarrying would eliminate all associated individuals as the surrounding sandy soils do not appear to provide suitable habitat. The local population would then be represented by individuals on other outcrops, such as Kangaroo Hill.

Likelihood of Extinction
Elimination of all individuals on Tin Pot Hill would not threaten the survival of local populations because of the alternate occurrences. The habitat of the lomandra has been least affected by development in the region because of its very low suitability for agriculture, and hence the habitat is effectively well conserved.

Conclusion
The proposed development will not disrupt the life cycle of *Lomandra patens* such that a viable population of this species is likely to be placed at risk of extinction.

(b) **in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,**

The population is not endangered.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

Using outcrops of the acid volcanic rock as an indicator of occurrence as well as habitat, Tin Pot Hill represents less than 2% of the regional habitat. The representation is less than 1% when outcrops of other rock types are considered

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

The proximity to other occurrences means that loss of the individuals on Tin Pot Hill will not significantly affect the interconnectivity of proximate areas of habitat.

(e) **whether critical habitat will be affected,**

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) **whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,**

The species is represented in the Cocoparra National Park. Moreover, the habitat of the lomandra has been least affected by development in the region because of its very low suitability for agriculture, and hence the habitat is regionally well conserved

Conclusion

That *Lomandra patens* is adequately represented in conservation reserves in New South Wales.

(g) **whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,**

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion

In view of the information given in the above sections of this assessment, no impact from the proposed development is likely to have the potential to threaten the survival or evolutionary development of the regional or local population of *Lomandra patens*.

(h) **whether any threatened species, population or ecological community is at the limit of its known distribution,**

Inspection of the distributional information on this species indicates that the location of the proposed development is well within the limits of the distribution of the species.

Summary of Conclusions Section 5A Assessment – *Lomandra patens*

As a result of the proposed development:

- It is not possible that the life cycle of the lomandra would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat, the development will potentially destroy less than 1%.
- No areas of known habitat will become isolated from currently interconnecting or proximate areas.
- The species is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the species will not be affected.
- The subject site is at a distributional limit of the species.

The conclusion is that while the proposed development will eliminate most individuals of *Lomandra patens* currently existing on Tin Pot Hill, it will not threaten the survival or evolutionary development of the regional or local populations.

Annex 3a: Fauna Survey

FAUNA OF TIN POT HILL QUARRY AREA ARDLETHAN, NEW SOUTH WALES

Fauna expected from the literature that occur or may occur in the general area of the proposed development site and fauna recorded in the immediate area (within 1km, approx.) of the subject site, including in the vicinity of an abandoned homestead.

Literature Scanned

General

CSIRO (1998) *CSIRO List of Australian Vertebrates. A Reference with Conservation Status.* CSIRO, Melbourne.

Amphibians and Reptiles:

Cogger, H.G. (1993) *Reptiles and Amphibians of Australia.* Reed Books, Chatswood, NSW.

Birds:

Marchant, S. & Higgins, P.J. (1990) (eds) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 1. Ratites to Ducks.* Oxford University Press, Melbourne.

Marchant, S. & Higgins, P.J. (1993) (eds) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2. Raptors to Lapwings.* Oxford University Press, Melbourne.

Higgins, P.J. & Davies (1996) (eds) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 3. Snipe to Pigeons.* Oxford University Press, Melbourne.

Higgins, P.J. (1999) (eds) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4. Parrots to Dollarbird.* Oxford University Press, Melbourne.

Schodde, R. & Mason, I.J. (1999) *The Directory of Australian Birds. Passerines.* CSIRO, Melbourne.

Mammals:

Strahan, R. (1998) *The Mammals of Australia.* Reed Books, Sydney.

Column 1.
Fauna that occur or may occur in 'hill' habitats: Dwyer's Red Gum – Pine Woodland. [Equivalent to Sivertsen and Metcalfe (1995)* Habitat Type H1]

Column 2.
Fauna that occur or may occur in 'footslope' habitats: Pine and Box Woodlands [Equivalent to Sivertsen and Metcalfe (1995) Habitat Types F2 and F3]

Column 3.
Fauna recorded or indicated from dung, scats or prints to be in the area on a site inspection 0900 – 1400 hrs 24th November 1999.

(-) From a literature scan, considered not likely to occur in nominated habitat but to occur in the general area depending, in many instances, on seasonal conditions.
(?) Uncertain as to whether the species may occur in the general area and/or utilise the nominated habitat.

Fauna listed in The Threatened Species Conservation Act (1995) are shown in bold. An '8-Part test', as required under S.5A of the EPA Act 1979, is given for only those species indicated from the literature as likely to use 'hill' habitats in the general region of the subject development site.

*Sivertsen, D. and Metcalfe, L. (1995). Natural Vegetation of the Southern Wheatbealt-Forbes 1:250 00 Map. *Cunninghamia* Vol 4.

AMPHIBIANS AND REPTILES

Note.
Amphibians and reptiles are sensitive to microclimatic factors and therefore their occurrences may not well correspond to the general habitat types used here.

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Eastern Sign-bearing Froglet	*Crinia parinsignifera* Main	-	-	-
Common Eastern Froglet	*Crinia signifera* (Girard)	-	-	-
Sloane's Froglet	*Crinia sloanei* Littlejohn	-	-	-
Long-thumbed Frog	*Limnodynastes fletcheri* Boulenger	-	-	-
Eastern Banjo Frog	*Limnodynastes dumerilii* Peters	-	-	-
Giant Banjo Frog	*Limnodynastes interioris* Fry	-	-	-
Salmon-striped Frog	*Limnodynastes salmini* Steindachner	-	-	-
Spotted Grass Frog	*Limnodynastes tasmaniensis* Günther	-	-	-
Sudell's Frog	*Neobatrachus sudelli* (Lamb)	-	-	-
Crucifix Toad	*Notaden bennettii* Günther	-	-	-
Brown Toadlet	*Pseudophryne bibronii* Günther	-	-	-
Wrinkled Toadlet	*Uperoleia rugosa* (Andersson)	-	-	-
Water-holding Frog	*Cyclorana platycephala* (Günther)	-	-	-
Green Tree Frog	*Litoria caerulea* (Shaw)	X	X	-
Peron's Tree Frog	*Litoria peronii* (Tschudi)	?	X	-
Southern Bell Frog	*Litoria raniformis* (Keferstein)	-	-	-
Desert Tree Frog	*Litoria rubella* (J.E. Gray)	?	X	-
Eastern Snake-necked Turtle	*Chelodina longicollis* (Shaw)	-	-	-
Marbled Gecko	*Christinus marmoratus* (J.E. Gray)	X	X	-
Eastern Spiny-tailed Gecko	*Diplodactylus intermedius* Ogilby	X	X	-
Box-patterned Gecko	*Diplodactylus steindachneri* Boulenger	X	X	-
Tessellated Gecko	*Diplodactylus tessellatus* Günther	X	X	-
Wood Gecko	*Diplodactylus vittatus* J.E. Gray	X	X	-
Tree Dtella	*Gehyra variegata* (Duméril & Bibron)	X	X	-
Bynoe's Gecko	*Heteronotia binoei* (J.E. Gray)	X	X	-
Beaked Gecko	*Rhynchoedura ornata* Günther	X	X	-
Thick-tailed Gecko	*Underwoodisaurus milii* (Bory de Saint-Vincent)	X	X	-
Pink-tailed Legless Lizard	*Aprasia parapulchella* Kluge	-	-	-
Unbanded Delma	*Delma butleri* Storr	-	-	-

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Patternless Delma	*Delma inornata* Kluge	X	X	-
Burton's Snake-lizard	*Lialis burtonis* J.E. Gray	X	X	-
Common Scaly-foot	*Pygopus lepidopodus* (Lacépède)	X	X	-
Hooded Scaly-foot	*Pygopus nigriceps* (Fischer)	X	X	-
Jacky Lizard	*Amphibolurus muricatus* (Shaw)	X	X	-
Nobbi	*Amphibolurus nobbi* Witten	X	X	-
Painted Dragon	*Ctenophorus pictus* (Peters)	-	-	-
Bearded Dragon	*Pogona barbata* (Cuvier)	X	X	-
Lined Earless Dragon	*Tympanocryptis lineata* Peters	-	X	-
Gould's Goanna	*Varanus gouldii* (J.E. Gray)	X	X	-
Lace Monitor	*Varanus varius* (Shaw)	?	-	-
Bold-striped Cool-skink	*Bassiana duperreyi* (J.E. Gray)	-	-	-
Southern Rainbow-skink	*Carlia tetradactyla* (O'Shaughnessy)	?	?	-
Spiny-palmed Shinning-skink	*Cryptoblepharus carnabyi* Storr	?	?	-
Brown-blazed Wedgesnout Ctenotus	*Ctenotus allotropis* Storr	?	X	-
Robust Ctenotus	*Ctenotus robustus* Storr	X	X	X
Eastern Barred Wedgesnout Ctenotus	*Ctenotus strauchii* (Boulenger)	-	-	-
Copper-tailed Skink	*Ctenotus taeniolatus* (Shaw)	?	?	-
Spotted Ctenotus	*Ctenotus uber* Storr	?	?	-
Tree Skink	*Egernia striolata* (Peters)	X	X	-
Eastern Water-skink	*Eulamprus quoyii* (Duméril & Bibron)	-	-	-
Three-toed Earless Skink	*Hemiergis decresiensis* (Cuvier)	?	?	-
South-eastern Slider	*Lerista bougainvillii* (J.E. Gray)	?	?	-
Wood Mulch-slider	*Lerista muelleri* (Fischer)	X	X	-
Eastern Robust Slider	*Lerista punctatovittata* (Günther)	X	X	-
Common Dwarf Skink	*Menetia greyii* J.E. Gray	X	X	-
South-eastern Morethia Skink	*Morethia boulengeri* (Ogilby)	X	X	-
Eastern Blue-tongued Lizard	*Tiliqua scincoides* (Shaw)	X	X	X
Shingle-back	*Trachydosaurus rugosus* J.E. Gray	X	X	X
Southern Blind Snake	*Ramphotyphlops australis* (J.E. Gray)	?	?	-
Prong-snouted Blind Snake	*Ramphotyphlops bituberculatus* (Peters)	X	X	-
Blackish Blind Snake	*Ramphotyphlops nigrescens* (J.E. Gray)	X	X	-
Proximus Blind Snake	*Ramphotyphlops proximus* (Waite)	X	X	-
Claw-snouted Blind Snake	*Ramphotyphlops unguirostris* (Peters)	X	X	-
Brown-snouted Blind Snake	*Ramphotyphlops wiedii* (Peters)	X	X	-
Carpet & Diamond Pythons	*Morelia spilota* (Lacépède)	X	X	-
Common Death Adder	*Acanthophis antarcticus* (Shaw & Nodder)	X	X	-
Yellow-faced Whip Snake	*Demansia psammophis* (Schlegel)	X	X	-
White-lipped Snake	*Drysdalia coronoides* (Günther)	X	X	-
Red-naped Snake	*Furina diadema* (Schlegel)	X	X	-
Eastern Tiger Snake	*Notechis scutatus* (Peters)	-	-	-
King Brown Snake	*Pseudechis australis* (J.E. Gray)	X	X	-
Spotted Black Snake	*Pseudechis guttatus* De Vis	X	X	-
Red-bellied Black Snake	*Pseudechis porphyriacus* (Shaw)	-	-	-
Eastern Brown Snake	*Pseudonaja textilis* (Duméril, Bibron & Duméril)	X	X	-
Spectacled Hooded Snake	*Suta spectabilis* (Krefft)	X	X	-
Curl Snake	*Suta suta* (Peters)	X	X	-
Bandy-bandy	*Vermicella annulata* (J.E. Gray)	X	X	-

BIRDS

* = Non-indigenous (human assisted) introductions

		1	2	3
COMMON NAMES	**SCIENTIFIC NAMES**	**HILLS**	**F/SLOPE**	**R/CD**
Emu	*Dromaius novaehollandiae* (Latham)	X	X	X-
Stubble Quail	*Coturnix pectoralis* Gould	-	?	-
Brown Quail	*Coturnix ypsilophora* Bosc	-	-	-
Malleefowl	*Leipoa ocellata* Gould	-	-	-
Plumed Whistling-Duck	*Dendrocygna eytoni* (Eyton)	-	-	-
Blue-billed Duck	*Oxyura australis* Gould	-	-	-
Musk Duck	*Biziura lobata* (Shaw)	-	-	-
Freckled Duck	*Stictonetta naevosa* (Gould)	-	-	-
Black Swan	*Cygnus atratus* (Latham)	-	-	-
Australian Shelduck	*Tadorna tadornoides* (Jardine & Selby)	-	-	-
Australian Wood Duck	*Chenonetta jubata* (Latham)	-	-	-
Mallard *	*Anas platyrhynchos* Linnaeus	-	-	-
Pacific Black Duck	*Anas superciliosa* Gmelin	-	-	-
Australasian Shoveler	*Anas rhynchotis* Latham	-	-	-
Grey Teal	*Anas gracilis* Buller	-	-	-
Chestnut Teal	*Anas castanea* (Eyton)	-	-	-
Pink-eared Duck	*Malacorhynchus membranaceus* (Latham)	-	-	-
Hardhead	*Aythya australis* (Eyton)	-	-	-
Australasian Grebe	*Tachybaptus novaehollandiae* (Stephens)	-	-	-
Hoary-headed Grebe	*Poliocephalus poliocephalus* (Jardine & Selby)	-	-	-
Great Crested Grebe	*Podiceps cristatus* (Linnaeus)	-	-	-
Darter	*Anhinga melanogaster* Pennant	-	-	-
Little Pied Cormorant	*Phalacrocorax melanoleucos* (Vieillot)	-	-	-
Pied Cormorant	*Phalacrocorax varius* (Gmelin)	-	-	-
Little Black Cormorant	*Phalacrocorax sulcirostris* (Brandt)	-	-	-
Great Cormorant	*Phalacrocorax carbo* (Linnaeus)	-	-	-
Australian Pelican	*Pelecanus conspicillatus* Temminck	-	-	-
White-faced Heron	*Egretta novaehollandiae* (Latham)	-	-	-
Little Egret	*Egretta garzetta* (Linnaeus)	-	-	-
White-necked Heron	*Ardea pacifica* Latham	-	-	-
Pied Heron	*Ardea picata* Gould	-	-	-
Great Egret	*Ardea alba* Linnaeus	-	-	-
Intermediate Egret	*Ardea intermedia* Wagler	-	-	-
Cattle Egret	*Ardea ibis* Linnaeus	-	-	-
Nankeen Night Heron	*Nycticorax caledonicus* (Gmelin)	-	-	-
Little Bittern	*Ixobrychus minutus* (Linnaeus)	-	-	-
Australasian Bittern	*Botaurus poiciloptilus* (Wagler)	-	-	-
Glossy Ibis	*Plegadis falcinellus* (Linnaeus)	-	-	-
Australian White Ibis	*Threskiornis molucca* (Cuvier)	-	-	-
Straw-necked Ibis	*Threskiornis spinicollis* (Jameson)	-	-	-
Royal Spoonbill	*Platalea regia* Gould	-	-	-
Yellow-billed Spoonbill	*Platalea flavipes* Gould	-	-	-
Black-shouldered Kite	*Elanus axillaris* (Latham)	-	X	X
Letter-winged Kite	*Elanus scriptus* Gould	-	X	-
Black-breasted Buzzard	*Hamirostra melanosternon* (Gould)	-	X	-
Black Kite	*Milvus migrans* (Boddaert)	-	X	-
Whistling Kite	*Haliastur sphenurus* (Vieillot)	-	X	X
Spotted Harrier	*Circus assimilis* Jardine & Selby	-	X	X

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Swamp Harrier	*Circus approximans* Peale	-	-	-
Brown Goshawk	*Accipiter fasciatus* (Vigors & Horsfield)	X	X	-
Collared Sparrowhawk	*Accipiter cirrocephalus* (Vieillot)	X	X	-
Wedge-tailed Eagle	*Aquila audax* (Latham)	X	X	-
Little Eagle	*Hleraaetus morphnoides* (Gould)	X	X	-
Brown Falcon	*Falco berigora* Vigors & Horsfield	-	X	-
Australian Hobby	*Falco longipennis* Swainson	X	X	-
Grey Falcon	*Falco hypoleucos* Gould	X	X	-
Black Falcon	*Falco subniger* G.R. Gray	-	X	-
Peregrine Falcon	*Falco peregrinus* Tunstall	X	X	-
Nankeen Kestrel	*Falco cenchroides* Vigors & Horsfield	-	X	X
Brolga	*Grus rubicunda* (Perry)	-	-	-
Buff-banded Rail	*Gallirallus philippensis* (Linnaeus)	-	-	-
Baillon's Crake	*Porzana pusilla* (Pallas)	-	-	-
Australian Spotted Crake	*Porzana fluminea* Gould	-	-	-
Spotless Crake	*Porzana tabuensis* (Gmelin)	-	-	-
Purple Swamphen	*Porphyrio porphyrio* (Linnaeus)	-	-	-
Dusky Moorhen	*Gallinula tenebrosa* Gould	-	-	-
Black-tailed Native-hen	*Gallinula ventralis* Gould	-	-	-
Eurasian Coot	*Fulica atra* Linnaeus	-	-	-
Australian Bustard	*Ardeotis australis* (J.E. Gray)	-	?	-
Little Button-quail	*Turnix velox* (Gould)	-	?	-
Red-chested Button-quail	*Turnix pyrrhothorax* (Gould)	-	?	-
Painted Button-quail	*Turnix varia* (Latham)	X	-	-
Latham's Snipe	*Gallinago hardwickii* (J.E. Gray)	-	-	-
Black-tailed Godwit	*Limosa limosa* (Linnaeus)	-	-	-
Bar-tailed Godwit	*Limosa lapponica* (Linnaeus)	-	-	-
Marsh Sandpiper	*Tringa stagnatilis* (Bechstein)	-	-	-
Common Greenshank	*Tringa nebularia* (Gunnerus)	-	-	-
Wood Sandpiper	*Tringa glareola* Linnaeus	-	-	-
Common Sandpiper	*Actitis hypoleucos* (Linnaeus)	-	-	-
Red-necked Stint	*Calidris ruficollis* (Pallas)	-	-	-
Pectoral Sandpiper	*Calidris melanotos* (Vieillot)	-	-	-
Sharp-tailed Sandpiper	*Calidris acuminata* (Horsfield)	-	-	-
Curlew Sandpiper	*Calidris ferruginea* (Pontoppidan)	-	-	-
Painted Snipe	*Rostratula benghalensis* (Linnaeus)	-	-	-
Bush Stone-curlew	*Burhinus grallarius* (Latham)	-	X	-
Black-winged Stilt	*Himantopus himantopus* (Linnaeus)	-	-	-
Red-necked Avocet	*Recurvirostra novaehollandiae* Vieillot	-	-	-
Red-capped Plover	*Charadrius ruficapillus* Temminck	-	-	-
Black-fronted Dotterel	*Elseyornis melanops* (Vieillot)	-	-	-
Red-kneed Dotterel	*Erythrogonys cinctus* Gould	-	-	-
Pacific Golden Plover	*Pluvialis fulva* (Gmelin)	-	-	-
Banded Lapwing	*Vanellus tricolor* (Vieillot)	-	X	-
Masked Lapwing	*Vanellus miles* (Boddaert)	-	-	-
Australian Pratincole	*Stiltia isabella* (Vieillot)	-	-	-
Silver Gull	*Larus novaehollandiae* Stephens	-	-	-
Gull-billed Tern	*Sterna nilotica* Gmelin	-	-	-
Caspian Tern	*Sterna caspia* Pallas	-	-	-
Whiskered Tern	*Chlidonias hybridus* (Pallas)	-	-	-

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Rock Dove *	*Columba livia* Gmelin (TOWNS ONLY)	-	-	-
Common Bronzewing	*Phaps chalcoptera* (Latham)	X	X	X
Crested Pigeon	*Ocyphaps lophotes* (Temminck)	?	X	X
Diamond Dove	*Geopelia cuneata* (Latham)	?	X	X
Peaceful Dove	*Geopelia placida* Gould	X	X	X
Bar-shouldered Dove	*Geopelia humeralis* (Temminck)	?	?	-
Galah	*Eolophus roseicapillus* (Vieillot)	X	X	X
Little Corella	*Cacatua sanguinea* Gould	-	X	-
Major Mitchell's Cockatoo	*Cacatua leadbeateri* (Vigors)	-	X	-
Sulphur-crested Cockatoo	*Cacatua galerita* (Latham)	X	X	-
Cockatiel	*Nymphicus hollandicus* (Kerr)	-	X	-
Little Lorikeet	*Glossopsitta pusilla* (Shaw)	X	X	-
Superb Parrot	*Polytelis swainsonii* (Desmarest)	-	X	-
Crimson Rosella	*Platycercus elegans* (Gmelin)	X	-	-
Eastern Rosella	*Platycercus eximius* (Shaw)	X	X	X
Australian Ringneck	*Barnardius zonarius* (Shaw)	?	X	X
Blue Bonnet	*Northiella haematogaster* (Gould)	-	X	X
Swift Parrot	*Lathamus discolor* (Shaw)	-	-	-
Red-rumped Parrot	*Psephotus haematonotus* (Gould)	-	X	-
Mulga Parrot	*Psephotus varius* Clark	X	?	-
Budgerigar	*Melopsittacus undulatus* (Shaw)	?	X	-
Turquoise Parrot	*Neophema pulchella* (Shaw)	X	?	-
Pallid Cuckoo	*Cuculus pallidus* (Latham)	X	X	-
Fan-tailed Cuckoo	*Cacomantis flabelliformis* (Latham)	X	?	-
Black-eared Cuckoo	*Chalcites osculans* Gould	X	-	-
Horsfield's Bronze-Cuckoo	*Chalcites basalis* (Horsfield)	-	X	X
Shining Bronze-Cuckoo	*Chalcites lucidus* (Gmelin)	X	-	-
Barking Owl	*Ninox connivens* (Latham)	-	?	-
Southern Boobook	*Ninox boobook* (Latham)	X	X	-
Barn Owl	*Tyto alba* (Scopoli)	-	X	-
Tawny Frogmouth	*Podargus strigoides* (Latham)	X	X	-
Australian Owlet-nightjar	*Aegotheles cristatus* (Shaw)	X	-	-
Spotted Nightjar	*Eurostopodus argus* (Hartert)	X	?	-
White-throated Needletail	*Hirundapus caudacutus* (Latham)	-	-	-
Fork-tailed Swift	*Apus pacificus* (Latham)	-	-	-
Laughing Kookaburra	*Dacelo novaeguineae* (Hermann)	X	X	X
Red-backed Kingfisher	*Todiramphus pyrrhopygia* (Gould)	-	X	-
Sacred Kingfisher	*Todiramphus sanctus* (Vigors & Horsfield)	X	X	-
Rainbow Bee-eater	*Merops ornatus* Latham	?	X	X
Dollarbird	*Eurystomus orientalis* (Linnaeus)	?	X	-
White-throated Treecreeper	*Cormobates leucophaeus* (Latham)	X	X	-
Brown Treecreeper	*Climacteris picumnus* Temminck	X	X	-
Splendid Fairy-wren	*Malurus splendens* (Quoy & Gaimard)	-	-	-
Superb Fairy-wren	*Malurus cyaneus* (Ellis)	-	X	-
Variegated Fairy-wren	*Malurus lamberti* Vigors & Horsfield	X	?	-
White-winged Fairy-wren	*Malurus leucopterus* Dumont	-	-	-
Spotted Pardalote	*Pardalotus punctatus* (Shaw)	X	?	-
Striated Pardalote	*Pardalotus striatus* (Gmelin)	X	X	-
White-browed Scrubwren	*Sericornis frontalis* (Vigors & Horsfield)	X	-	-
Chestnut-rumped Heathwren	*Hylacola pyrrhopygia* (Vigors & Horsfield)	X	-	-

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Shy Heathwren	*Hylacola cauta* Gould	-	-	-
Speckled Warbler	*Chthonicola sagittata* (Latham)	X	-	-
Weebill	*Smicrornis brevirostris* (Gould)	X	X	-
Western Gerygone	*Gerygone fusca* (Gould)	X	X	-
White-throated Gerygone	*Gerygone olivacea* (Gould)	?	X	-
Brown Thornbill	*Acanthiza pusilla* (Shaw)	X	X	X
Inland Thornbill	*Acanthiza apicalis* Gould	X	?	-
Chestnut-rumped Thornbill	*Acanthiza uropygialis* Gould	-	?	-
Buff-rumped Thornbill	*Acanthiza reguloides* Vigors & Horsfield	X	-	-
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa* (Quoy & Gaimard)	-	X	-
Yellow Thornbill	*Acanthiza nana* Vigors & Horsfield	?	X	-
Striated Thornbill	*Acanthiza lineata* Gould	X	-	-
Southern Whiteface	*Aphelocephala leucopsis* (Gould)	-	X	X
Red Wattlebird	*Anthochaera carunculata* (Shaw)	X	X	-
Spiny-cheeked Honeyeater	*Acanthagenys rufogularis* Gould	-	X	-
Striped Honeyeater	*Plectorhyncha lanceolata* Gould	-	X	-
Noisy Friarbird	*Philemon corniculatus* (Latham)	X	X	-
Little Friarbird	*Philemon citreogularis* (Gould)	-	?	-
Regent Honeyeater	*Xanthomyza phrygia* (Shaw)	X	X	-
Blue-faced Honeyeater	*Entomyzon cyanotis* (Latham)	-	X	-
Noisy Miner	*Manorina melanocephala* (Latham)	-	X	X
Yellow-throated Miner	*Manorina flavigula* (Gould)	-	-	-
Yellow-faced Honeyeater	*Lichenostomus chrysops* (Latham)	X	?	X
Singing Honeyeater	*Lichenostomus virescens* (Vieillot)	-	X	-
White-eared Honeyeater	*Lichenostomus leucotis* (Latham)	X	?	-
Yellow-tufted Honeyeater	*Lichenostomus melanops* (Latham)	X	-	-
Yellow-plumed Honeyeater	*Lichenostomus ornatus* (Gould)	-	-	-
Grey-fronted Honeyeater	*Lichenostomus plumulus* (Gould)	X	X	-
Fuscous Honeyeater	*Lichenostomus fuscus* (Gould)	X	-	-
White-plumed Honeyeater	*Lichenostomus penicillatus* (Gould)	-	X	X
Black-chinned Honeyeater	*Melithreptus gularis* (Gould)	X	X	-
Brown-headed Honeyeater	*Melithreptus brevirostris* Vigors & Horsfield	X	?	-
White-naped Honeyeater	*Melithreptus lunatus* (Vieillot)	X	?	-
Painted Honeyeater	*Grantiella picta* (Gould)	X	X	-
Eastern Spinebill	*Acanthorhynchus tenuirostris* (Latham)	X	-	-
Black Honeyeater	*Certhionyx niger* (Gould)	X	X	-
Crimson Chat	*Epthianura tricolor* Gould	-	?	-
Orange Chat	*Epthianura aurifrons* Gould	-	-	-
White-fronted Chat	*Epthianura albifrons* (Jardine & Selby)	-	-	-
Jacky Winter	*Microeca fascinans* (Latham)	-	X	-
Scarlet Robin	*Petroica multicolor* (Gmelin)	X	-	-
Red-capped Robin	*Petroica goodenovii* (Vigors & Horsfield)	X	X	-
Flame Robin	*Petroica phoenicea* Gould	-	X	-
Rose Robin	*Petroica rosea* Gould	?	-	-
Hooded Robin	*Melanodryas cucullata* (Latham)	X	X	-
Eastern Yellow Robin	*Eopsaltria australis* (Shaw)	X	-	-
Southern Scrub-robin	*Drymodes brunneopygia* Gould	-	-	-
Grey-crowned Babbler	*Pomatostomus temporalis* (Vigors & Horsfield)	-	X	-
White-browed Babbler	*Pomatostomus superciliosus* (Vigors & Horsfield)	X	-	X

		1	2	3
COMMON NAMES	SCIENTIFIC NAMES	HILLS	F/SLOPE	R/CD
Spotted Quail-thrush	*Cinclosoma punctatum* (Shaw)	X	-	-
Chestnut Quail-thrush	*Cinclosoma castanotus* Gould	-	-	-
Varied Sittella	*Daphoenositta chrysoptera* (Latham)	X	X	-
Crested Shrike-tit	*Falcunculus frontatus* (Latham)	X	?	-
Crested Bellbird	*Oreoica gutturalis* (Vigors & Horsfield)	?	X	-
Gilbert's Whistler	*Pachycephala inornata* Gould	X	-	-
Golden Whistler	*Pachycephala pectoralis* (Latham)	X	X	-
Rufous Whistler	*Pachycephala rufiventris* (Latham)	X	X	X
Grey Shrike-thrush	*Colluricincla harmonica* (Latham)	X	X	X
Leaden Flycatcher	*Myiagra rubecula* (Latham)	X	X	-
Satin Flycatcher	*Myiagra cyanoleuca* (Vieillot)	X	-	-
Restless Flycatcher	*Myiagra inquieta* (Latham)	X	X	-
Magpie-lark	*Grallina cyanoleuca* (Latham)	-	X	X
Rufous Fantail	*Rhipidura rufifrons* (Latham)	X	-	-
Grey Fantail	*Rhipidura fuliginosa* (Sparrman)	X	X	-
Willie Wagtail	*Rhipidura leucophrys* (Latham)	-	X	X
Black-faced Cuckoo-shrike	*Coracina novaehollandiae* (Gmelin)	X	X	X
White-bellied Cuckoo-shrike	*Coracina papuensis* (Gmelin)	-	?	-
Ground Cuckoo-shrike	*Coracina maxima* (Rüppell)	-	X	-
White-winged Triller	*Lalage sueurii* (Vieillot)	?	X	X
Olive-backed Oriole	*Oriolus sagittatus* (Latham)	X	?	-
White-breasted Woodswallow	*Artamus leucorhynchus* (Linnaeus)	-	-	-
Masked Woodswallow	*Artamus personatus* (Gould)	-	X	-
White-browed Woodswallow	*Artamus superciliosus* (Gould)	X	X	X
Black-faced Woodswallow	*Artamus cinereus* Vieillot	-	X	-
Dusky Woodswallow	*Artamus cyanopterus* (Latham)	X	?	-
Grey Butcherbird	*Cracticus torquatus* (Latham)	X	-	X
Pied Butcherbird	*Cracticus nigrogularis* (Gould)	-	X	-
Australian Magpie	*Gymnorhina tibicen* (Latham)	-	X	X
Pied Currawong	*Strepera graculina* (Shaw)	X	X	-
Grey Currawong	*Strepera versicolor* (Latham)	X	-	-
Australian Raven	*Corvus coronoides* Vigors & Horsfield	X	X	X
Little Raven	*Corvus mellori* Mathews	-	X	-
Little Crow	*Corvus bennetti* North	-	-	-
White-winged Chough	*Corcorax melanorhamphos* (Vieillot)	?	X	X
Apostlebird	*Struthidea cinerea* Gould	?	X	X
Spotted Bowerbird	*Chlamydera maculata* (Gould)	-	?	-
Singing Bushlark	*Mirafra javanica* Horsfield	-	-	-
Richard's Pipit	*Anthus novaeseelandiae* (Gmelin)	-	-	-
Eurasian Tree Sparrow *	*Passer montanus* (Linnaeus) (TOWNS ONLY)	-	-	-
House Sparrow *	*Passer domesticus* (Linnaeus) (HOUSES ONLY)	-	-	-
Zebra Finch	*Taeniopygia guttata* (Vieillot)	-	X	-
Double-barred Finch	*Taeniopygia bichenovii* (Vigors & Horsfield)	?	X	-
Plum-headed Finch	*Neochmia modesta* (Gould)	-	X	-
Red-browed Finch	*Neochmia temporalis* (Latham)	X	-	-
Diamond Firetail	*Stagonopleura guttata* (Shaw)	X	X	-
Mistletoebird	*Dicaeum hirundinaceum* (Shaw)	X	X	-
White-backed Swallow	*Cheramoeca leucosternus* (Gould)	-	-	-
Welcome Swallow	*Hirundo neoxena* Gould	-	-	-

		1	2	3
COMMON NAMES	**SCIENTIFIC NAMES**	**HILLS**	**F/SLOPE**	**R/CD**
Tree Martin	*Hirundo nigricans* Vieillot	-	-	-
Fairy Martin	*Hirundo ariel* (Gould)	-	-	-
Clamorous Reed-Warbler	*Acrocephalus stentoreus* (Ehrenberg)	-	-	-
Little Grassbird	*Megalurus gramineus* (Gould)	-	-	-
Rufous Songlark	*Cincloramphus mathewsi* Iredale	-	X	-
Brown Songlark	*Cincloramphus cruralis* (Vigors & Horsfield)	-	-	-
Golden-headed Cisticola	*Cisticola exilis* (Vigors & Horsfield)	-	-	-
Silvereye	*Zosterops lateralis* (Latham)	X	X	-
Common Blackbird *	*Turdus merula* Linnaeus	X	-	-
Common Starling *	*Sturnus vulgaris* Linnaeus	-	X	-

MAMMALS

* = Non-indigenous (human assisted) introductions

		1	2	3
COMMON NAMES	**SCIENTIFIC NAMES**	**HILLS**	**F/SLOPE**	**R/CD**
Short-beaked Echidna	*Tachyglossus aculeatus* (Shaw)	X	X	X
Yellow-footed Antechinus	*Antechinus flavipes* (Waterhouse)	X	X	-
Fat-tailed Dunnart	*Sminthopsis crassicaudata* (Gould)	X	X	-
Common Dunnart	*Sminthopsis murina* (Waterhouse)	X	X	-
Koala	*Phascolarctos cinereus* (Goldfuss)	-	-	-
Eastern Pygmy-possum	*Cercartetus nanus* (Desmarest)	-	-	-
Sugar Glider	*Petaurus breviceps* Waterhouse	-	-	-
Squirrel Glider	*Petaurus norfolcensis* (Kerr)	-	-	-
Common Ringtail Possum	*Pseudocheirus peregrinus* (Boddaert)	-	-	-
Feathertail Glider	*Acrobates pygmaeus* (Shaw)	-	-	-
Common Brushtail Possum	*Trichosurus vulpecula* (Kerr)	-	-	-
Western Grey Kangaroo	*Macropus fuliginosus* (Desmarest)	X	X	X(?)
Eastern Grey Kangaroo	*Macropus giganteus* Shaw	X	X	X(?)
Common Wallaroo	*Macropus robustus* Gould	X	-	-
Red Kangaroo	*Macropus rufus* (Desmarest)	-	X	-
Swamp Wallaby	*Wallabia bicolor* (Desmarest)	-	-	-
Grey-headed Flying-fox	*Pteropus poliocephalus* Temminck	X	X	-
Little Red Flying-fox	*Pteropus scapulatus* Peters	X	X	-
Eastern Horseshoe-bat	*Rhinolophus megaphyllus* J.E. Gray	X	X	-
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris* (Peters)	X	X	-
Troughton's Sheathtail-bat	*Taphozous troughtoni* Tate	X	X	-
Southern Freetail-bat	*Mormopterus planiceps* (Peters)	X	X	-
White-striped Freetail-bat	*Nyctinomus australis* (J.E. Gray)	X	X	-
Lesser Long-eared Bat	*Nyctophilus geoffroyi* Leach	X	X	-
Gould's Long-eared Bat	*Nyctophilus gouldi* Tomes	X	X	-
Greater Long-eared Bat	*Nyctophilus timoriensis* (Geoffroy [Saint-Hilaire])	X	X	-
Large-eared Pied Bat	*Chalinolobus dwyeri* Ryan	X	X	-
Gould's Wattled Bat	*Chalinolobus gouldii* (J.E. Gray)	X	X	-
Chocolate Wattled Bat	*Chalinolobus morio* (J.E. Gray)	X	X	-
Inland Broad-nosed Bat	*Scotorepens balstoni* (Thomas)	X	X	-
Large Forest Bat	*Vespadelus darlingtoni* (Allen)	X	X	-
Southern Forest Bat	*Vespadelus regulus* (Thomas)	X	X	-
Little Forest Bat	*Vespadelus vulturnus* (Thomas)	X	X	-

		1	2	3
COMMON NAMES	**SCIENTIFIC NAMES**	**HILLS**	**F/SLOPE**	**R/CD**
Water-rat	*Hydromys chrysogaster* Geoffroy [Saint-Hilaire]	-	-	-
House Mouse *	*Mus musculus* Linnaeus	X	X	X
Black Rat *	*Rattus rattus* (Linnaeus)	X	X	-
Dingo/Dog	*Canis lupus dingo* F.A. Meyer	X	X	X
Fox *	*Vulpes vulpes* (Linnaeus)	X	X	X
Cat *	*Felis catus* Linnaeus	X	X	-
Rabbit *	*Oryctolagus cuniculus* (Linnaeus)	X	X	X
Brown Hare *	*Lepus capensis* Linnaeus	X	X	-
Pig *	*Sus scrofa* Linnaeus	X	X	-
Goat *	*Capra hircus* Linnaeus	X	X	-

Annex 3b: Fauna '8 Part Test'

EPA Act 1979 - S 5A Assessment - '8-Part Test' Significant Effect on Threatened Species, Populations or Ecological Communities, or their Habitats

BIRDS

Malleefowl *Leipoa ocellata*

S.5A of the Act states:
'For the purposes of this Act and, in particular, in the administration of sections 77, 90 and 112, the following factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats.'

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description

Malleefowl are sedentary and territorial. They prefer tall, dense and floristically dense mallee. Nesting occurs in areas of light soils with abundant litter for constructing the egg-incubating mounds (Marchant and Higgins 1993). The immediate area that will be affected by the proposed development comprises an exposed knoll of rock outcropping with areas of clay overlying the rock to the west and south. To the north and east the overlying soil is light sandy loam. The vegetation comprises a light overstorey of mostly White Cypress Pine *Callitris glaucophylla* and, at the time of the site inspection and on account of good seasonal rains, a grassy ground cover in areas of lighter soils to the north and east of the site. This is inappropriate habitat for the Malleefowl. The broader area, the foothill, surrounding the proposed development also comprises mostly White Cypress Pine woodland and has been subject to evidently heavy grazing by rabbits, that are abundant in the area, and by sheep. Elsewhere, on lower-lying country, the native woodland has been extensively cleared for crop growing. Again, this is inappropriate habitat for the Malleefowl. In the area to the north and east of the site on the lighter soils there is a particularly extensive and active rabbit warren. The rabbit warren seems to have been long established in this site covering, I estimate, some 0.3 ha. Associated with the rabbit warren was also evidence, at the time of inspection, of foxes from scats and fox 'tap holes' in the warren. In drier periods I would judge that the high rabbit population in this area would, in combination with sheep, cause excessive over-grazing of this area. The combination of likely effects of the grazing of rabbits, as well as sheep, and of the presence of foxes severely constrains the usefulness of the subject site as habitat for Malleefowl.

Extent of the local population

The Malleefowl is known from the general region (Garnett 1992), however on account of the above-mentioned habitat conditions is highly unlikely to occur in the immediate area of the proposed development.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat of the Malleefowl. The Malleefowl will not be affected.

Likelihood of Extinction
The subject development site does not comprise habitat of the Malleefowl. The Malleefowl will not be affected. Extinction of the local population of the Malleefowl as a consequence of the proposed development is therefore not possible.

Conclusion
It is not possible for this proposed development to disrupt the life cycle of the Malleefowl such that a viable population of this species is likely to be placed at risk of extinction.

(b) **in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,**

For the above-mentioned reasons it is not possible for this proposed development to disrupt the life cycle of the Malleefowl such that a viable population of this species is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

As indicated above, this proposed development is highly unlikely to result in the modification or removal of any habitat of the Malleefowl.

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

There is no habitat of likely use to Malleefowl in the immediate area of this proposed development. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) **whether critical habitat will be affected,**

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) **whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,**

Garnett (1992) lists the following conservation reserves in which the Malleefowl occurs in New South Wales: Budigower NR, Coolbaggie NR, Goulburn River NP,

Ingalba NR, Loughman NR, Mallee Cliffs NP, Nombinnie NR, Pilliga NR, Pulletop NR, Roun Hill NR, Yathong NR.

Conclusion
That the Malleefowl is adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, no impact from the proposed development is likely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Malleefowl.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Marchant and Higgins (1993) indicates that the location of the proposed development to be near the geographic eastern limit of the Malleefowls' distribution at this latitude. East of this location the native vegetation grades to mostly box and/or ironbark woodland characteristic of heavier soils. On the basis of the Malleefowl's known preference of habitat it seems that, pre-settlement, this species was unlikely to occur much further east in this part of New South Wales.

Summary of Conclusions Section 5A Assessment – Malleefowl

As a result of the proposed development:

- It is not possible that the life cycle of the Malleefowl would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Malleefowl, no area of known habitat of this species utilising this site will be modified or removed.
- No areas of known habitat of the Malleefowl will become isolated from currently interconnecting or proximate areas.
- The Malleefowl is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Malleefowl will not be affected.
- The subject site is at the eastern distributional limit of the Malleefowl.

Grey Falcon *Falco hypoleucos*

(a) **in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction**

Habitat Description
Relatively little is known about the Grey Falcon. It is principally a species of the arid inland of temperate and tropical Australia. It seldom occurs in waterless desert, preferring the plains of drainage systems of the arid zone with lightly timbered (eucalypt) watercourses. Here, it is mostly known to breed nesting, usually, in a tall eucalypt near a watercourse. It feeds mostly on birds, particularly parrots and pigeons (Marchant and Higgins 1993). On this information the habitat of the area of the proposed development, a rocky knoll supporting overstorey vegetation of predominantly White Cypress Pine is thus indicated to be unsuitable for the Grey Falcon.

Extent of the local population
The Grey Falcon has an extensive distribution, in excess of one half of the Australian continent. Little is known of its movements (Marchant and Higgins 1993). Any birds that from time to time might occur in the area of the proposed development might possibly form part of the continental population.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat likely to be used by the Grey Falcon. It is highly unlikely that the Grey Falcon will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat likely to be used by the Grey Falcon. The Grey Falcon is highly unlikely to be affected. In view of the known distribution of this species and its preferences of habitat, extinction of the local population of the Grey Falcon, if it occurs in the area, as a consequence of the proposed development is not possible.

Conclusion
It is not possible for this proposed development to disrupt the life cycle of the Grey Falcon such that a viable population of this species is likely to be placed at risk of extinction.

(b) **in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,**

The area of the subject development does not provide likely habitat for the Grey Falcon. In view of this species' known preferences of habitat it is not possible for this proposed development to disrupt the life cycle of the Grey Falcon such that a viable population is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

This proposed development will not modify or remove any habitat of likely use to the Grey Falcon.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,

There is no habitat likely to be used by the Grey Falcon in the immediate area of this proposed development and that will be affected by this development. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

This is a species whose extensive distribution over remote areas of the arid Australian inland means that many of its habitats are possibly unaffected by human related activities such as pastoralism. Such habitats effectively, by default, may serve the purpose of conservation reserves. Conservation reserves in which the species has been recorded include Yathong NR, Round Hill NR, and Warrumbungle NP.

Conclusion
That the Grey Falcon is probably adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, the proposed development is highly unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Grey Falcon.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Marchant and Higgins (1993) indicates that the location of the proposed development to be near the geographic eastern limit of the Grey Falcons' distribution at this latitude. This

location, however, also appears to be about the eastern limit of the kinds of habitat historically used by this species.

Summary of Conclusions Section 5A Assessment – Grey Falcon

As a result of the proposed development:

- It is not possible for the life cycle of the Grey Falcon to be disrupted such that a viable population of this species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Grey Falcon, no area of known habitat of this species utilising this site is likely to be modified or removed.
- No areas of known habitat of the Grey Falcon will become isolated from currently interconnecting or proximate areas.
- The Grey Falcon is probably adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Grey Falcon will not be affected.
- The subject site is at the approximate eastern limit of the Grey Falcon's distribution in southern New south Wales.

Regent Honeyeater *Xanthomyza phrygia*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description

The distribution of the Regent Honeyeater is indicated by Schodde and Tidemann (1986) as south-eastern South Australia, Victoria, eastern New South Wales and south-eastern Queensland. Schodde and Mason (1999) indicate a present day core distribution of northern central and east coastal Victoria, eastern New South Wales and, inland, south-eastern Queensland. It is a species particularly characteristic of White Box *E. albens*, Yellow Box *E. melliodora* and Ironbark *E. sideroxylon* woodlands – woodlands that since settlement and on account of their characteristically more fertile soils (see Boland *et al.* 1984) have been extensively subjected to land clearance (Garnett 1992). The Regent Honeyeater favours areas of heavily flowering eucalypts, feeding on nectar and insects. Whilst the Regent Honeyeater may thus occur within the general area of the subject development the habitat of the site and of the immediately surrounding area of predominantly White Cypress Pine *Callitris glaucophylla,* is not a habitat likely to be utilised by this species.

Extent of the local population

Movement patterns of the Regent Honeyeater are considered irruptive and migratory, shifting north in autumn and winter and south in spring (Schodde and Tidemann

1986). This suggests that any birds possibly from time to time occurring the general region of the subject site may be part of the broader population of this species.

Stages of lifecycle affected by the proposed development
The subject development site comprises habitat of a kind unlikely to be used by the Regent Honeyeater. The Regent Honeyeater is highly unlikely to be affected by the proposed development.

Likelihood of Extinction
The subject development site comprises habitat unlikely to be used by the Regent Honeyeater. The Regent Honeyeater is unlikely to be affected. Extinction of the local population of the Regent Honeyeater as a consequence of the proposed development is therefore highly unlikely.

Conclusion
It is highly unlikely that this proposed development will disrupt the life cycle of the Regent Honeyeater such that the population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

For the reasons outlined above the area of the subject development is unlikely to provide habitat for the Regent Honeyeater. It is unlikely that this proposed development will disrupt the life cycle of the Regent Honeyeater such that a viable population of this species is likely to be significantly compromised.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,

This proposed development is highly unlikely to modify or remove any habitat utilised by the Regent Honeyeater.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,

It is unlikely that the Regent Honeyeater will utilise the kind of habitat that occurs in the immediate area of this proposed development and that will be affected by this development. The subject development is constrained in area. It will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

Garnett (1992) lists the following conservation reserves in which the Regent Honeyeater occurs in New South Wales: Goulburn River NP, Dharug NP, Warrumbungle NP, Blue Mountains NP, Botany Bay NP, Brisbane Water NP, Yuragir NP, Hat Head NP, Morton NP, Weddin Mountains NP, Royal NP, Munghorn Gap NR, Currumbenya NR, Nadgee NR and the Ingalba NR.

Conclusion
That the Regent Honeyeater is adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, the proposed development is unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Regent Honeyeater.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Schodde and Tidemann (1986) indicates that the location of the proposed development is approximately on the western boundary of the Regent Honeyeater's distribution in eastern New South Wales but outside what is indicated by Schodde and Mason (1999) to be the species' present day 'core distribution' in this part of New South Wales.

Summary of Conclusions Section 5A Assessment – Regent Honeyeater

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Regent Honeyeater would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Regent Honeyeater, it is highly unlikely that any area of habitat utilised by this species will be modified or removed.
- No areas of known habitat of the Regent Honeyeater will become isolated from currently interconnecting or proximate areas.

- The Regent Honeyeater is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Regent Honeyeater will not be affected.
- The subject site is at the western geographic limit the Regent Honeyeater's distribution in New South Wales at the latitude of the subject site.

Painted Honeyeater *Grantiella picta*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
The Painted Honeyeater is distributed over most of inland eastern Australia including central Queensland and eastern Northern Territory. It is a highly nomadic species and particularly favours mistletoe infested trees. It feeds on nectar and fruit of mistletoe and on insects (Blakers *et al.* 1984; Schodde and Tidemann 1986; Schodde and Mason 1999). The vegetation of the site of the proposed development comprises a light overstorey of mostly White Cypress Pine *Callitris glaucophylla* with no mistletoe in the trees on the site itself and only scattered specimens of *Amyema linophyllum* in trees of the surrounding woodland (N. Taws *pers. comm.* 21st December 1999). It is therefore unlikely that the Painted Honeyeater occurs in the area or may utilise area of the subject site itself.

Extent of the local population
The extent of the local population of the Painted Honeyeater is not known. Since this species is highly nomadic (Schodde and Tidemann 1986), any individuals that might occur in the area of the proposed development could probably be considered as part of a broad regional population of this species.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat of the Painted Honeyeater. The Painted Honeyeater will not be affected.

Likelihood of Extinction
The subject development site does not comprise habitat of the Painted Honeyeater. The Painted Honeyeater will not be affected. Extinction of the local population of the Painted Honeyeater as a consequence of the proposed development is therefore highly unlikely.

Conclusion
It is not possible for this proposed development to disrupt the life cycle of the Painted Honeyeater such that a viable population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted

such that the viability of the population is likely to be significantly compromised,

For the above-mentioned reasons it is highly unlikely that this proposed development might disrupt the life cycle of the Painted Honeyeater such that a viable population of this species is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

As indicated above, it is highly unlikely that this proposed development will modify or remove any habitat utilised by the Painted Honeyeater.

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

There is minimal habitat of likely use to the Painted Honeyeater in the general area of this proposed development and this habitat is unlikely to be affected. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) **whether critical habitat will be affected,**

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) **whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,**

Resource Strategies Pty Ltd (1997) list the following conservation reserves in which the Painted Honeyeater occurs in New South Wales: Cocoparra NP, Ingalba NP, Weddin Mountains NP, Round Hill NR, Yathong NR, Willandra NP, Wollemi NP, Goulburn River NP and Warrumbungle NP.

Conclusion
That the Painted Honeyeater is adequately represented in conservation reserves in New South Wales.

(g) **whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,**

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment no impact from the proposed development is likely to have the potential to threaten the survival

or evolutionary development of the regional or local population of the Painted Honeyeater.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Schodde and Tidemann (1986) and Schodde and Mason (1999) indicates that the location of the proposed development to be near well within the southern limit of the Painted Honeyeaters' distribution in eastern Australia.

Summary of Conclusions Section 5A Assessment – Painted Honeyeater

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Painted Honeyeater might be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Painted Honeyeater, it is highly unlikely that habitat of this species will be modified or removed.
- No areas of known habitat of the Painted Honeyeater are likely to become isolated from currently interconnecting or proximate areas.
- The Painted Honeyeater is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Painted Honeyeater is highly unlikely to be affected.
- The subject site is well within the southern distributional limit of Painted Honeyeater.

Gilbert's Whistler *Pachycephala inornata*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description

Gilbert's Whistler is distributed across most of southern Australia west of the Great Dividing Range. It is mainly a species inhabiting understorey shrubs in otherwise lightly timbered country, including mallee, where it forages for arthropods (Schodde and Tidemann 1986, Schodde and Mason 1999). The site of the proposed development comprises an exposed knoll of rock outcropping with areas of clay overlying the rock to the west and south. To the north and east the overlying soil is light sandy loam. The vegetation comprises a light overstorey of mostly White Cypress Pine *Callitris glaucophylla* and, at the time of the site inspection and on account of good seasonal rains, a grassy ground cover in areas of lighter soils to the north and east of the site. This is inappropriate habitat for the Gilbert's Whistler. The broader area, the foothill, surrounding the proposed development also comprises mostly White Cypress Pine woodland and has been subject to evidently heavy grazing by rabbits, that are abundant in the area, and by sheep. There is however in

patches a dense understorey shrub layer of *Acacia*, predominantly *A. doratoxylon* and *A. oswaldii* (N. Taws *pers. comm.* 21st December 1999). The Gilbert's Whistler may therefore occur in the area.

Extent of the local population
The extent of the local population of the Gilbert's Whistler is not known. Individuals of this species are thought to be generally sedentary (Schodde and Tidemann 1986). Although the species is known from the general region (Resource Strategies Pty Ltd 1997) and may occur is the general area of the subject site, on account of its preferences of habitat it is highly unlikely to utilise habitat of the subject site itself.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat of the Gilbert's Whistler. It is highly unlikely that the Gilbert's Whistler will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat preferred by the Gilbert's Whistler. The Gilbert's Whistler is highly unlikely to be affected. Extinction of the local population of the Gilbert's Whistler as a consequence of the proposed development is therefore highly unlikely.

Conclusion
It is highly unlikely that this proposed development may disrupt the life cycle of the Gilbert's Whistler such that a viable population of this species is likely to be placed at risk of extinction.

(b) **in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,**

For the above-mentioned reasons, it is highly unlikely that this proposed development may disrupt the life cycle of the Gilbert's Whistler such that a viable population of this species is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

As indicated above it is highly unlikely that this proposed development might modify or remove any potential habitat of the Gilbert's Whistler.

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

The habitat of likely use to the Gilbert's Whistler in the general area of this proposed development is unlikely to be affected. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

Resource Strategies Pty Ltd (1997) list the following conservation reserves in which the Gilbert's Whistler occurs in New South Wales: Cocoparra NP, Ingalba NP, Weddin Mountains NP, Round Hill NR, Yathong NR, Woggoon NR.

Conclusion
That the Gilbert's Whistler is adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, the proposed development is unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Gilbert's Whistler.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Schodde and Tidemann (1986) and Schodde and Mason (1999) indicates that the location of the proposed development to be near the geographic eastern limit of the Gilbert's Whistlers' distribution. East of this location the native vegetation grades to mostly box and/or ironbark woodland characteristic of heavier and more fertile soils than those of the subject area. On the basis of the Gilbert's Whistler's known preference of habitat it seems that, pre-settlement, this species was unlikely to occur much further east in this part of New South Wales.

Summary of Conclusions Section 5A Assessment – Gilbert's Whistler

As a result of the proposed development:

- It is not possible for the life cycle of the Gilbert's Whistler to be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Gilbert's Whistler, no area of known habitat of this species utilising this site is likely to be modified or removed.

- No areas of known habitat of the Gilbert's Whistler will become isolated from currently interconnecting or proximate areas.
- The Gilbert's Whistler is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Gilbert's Whistler will not be affected.
- The subject site is at the eastern distributional limit of Gilbert's Whistler.

Superb Parrot *Polytelis swainsonii*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
The Superb Parrot occurs mostly in northern, central Victoria and New South Wales, breeding along the watercourses of the Murray, Edward, Murrumbidgee and Lachlan Rivers and the woodlands of the western slopes of the Great Dividing Range between Canberra, Cowra, Temora and Gundagai. The trees in which it nests are usually large, height range of up to 50 metres, and with nesting hollows mostly within the height range of 10-20 metres. The tree species in which it has been recorded nesting include River Red Gum *E. camaldulensis*, Blakely's Red *Gum E. Blakelyi*, Narrow-leaved Box *E. microcarpa* and Inland Red Box *E. intertexta*. The Superb Parrots' diet is varied, comprising a broad range of seeds of grasses, herbaceous plants, berries, nectar, flowers and insects. Its habit of feeding on waste grain on roadsides results in it often being killed by motor vehicles on country roads (Higgins 1999). Whilst the Superb Parrot thus occurs within the general area of the subject development the habitat of the site and of the immediately surrounding area of predominantly White Cypress Pine *Callitris glaucophylla,* is not a habitat likely to be utilised by this species.

Extent of the local population
The total breeding population of the Superb Parrot is thought to be less than 5000 pairs (Higgins 1999).

Stages of lifecycle affected by the proposed development
The subject development site comprises habitat of a kind unlikely to be used by the Superb Parrot. The Superb Parrot is highly unlikely to be affected by the proposed development.

Likelihood of Extinction
The subject development site comprises habitat unlikely to be used by the Superb Parrot. The Superb Parrot is unlikely to be affected. Extinction of the local population of the Superb Parrot as a consequence of the proposed development is therefore highly unlikely.

Conclusion
It is highly unlikely that this proposed development will disrupt the life cycle of the

Superb Parrot such that the population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

The area of the subject development is unlikely to provide habitat for the Superb Parrot. It is unlikely that this proposed development will disrupt the life cycle of the Superb Parrot such that a viable population of this species is likely to be significantly compromised.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,

This proposed development is highly unlikely to modify or remove any habitat utilised by the Superb Parrot.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,

It is unlikely that the Superb Parrot utilises the kinds of habitat that occur in the immediate area of this proposed development and that will be affected by this development. The subject development is constrained in area. It will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

Garnett (1992) lists the following conservation reserves in which the Superb Parrot occurs in New South Wales: Conimba NP, Weddin Mountains NP, Warrumbungle NP, Cocoparra NP, Ingalba NR, Narranderra NR, Pilliga NR, Cocoparra NR.

Conclusion
That the Superb Parrot is adequately represented in conservation reserves in New South Wales.

(g) **whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,**

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the above information the proposed development is highly unlikely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Superb Parrot.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Higgins (1999) indicates that the location of the proposed development to be approximately at the geographic centre the Superb Parrot's distribution in mainland Australia. Therefore, the subject site is not at the limit of the Superb Parrot's distribution.

Summary of Conclusions Section 5A Assessment – Superb Parrot

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Superb Parrot would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Superb Parrot, it is highly unlikely that any area of habitat utilised by this species will be modified or removed.
- No areas of known habitat of the Superb Parrot will become isolated from currently interconnecting or proximate areas.
- The Superb Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Superb Parrot will not be affected.
- The subject site is not at the limit of the Superb Parrot's distribution.

Swift Parrot Lathamus discolour

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
The Swift Parrot breeds in Tasmania between October and March, migrating to the south-eastern mainland from April to September (Higgins, 1999). Its breeding requirements are therefore not relevant to the subject development. On the south-eastern mainland flocks of the Swift Parrot may concentrate where eucalypts are flowering profusely and there is an abundance of lerps, manna and insects (Higgins, 1999). The Swift Parrot is recorded using a broad range of eucalypts for foraging in south-eastern mainland Australia including mainly species such as Blue Gum *E. globulus*, Swamp Gum *E. ovata*, Yellow Box *E. melliodora*, White Box, *E. albens* and Red Ironbark *E. tricarpa*. In relation to the subject development it has been

recorded utilising Narrow-leaved Box *E. microcarpa* but not Dwyer's Red Gum *E. dwyeri* (Higgins 1999). Dwyer's Red Gum occurs, but is a minor component of the overstorey flora on the proposed development site. Narrow-leaved Box occurs within the general area of the subject development but not on the site itself (N. Taws *pers. comm.* 16th December 1999). The habitat of the subject site is therefore inappropriate for, and highly unlikely to be used by, the Swift Parrot.

Extent of the local population
The Swift Parrot is a migratory species likely to occur seasonally and from time to time in the general region of the subject development. Any birds occurring in the area of the subject development can probably be considered to form portion of the Australian population of this species. In this regard Higgins (1999) reports that the estimated total breeding population of this species in 1995-96 was 940 pairs.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat of a kind likely to be used by the Swift Parrot. It is therefore highly unlikely that the Swift Parrot will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat likely to be used by the Swift Parrot. The Swift Parrot is highly unlikely to be affected. Extinction of the local population of the Swift Parrot as a consequence of the proposed development is therefore highly unlikely.

Conclusion
It is highly unlikely that this proposed development may disrupt the life cycle of the Swift Parrot such that a viable population of this species is likely to be placed at risk of extinction.

(b) **in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,**

The area of the subject development does not provide habitat likely to be used by the Swift Parrot. It is highly unlikely that this proposed development may disrupt the life cycle of the Swift Parrot such that a viable population of this species is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

It is highly unlikely that this proposed development will modify or remove any habitat of potential use to the Swift Parrot.

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

There is no habitat likely to be used by the Swift Parrot in the immediate area of this proposed development and that may be affected by this development. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

Garnett (1992) lists the following conservation reserves in which the Swift Parrot occurs in New South Wales: Ku-ring-gai Chase NP, Botany Bay NP, Brisbane Water NP, Yuraygir NP, Wollemi NP, Cocoparra NP, Morton NP, Royal NP, Warrumbungle NP, Barren Grounds NR, Ingalba NR, Goobang NP, Munghorn Gap NR, Cocoparra NR.

Conclusion
That the Swift Parrot is adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, it is highly unlikely that the proposed development may have the potential to threaten the survival or evolutionary development of the regional or local population of the Swift Parrot.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Higgins (1999) indicates that the location of the proposed development to be approximately at the geographic centre the Swift Parrot's distribution in mainland Australia. Therefore, the subject site is not at the limit of the Swift Parrot's distribution.

Summary of Conclusions Section 5A Assessment – Swift Parrot

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Swift Parrot may be disrupted such that a viable population of the species may be placed at the risk of extinction.

- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Swift Parrot, no area of known habitat of this species utilising this site is likely to be modified or removed.
- No areas of known habitat of the Swift Parrot will become isolated from currently interconnecting or proximate areas.
- The Swift Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Swift Parrot will not be affected.
- The subject site is not at the limit of the Swift Parrot's distribution.

Turquoise Parrot Noephema pulchella

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
The Turquoise Parrot's preferred habitats are woodlands and open forests with a ground cover of grasses or sometimes a low understorey of shrubs. There is usually a variety of eucalypts including White Box *E. albens*, Blakeley's Red Gum *E. blakeleyi* Yellow Box and *E. melliodora* and Red Box, *E. polyanthemos*. The species also occurs in savanna woodland and riparian woodlands and forests including those on alluvial flats with stands of River Red Gum *E. camaldulensis* and Swamp *Gum E. camphora*. These characteristics of habitat are indicative of a strong preference by the Turquoise Parrot for habitats of high quality soils – habitats that since settlement have been sought for pastoral and agricultural development and therefore have been extensively cleared (Higgins 1999).

Extent of the local population
Little is known of the movements of the Turquoise Parrot. Though the species has an extensive distribution in eastern New South Wales and south-eastern Queensland, groups or small flocks are thought to be relatively sedentary (Higgins 1999). It has been recorded in the Cocoparra NP and therefore may occur in the area of the proposed development site.

Stages of lifecycle affected by the proposed development
The subject development site with its overstorey flora of predominantly White Cypress Pine *Callitris glaucophylla,* which is also extensively represented in the general area, is unlikely to be used by the Turquoise Parrot. It is highly unlikely that the Turquoise Parrot will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat likely to be used by the Turquoise Parrot. The Turquoise Parrot is highly unlikely to be affected. In view of the known distribution of this species and its preference of habitat extinction of the population of the Turquoise Parrot as a consequence of the proposed development is highly unlikely.

Conclusion
It is highly unlikely that the proposed development will disrupt the life cycle of the Turquoise Parrot such that a viable population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

The area of the subject development does not provide habitat of likely use to the Turquoise Parrot. In view of this species' known preference of habitat comprising a suite of eucalypt species characteristic of soils of higher fertility than that of the subject site, it is highly unlikely that this proposed development will disrupt the life cycle of the Turquoise Parrot such that a viable population is likely to be significantly compromised.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,

This proposed development is highly unlikely to modify or remove any habitat of likely use to the Turquoise Parrot.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,

The subject development is constrained in area. The vegetation type of the subject site is extensively represented in the general area. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

The Turquoise Parrot has an extensive distribution in eastern New South Wales and south-eastern Queensland. Conservation reserves in which the species has been recorded include Cocoparra NP, Yathong NR, Round Hill NR, Wedden Mountains NP, Conimba NP, Goobang NP, Warrumbungle NP, Goulburn River NP, Wollemi NP, Blue Mountains NP, Nattai, NP, Morton NP, Budderoo NP.

Conclusion
That the Turquoise Parrot is probably adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the above assessments, no impact from the proposed development is likely to have the potential to threaten the survival or evolutionary development of the regional or local population of the Turquoise Parrot.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Higgins (1999) shows the location of the proposed development to be well within the southern boundary of the Turquoise Parrot's distribution in south-eastern Australia.

Summary of Conclusions Section 5A Assessment – Turquoise Parrot

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Turquoise Parrot would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Turquoise Parrot, it is highly unlikely that any habitat likely to be used by this species will be modified or removed.
- No areas of known habitat of the Turquoise Parrot will become isolated from currently interconnecting or proximate areas.
- The Turquoise Parrot is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Turquoise Parrot will not be affected.
- The subject site is well within the southern boundary of the Turquoise Parrot's distribution in south-eastern Australia.

MAMMALS

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description
Very little is known about the Yellow-bellied Sheathtail-bat. It is widely distributed, occurring over most of eastern and northern Australia. It is a fast, high flying bat, typically feeding above the canopy of forests and woodlands. Evidently for these reasons few specimens of this species have been collected (Richards 1998). This species' rarity may thus be more apparent than real. In central coastal Queensland a survey of a broad range of environments using bat-detectors found this species to predominantly utilise the more densely forested habitats (CSIRO 1993). On this information the habitat characteristics of the area of the proposed development, of overstorey vegetation of predominantly White Cypress Pine on a rocky knoll, indicate that the site is likely to be little, if at all, potential use to Yellow-bellied Sheathtail-bat.

Extent of the local population
The Yellow-bellied Sheathtail-bat has an extensive distribution, approximately two thirds of the Australian continent. As this is a fast, high flying species any bats that from time to time might occur in the area of the proposed development might possibly form part of a broad regional population.

Stages of lifecycle affected by the proposed development
The subject development site does not comprise habitat likely to be used by the Yellow-bellied Sheathtail-bat. It is highly unlikely that the Yellow-bellied Sheathtail-bat will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat likely to be used by the Yellow-bellied Sheathtail-bat. Individuals of this species evidently forage nightly over an area of possibly many square kilometres. The Yellow-bellied Sheathtail-bat is therefore highly unlikely to be affected. In view of the known broad distribution of this species and its preferences of habitat, extinction of the population of the Yellow-bellied Sheathtail-bat as a consequence of the proposed development is highly unlikely.

Conclusion
It is not possible for this proposed development to disrupt the life cycle of the Yellow-bellied Sheathtail-bat such that a viable population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

The area of the subject development does not provide likely habitat for the Yellow-bellied Sheathtail-bat. In view of this species' known preferences of habitat it is highly unlikely that this proposed development may disrupt the life cycle of the Yellow-bellied Sheathtail-bat such that a viable population is likely to be significantly compromised.

(c) **in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,**

This proposed development will not modify or remove any habitat of likely use to the Yellow-bellied Sheathtail-bat.

(d) **whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,**

There is no habitat of likely to be use to the Yellow-bellied Sheathtail-bat in the immediate area of this proposed development that may be affected by this development. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) **whether critical habitat will be affected,**

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) **whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,**

This is a species whose extensive distribution over approximately two thirds of the Australian continent means that many of its habitats are possibly unaffected or minimally affected by many human related activities. In inland New South Wales this species is known from Sturt NP, Kinchega NP, Nocoleche NP, and the Willandra Lakes World Heritage Region.

Conclusion
That the Yellow-bellied Sheathtail-bat is probably adequately represented in conservation reserves in New South Wales.

(g) **whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,**

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, it is highly unlikely that the proposed development has the potential to threaten the survival or evolutionary development of the regional or local population of the Yellow-bellied Sheathtail-bat.

(h) **whether any threatened species, population or ecological community is at the limit of its known distribution,**

Inspection of the distributional information on this species provided by Richards (1998) indicates that the location of the proposed development to be well within the Yellow-bellied Sheathtail-bats' distribution in eastern Australia.

Summary of Conclusions Section 5A Assessment – Yellow-bellied Sheathtail-bat

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Yellow-bellied Sheathtail-bat would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Yellow-bellied Sheathtail-bat, it is highly unlikely that habitat of likely use to this species will be modified or removed.
- No areas of known habitat of the Yellow-bellied Sheathtail-bat will become isolated from currently interconnecting or proximate areas.
- The Yellow-bellied Sheathtail-bat is probably adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Yellow-bellied Sheathtail-bat will not be affected.
- The subject site is well within the Yellow-bellied Sheathtail-bat's distribution in eastern Australia.

Greater Long-eared Bat *Nyctophilus timoriensis*

(a) in the case of a threatened species, whether the life cycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Habitat Description

Very little is known about the Greater Long-eared Bat. The taxonomy of the species is at present uncertain. It has a broad distribution, comprising southern central Queensland, central western New South Wales, north western Victoria and south Australia. It utilises a broad range of habitats including tall forests, River Red Gum forests, box/ironbark/*Callitris* open forests and woodland and mallee (Parnaby 1998; Duncan *et al.* 1999). The species is thought to forage for arthropods gleaned from substrates (Resource Strategies Pty Ltd 1997). On this information the habitat of the area of the proposed development, a rocky knoll supporting overstorey vegetation of predominantly White Cypress Pine which provides few if any tree hollows, is thus likely to be little, if at all, utilised by the Greater Long-eared Bat.

Extent of the local population

The Greater Long-eared Bat has an extensive distribution, approximately two fifths of the Australian continent. It is not known to what extend individuals of this species may move within the limits of this distribution.

Stages of lifecycle affected by the proposed development

The subject development site does not comprise habitat likely to be used by the

Greater Long-eared Bat. It is highly unlikely that the Greater Long-eared Bat will be affected.

Likelihood of Extinction
The subject development site does not comprise habitat likely to be used by the Greater Long-eared Bat. The Greater Long-eared Bat is highly unlikely to be affected. In view of the known broad distribution of this species extinction of the population of the Greater Long-eared Bat as a consequence of the proposed development is Highly unlikely.

Conclusion
It is highly unlikely that this proposed development may disrupt the life cycle of the Greater Long-eared Bat such that a viable population of this species is likely to be placed at risk of extinction.

(b) in the case of an endangered population, whether the life cycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised,

The area of the subject development does not provide likely habitat for the Greater Long-eared Bat. In view of this species' known preferences of habitat it is highly unlikely that this proposed development may disrupt the life cycle of the Greater Long-eared Bat such that a viable population is likely to be significantly compromised.

(c) in relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of the known habitat is to be modified or removed,

This proposed development will not modify or remove any habitat of likely use to the Greater Long-eared Bat.

(d) whether an area of known habitat is likely to become isolated from currently interconnecting proximate areas of habitat for a threatened species, population or ecological community,

There is little habitat likely to be used by the Greater Long-eared Bat in the immediate area of this proposed development that will be affected by this development. The subject development will not isolate currently interconnecting proximate areas of habitat.

(e) whether critical habitat will be affected,

Critical habitats are yet to be defined in the Threatened Species Conservation Act 1995.

(f) whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region,

This is a species whose extensive distribution over approximately two fifths of the Australian continent means that many of its habitats are possibly unaffected or minimally affected by many human related activities. In inland New South Wales this species is known from Goulburn River NP, Monabalai NR, Yathong NR, Budigower NR, Woggon NR, Mungo NP, Cocoparra NP, Ben Halls Gap NP, Pilliga NR, Goobang NP, Warrumbungle NP and The Rock NR.

Conclusion
That the Greater Long-eared Bat is adequately represented in conservation reserves in New South Wales.

(g) whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process,

Terrestrial threatening processes that have been gazetted to date (bush rock removal, invasion by Bitou Bush and fox predation) are not expected as a result of this proposed development.

Conclusion
In view of the information given in the above sections of this assessment, it is highly unlikely that the proposed development may have the potential to threaten the survival or evolutionary development of the regional or local population of the Greater Long-eared Bat.

(h) whether any threatened species, population or ecological community is at the limit of its known distribution,

Inspection of the distributional information on this species provided by Parnaby (1998) indicates the location of the proposed development to be well within the Greater Long-eared Bats' distribution in eastern Australia.

Summary of Conclusions Section 5A Assessment – Greater Long-eared Bat

As a result of the proposed development:

- It is highly unlikely that the life cycle of the Greater Long-eared Bat would be disrupted such that a viable population of the species was placed at the risk of extinction.
- In relation to the regional distribution of habitat providing opportunity for foraging and for breeding of the Greater Long-eared Bat, it is highly unlikely that habitat of likely use to this species will be modified or removed.
- No areas of known habitat of the Greater Long-eared Bat will become isolated from currently interconnecting or proximate areas.
- The Greater Long-eared Bat is adequately represented in conservation reserves in New South Wales.
- The survival or evolutionary development of the local or regional population of the Greater Long-eared Bat will not be affected.
- The subject site is well within the Greater Long-eared Bat's distribution in Australia.

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ANNEX 4: ABORIGINAL HERITAGE

Wiradjuri Branch

New South Wales Aboriginal Land Council

153 Docker Street, Wagga Wagga 2650. P.O. Box 5515, Wagga Wagga 2650
Telephone: (069) 21 6544 - 21 6339, Fax: (069) 21 7903

Colleen Hillman
Company Secretary
H.R.D. READYMIX PTY LTD
P.O. Box 414
LEETON NSW 2705

Dear Colleen

RE: ABORIGINAL SITES SURVEY OF PROPOSED QUARRY AT PORTIONS 4,23, 31&32 PARISH OF SANDY CREEK, COUNTY OF COOPER

I write to confirm that I did not find any evidence of Aboriginal Sites within the above proposed development areas (as indicated in attached map) during a survey which I carried out on the 9 November 1999, and as discussed with Robert Hillman on site, that I have no objections against the proposed development.

Should you require any further information, then please do not hesitate to contact me at the above office.

Yours faithfully

RSWilliams.

Roland Williams
SITES CURATOR
11 November 1999

ANNEX 5

REPORT 10-1012-R1

Tin Pot Hill Quarry
Noise and Transportation Impact Assessment

Prepared for

Environmental Research & Information Consortium
PO Box 179
DEAKIN WEST ACT 2600

27 January 2000

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Tin Pot Hill Quarry
Noise and Transportation Impact Assessment

Quality System

Quality Endorsed Company
ISO 9001 Lic 3236
Standards Australia

Richard Heggie Associates Pty Ltd operates under a Quality System which has been certified by Quality Assurance Services Pty Limited to comply with all the requirements of ISO 9001:1994 "Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing" (Licence No 3236).

This document has been prepared in accordance with the requirements of that System.

AAAC
MEMBER FIRM OF THE ASSOCIATION OF AUSTRALIAN ACOUSTICAL CONSULTANTS

Richard Heggie Associates Pty Ltd is a Member Firm of the Association of Australian Acoustical Consultants.

Reference	Status	Date	Prepared	Checked	Authorised
10-1012-R1	Revision 0	27 January 2000	DL	DG	

TABLE OF CONTENTS

1 INTRODUCTION

A quarry is proposed to be operated at Tin Pot Hill approximately 20 km north-east of Barellan in Bland Shire. The site on which the quarry is to be located currently operates as a sheep station. The proposed quarrying operations will be conducted concurrently with the existing use of the land.

It is proposed that the quarry would supply hardrock aggregate at the rate of approximately 10,000 tonnes per annum. Assuming 200 working days per year, normally two truck loads of material would leave the site per day.

There are four residential properties in the immediate vicinity of the proposed quarry site as shown in **Figure 1.** These properties are:

- The Homestead - 750 m east south-east of the quarry site
- Woodlands - 1.4 km south
- Glenisla - 1.2 km north north-east
- Glenburnie - approximately 3 km north north-east

Glenisla however is located on a property owned by the proponent and will be demolished.

2 PROJECT DESCRIPTION

2.1 Overview

The hardrock extracted from the subject quarry will be crushed and sorted by size on site and subsequently transported by truck either to Leeton (for use in concrete) or to various regional areas for use in road construction and maintenance.

The project site was a former quarry which operated approximately 20 years ago.

2.2 Quarrying Procedure and Plant Items

Drilled blast techniques will be used to fragment up the hardrock. The material will then be crushed, sieved and stockpiled prior to despatch by truck from the site.

Table 2.2.1 presents a list of plant items and associated sound power levels that will be used in the various operations at the quarry.

Table 2.2.1 Plant Items sand Associated Sound Power Levels

Plant Item		Sound Power Level
Mobile Plant	Frontend loaders (2 off)	107 dBA
	Road Truck	111 dBA
	Drill (for blasting)	115 dBA
Crushing and Sieving	Feed bin - $20m^3$	Total for Crushing and Sieving plant 116 dBA
	Mechanical vibrating feeder	
	42 x 32 Jaw crusher	
	Scalping screen	
	Transfer conveyor	
	Crusher	
	Sizing screens	
	Transfer and stockpile conveyors	
	1,200 g Cone	
Fixed Plant	Generating plant	111 dBA

There are two personnel who will operate the various plant items at the quarry whilst a third person is involved with the product transportation.

2.3 Traffic Flows on Surrounding Roads

The roads in the immediate vicinity of the quarry would be classified as local rural roads and would carry only isolated traffic.

3 EXISTING ACOUSTICAL ENVIRONMENT

There have been no acoustical surveys conducted to determine the background noise level at any of the locations in the immediate vicinity of the development site. In order to estimate the background noise, has been made to Australia Standard AS 1055.3 (1997), "Acoustics - Description and Measurement of Environmental Noise, Part 3 Acquisition of Data Pertinent to Land Use".

This Standard presents guidance in estimating the background noise levels for areas of various land uses. The area category with the lowest ambient noise are "areas with negligible transportation (Noise Area Category R1)". In this category, the average background A-weighted sound pressure levels for the various times of day, Monday to Saturday are presented in **Table 3.1.**

Table 3.1 Estimated Outdoor Background Noise Levels (AS1055.3)

Monday to Saturday		
Time (hrs)	**0700 to 1800**	**1800 to 2200**
Areas with negligible transportation	40 dBA	35 dBA

For the purpose of this assessment, a conservative background noise level of 35 dBA has been assumed, given that the operations will be restricted to 0700 hours to 1700 hours, Monday to Saturday.

4 AIRBORNE NOISE IMPACT ASSESSMENT PROCEDURES

4.1 Airborne Noise Emission General Objectives

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the Environment Protection Authority (EPA) which administers the Noise Control Act, 1975. In implementing its environmental noise control policy, the EPA has two broad objectives:

a. That the noise from any single source does not intrude greatly above the prevailing background noise level.

b. That the background noise level does not exceed the level appropriate for the particular locality and land use.

4.2 Quarry Operation Noise Emission Design Goal

To assist in balancing possibly adverse effects on individuals and potential benefits to the broader community arising from infrastructure development and resource use (especially in the light of its social worth or as a result of government decisions), the Environment Protection Authority (EPA) has drafted a schedule of recommended L_{A90} background noise levels for various land-use categories. An extract from the schedule relating to the three most stringent classifications appears in **Table 4.2.1**.

Table 4.2.1 EPA Recommended Outdoor Background Noise Levels

Zoning Description	Time Period	Recommended Limit - L_{A90}	
		Acceptable	Maximum
Residences in Rural Areas (approximately R1 in AS 1055)	Day Night	45 dBA 35 dBA	50 dBA 40 dBA
Residences in Residential Areas (approximately R1 - R2 in AS 1055)	Day Night	45 dBA 35 dBA	50 dBA 40 dBA
Residential area on a busy road or near an industrial area (approximately R2 - R3 in AS 1055)	Day Night	50 dBA 40 dBA	55 dBA 45 dBA

Notes: 1 For Monday to Saturday, "day" is defined at 7.00 am to 10.00 pm
2 On Sundays and Public Holidays, "day" is defined as 8.00 am to 10.00 pm

In order to satisfy Item a. of **Section 4.1**, the EPA recommends that the L_{A10} noise level contribution from the source or sources under consideration should not exceed the L_{A90} background level by more than 5 dBA.

In localities where there is likely to be ongoing industrial or commercial development, consideration also needs to be given to the cumulative effects of noise from successive development in order to avoid what is known as a "creeping background noise" effect.

For quarrying operations where only a few plant items are being used, experience indicates that the L_{A10} design goal is usually the controlling criterion.

The predicted L_{A90} ambient noise environment in the vicinity of the project site are presented in **Table 3.1** On the basis of the estimated minimum repeated L_{A90} ambient noise levels and in accordance with the EPA's Environmental Noise Control Manual (Chapter 20), the acceptable L_{A10} contributed noise level design goal for the proposed hours of daytime operation is 40 dBA (ie 35 dBA + 5 dBA).

4.3 Road Traffic Noise Design Goals

In the vicinity of privately owned property, the noise assessment procedure adopted for trucks associated with the quarry operations is as outlined in **Section 4.2**, that is, the predicted L_{A10} noise contributions are added to the predicted L_{A10} noise level of the items of mobile equipment and processing plant and compared to the design goal.

Away from the quarrying operations, when the trucks travel on public roads (or when the trucks are on a private access road where the noise emission characteristics would be perceived in a similar fashion to normal traffic), different criteria apply for truck noise impact assessment.

The Environment Protection Authority (EPA) has recently released a document entitled "*Environmental Criteria for Road Traffic Noise*". This document describes thirteen types of development and for which it nominates daytime and night-time target noise criteria. Noise from the road traffic associated with movements to and from the subject quarry would best be described as *"13. Land use developments with the potential to create additional traffic on local roads"*. Here, the EPA recommend that the daytime and night-time noise criteria are set to an $L_{Aeq(1hour)}$ level of 55 dBA and 50 dBA respectively. However, where the criterion is already exceeded and where it is feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Notwithstanding the above, the EPA document states that traffic associated with a development should not lead to an increase in the existing noise levels of more than 2 dBA.

The EPA's preferred hours for truck movements, as nominated in their Environmental Noise Control Manual, are presented in **Table 4.3.1**.

Table 4.3.1 EPA's Preferred Hours for Truck Movements

Frequency of Vehicle Movement	Preferred Hours of operation	
	Monday to Saturday	**Sunday and Public Holidays**
Normal frequency	0700 hrs to 1800 hrs	Minimal movement, subject to individual assessment
At substantially reduced frequency	0600 hrs to 0700 hrs 1800 hrs to 2200 hrs	0800 hrs to 1800 hrs
Minimal or isolated occurrence	2200 hrs to 0600 hrs	1800 hrs to 0800 hrs

5 ASSESSMENT OF AIRBORNE NOISE IMPACTS

5.1 General

In order to determine the acoustical impact of the quarry and product transportation operations, a computer model was developed incorporating the most significant noise sources, the 3-dimensional profile of the surrounding terrain and the location of the nearby potentially affected receivers.

The noise model was prepared using the SoundPLAN computer model, a commercial suite of programs which uses CONCAWE algorithms.

The noise model calculates the maximum contribution in each octave band from each of the sources to the receiver locations considered most potentially affected by the quarry project.

Based on field measurements of noise emissions from similar projects, the difference between the maximum noise level and the average maximum (L_{A10}) noise levels can be up to 10 dBA, depending upon the number of plant items and mobile equipment, the relative contributions and variation in the intensity of the work. The difference between the maximum overall and L_{A10} noise levels for small quarrying projects is greater than the difference arising from large operations as the former is more sporadic and variable in nature.

For the plant and equipment items detailed in **Section 2.2**, a conservative reduction of 5 dBA has been applied to convert the predicted maximum noise levels to an operational L_{A10} noise level.

5.2 Meteorological Parameters

There are no meteorological stations in the immediate area of the project site from which hourly wind speed directions or sigma-theta (used for the stability classification) data can be obtained. As a result, calculations have been conducted that incorporate a noise enhancing wind of 2m/s blowing from the source to each of the receivers and a temperature inversion profile of 2°/100m.

5.3 CONCAWE Noise Modelling Methodology

The predicted noise emission level for the selected operational scenario to the nearest potentially affected receiver have been calculated with the following meteorological parameters:

a. During calm daytime conditions (ie 20° air temperature, 70% relative humidity, zero wind speed and 0°C\100 m temperature gradient).

b. During conditions of prevailing winds, (2 m/s wind speed blowing in all directions simultaneously to all the residents, 20°C air temperature, 70% relative humidity and 0°C\100 m temperature gradient).

c. During prevailing temperature inversion conditions, (ie 20°C air temperature, 70% relative humidity, 0 m/s wind speed and a 2°C/100 m temperature inversion).

The noise emissions from the above calculations are presented graphically in **Appendix A** to **Appendix C**, for Scenarios a. to c. above.

5.4 Noise Impacts and Conclusion

Table 5.4.1 presents the L_{A10} operational emissions for each of the three meteorological conditions detailed in **Section 5.2**.

Table 5.4.1 Operational L_{A10} Noise Emissions

Residence	Calm Conditions	2 m/s Wind Towards Residence	2°C/100 m Temperature Inversion
The Homestead	26 dBA	28 dBA	28 dBA
Woodlands	36 dBA	40 dBA	39 dBA
Glenburnie	28 dBA	32 dBA	32 dBA

The predicted noise emission levels in **Table 5.4.1** indicate that the development will fully comply with the relevant EPA noise emission guidelines under both calm and adverse weather conditions.

6 TRAFFIC NOISE IMPACTS

The US Environment Protection Agency's method for the prediction of $L_{Aeq,T}$ was employed to calculate the $L_{Aeq(1hour)}$ noise level for a truck speed of 60 km/hr.

Assuming that there are dwellings located (at a relatively close) 15 m from the centre of the roadway and that the two truck loads per day (four movements) occur within the same one hour period, the resulting $L_{Aeq(1hour)}$ noise level from the operations is predicted to be 53 dBA and readily complies with the EPA's recommended 55 dBA $L_{Aeq(1hour)}$ criterion.

7 CONCLUSION

Richard Heggie Associates was commission to conduct a noise and transportation impact assessment of a proposed hardrock quarry operation at Tin Pot Hill, Bland Shire.

In conducting this assessment, it has been demonstrated that the resultant quarry operational and transportation noise levels achieve compliance with the respective EPA's criteria, thus minimising the extent of any acoustical impacts. The resulting noise emissions from the quarry operations should consequently not give rise to the loss of acoustical amenity to any residence in the vicinity of the project site.

Appendix A

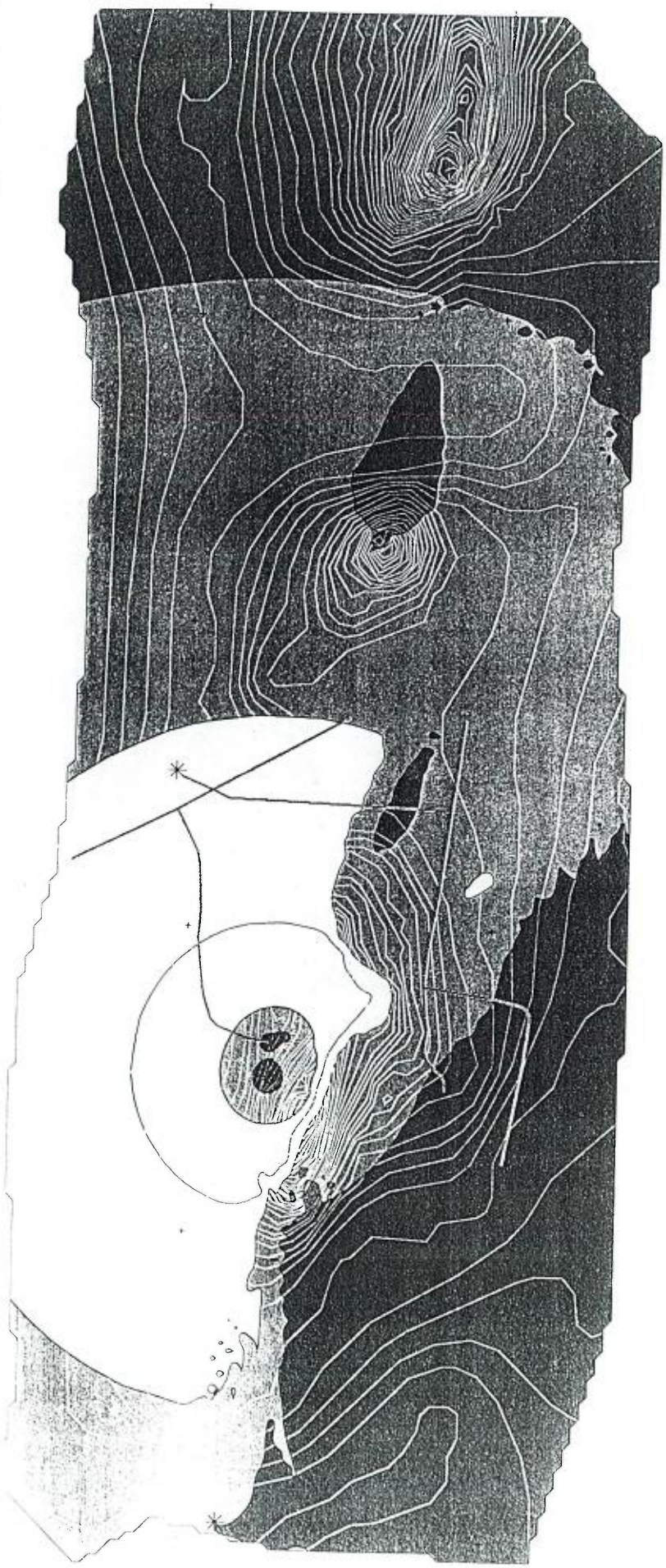
Tin Pot Hill Quarry
LA10 Noise Emissions
Calm Conditions

Richard Heggie Associates P/L

Legend

- Road as a band
- Industrial sources Point
- Receiver
- Elevation line

Scale factor 1: 19485



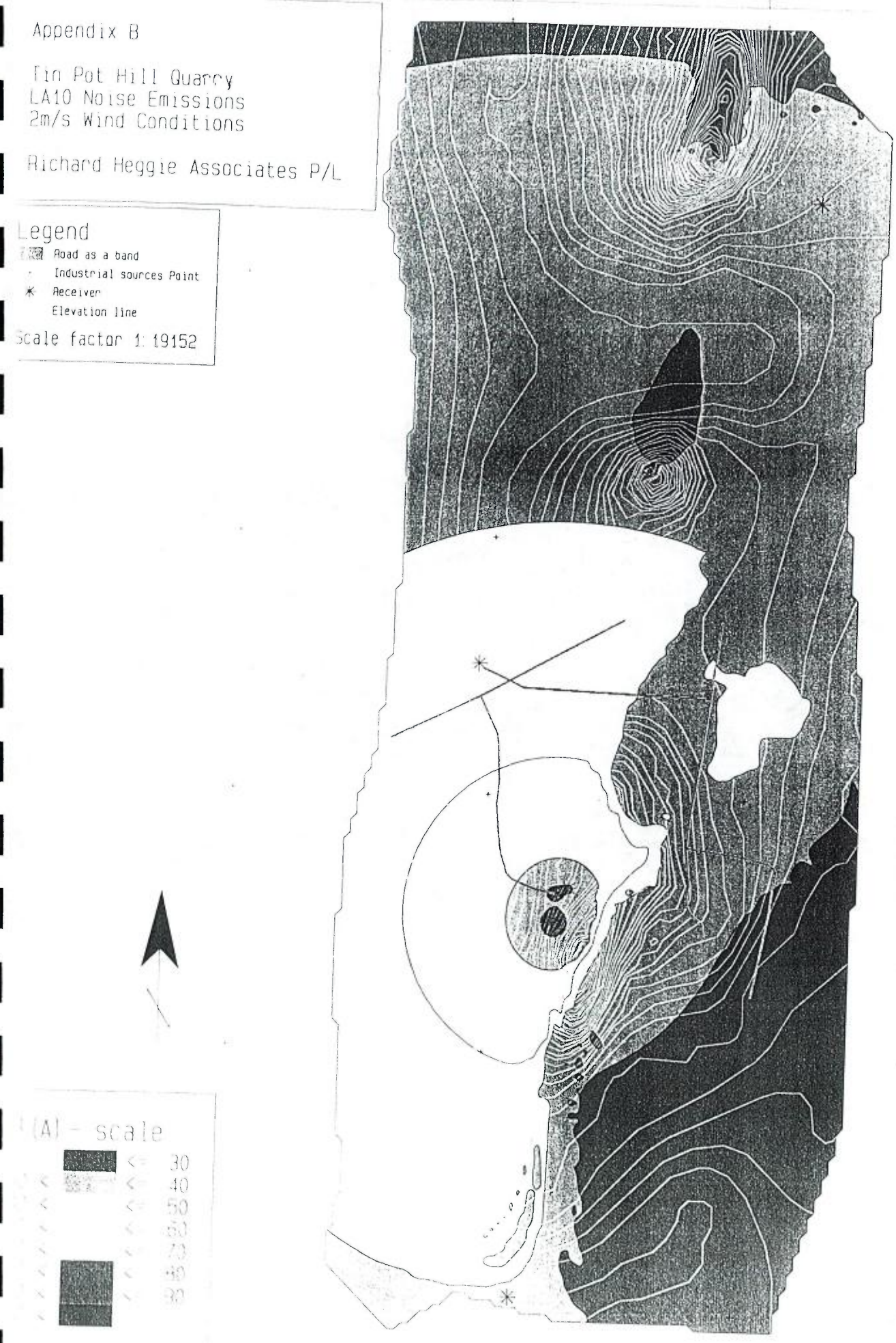
dB(A) - scale

	<	30
40 <	<	40
50 <	<	50
60 <	<	60
70 <	<	70
80 <	<	80
90 <	<	90

Appendix B

Tin Pot Hill Quarry
LA10 Noise Emissions
2m/s Wind Conditions

Richard Heggie Associates P/L



Appendix C

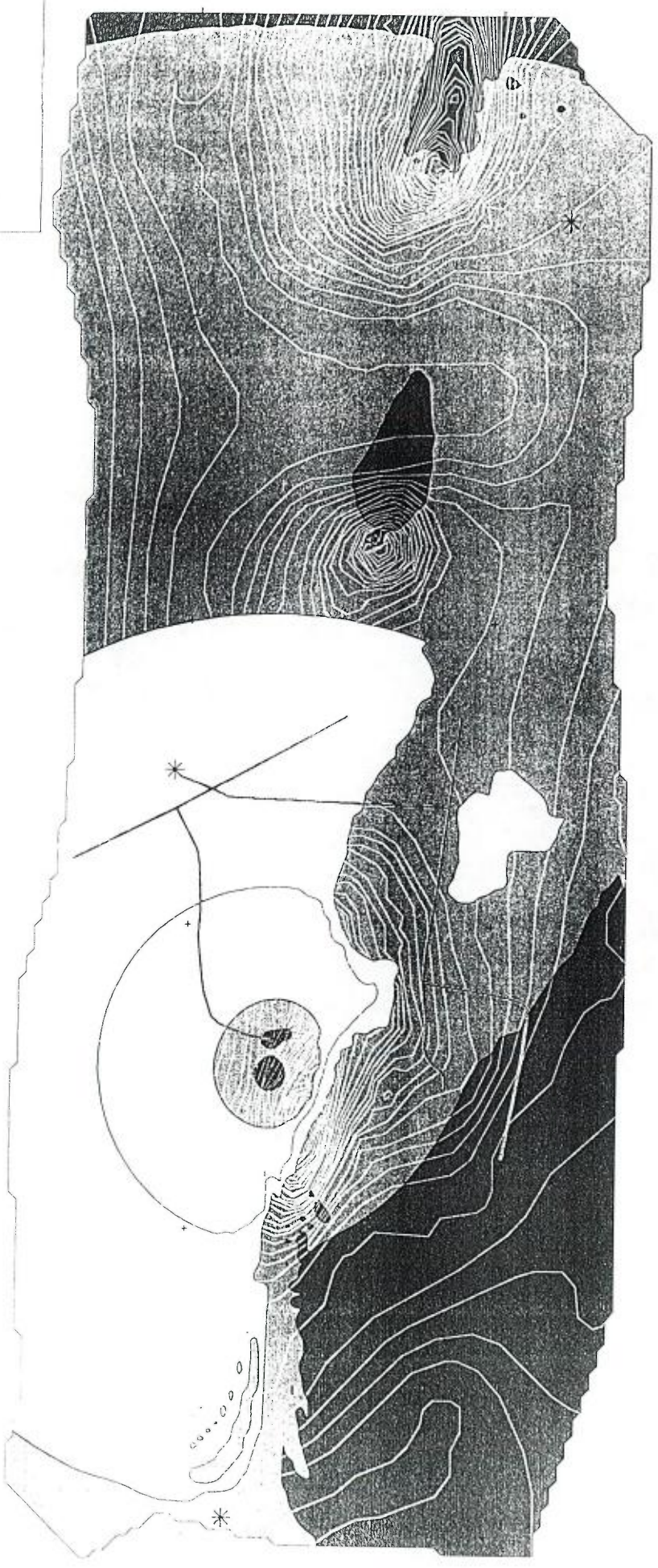
Tin Pot Hill Quarry
LA10 Noise Emissions
2degC Inversion Conditions

Richard Heggie Associates P/L

Legend

- Road as a band
- Industrial sources Point
- Receiver
- Elevation line

Scale factor 1: 19152



dB (A) - scale

	<= 30
30 <	<= 40
40 <	<= 50
50 <	<= 60
60 <	<= 70
70 <	<= 80
80 <	<= 90
90 <	

Annex 6: Dust Modelling

Dust modelling was undertaken using AUSPLUME 5.4 on sample data obtained at the site during crushing. This identifies the settings and parameters used in the modeling and the significant results.

AUSPLUME Configuration:

Concentration or deposition	Dry deposition only
Emission load units	grams/second
Deposition units	microgram/m2
Units conversion factor	1.00E+06
Plume depletion due to dry removal mechanisms included.	
Smooth stability class changes?	No
Other stability class adjustments ("urban modes")	None
Ignore building wake effects?	No
Decay coefficient (unless overridden by met. file) 0.000	
Anemometer height	10 m
Roughness height at the wind vane site 0.300 m	
Averaging time for sigma-theta values	60 min.
DISPERSION CURVES	
Horizontal dispersion curves for sources <100m high	Sigma-theta
Vertical dispersion curves for sources <100m high	Pasquill-Gifford
Horizontal dispersion curves for sources >100m high	Briggs Rural
Vertical dispersion curves for sources >100m high	Briggs Rural
Enhance horizontal plume spreads for buoyancy?	Yes
Enhance vertical plume spreads for buoyancy?	Yes
Adjust horizontal P-G formulae for roughness height?	Yes
Adjust vertical P-G formulae for roughness height?	Yes
Roughness height	0.400m
Adjustment for wind directional shear	None
PLUME RISE OPTIONS	
Gradual plume rise?	Yes
Stack-tip downwash included?	Yes
Building downwash algorithm:	PRIME method.
Entrainment coeff. for neutral & stable lapse rates	0.60,0.60
Partial penetration of elevated inversions?	No
Disregard temp. gradients in the hourly met. file?	No

A value from the following table is used where boundary-layer potential temperature gradients are not given by the hourly meteorological file.

Wind Speed Stability Class (K/m)

Category	A	B	C	D	E	F
1	0.000	0.000	0.000	0.000	0.020	0.035
2	0.000	0.000	0.000	0.000	0.020	0.035
3	0.000	0.000	0.000	0.000	0.020	0.035
4	0.000	0.000	0.000	0.000	0.020	0.035
5	0.000	0.000	0.000	0.000	0.020	0.035
6	0.000	0.000	0.000	0.000	0.020	0.035

WIND SPEED CATEGORIES
Boundaries between categories (in m/s) are: 1.54, 3.09, 5.14, 8.23, 10.80

WIND PROFILE EXPONENTS: "Irwin Urban" values (unless overridden by met. file)

AVERAGING TIMES: 1 hour

SOURCE CHARACTERISTICS

STACK SOURCE: 1

X(m)	Y(m)	Ground Elev.	Stack Height	Diameter	Temperature	Speed
475295	6218640	200m	4m	0.50m	22C	2.0m/s

No building wake effects.
(Constant) emission rate = 3.00E-03 grams/second

Particle Mass fraction	Particle Size (micron)	Particle Density (g/cm3)
0.9790	999.0	2.60
0.0170	848.0	2.60
0.0010	213.0	2.60
0.0010	54.0	2.60
0.0010	15.0	2.60
0.0010	4.0	2.60

RECEPTOR LOCATIONS

The Cartesian receptor grid has the following x-values (or eastings):
471600.m 471700.m 471800.m 471900.m 472000.m 472100.m 472200.m
472300.m 472400.m 472500.m 472600.m 472700.m 472800.m 472900.m
473000.m 473100.m 473200.m 473300.m 473400.m 473500.m 473600.m
473700.m 473800.m 473900.m 474000.m 474100.m 474200.m 474300.m
474400.m 474500.m 474600.m 474700.m 474800.m 474900.m 475000.m
475100.m 475200.m 475300.m 475400.m 475500.m 475600.m 475700.m
475800.m 475900.m 476000.m 476100.m 476200.m 476300.m 476400.m
476500.m 476600.m 476700.m 476800.m 476900.m 477000.m 477100.m
477200.m 477300.m 477400.m 477500.m 477600.m 477700.m 477800.m
477900.m 478000.m 478100.m 478200.m 478300.m 478400.m 478500.m
478600.m 478700.m 478800.m 478900.m 479000.m 479100.m 479200.m
479300.m 479400.m

and these y-values (or northings):
6213857.m 6213957.m 6214057.m 6214157.m 6214257.m 6214357.m 6214457.m
6214558.m 6214658.m 6214758.m 6214858.m 6214958.m 6215058.m 6215158.m
6215258.m 6215358.m 6215458.m 6215558.m 6215658.m 6215758.m 6215858.m
6215958.m 6216058.m 6216158.m 6216258.m 6216358.m 6216458.m 6216558.m
6216658.m 6216758.m 6216858.m 6216958.m 6217058.m 6217158.m 6217258.m
6217358.m 6217458.m 6217558.m 6217658.m 6217758.m 6217858.m 6217958.m
6218058.m 6218158.m 6218258.m 6218358.m 6218458.m 6218558.m 6218658.m
6218758.m 6218858.m 6218958.m 6219058.m 6219158.m 6219258.m 6219358.m
6219458.m 6219558.m 6219658.m 6219758.m 6219858.m 6219958.m 6220058.m
6220158.m 6220258.m 6220358.m 6220458.m 6220558.m 6220658.m 6220758.m
6220858.m 6220958.m 6221058.m 6221158.m 6221258.m 6221358.m 6221458.m
6221558.m 6221658.m 6221758.m 6221858.m 6221958.m 6222058.m 6222158.m
6222258.m 6222358.m 6222458.m 6222558.m 6222658.m 6222758.m 6222858.m
6222958.m 6223058.m 6223158.m 6223258.m 6223358.m

DISCRETE RECEPTOR LOCATIONS (in metres)

No.	X	Y	ELEVN	HEIGHT
1	475923	6218252	191.0	0.0

METEOROLOGICAL DATA : AUSPLUME METEOROLOGICAL DATA (40CM ROUGHNESS HEIGHT)

AUSPLUME MODEL RESULTS - Peak values for the 100 worst cases (in microgram/m2)

Averaging time = 1 hour

Rank	Value	Time Recorded	Coordinates	
1	6.54E+01	21,19/10/01	(475300, 6218658,	0.0)
2	6.46E+01	23,10/07/00	(475300, 6218658,	0.0)
3	6.46E+01	03,30/09/00	(475300, 6218658,	0.0)
4	6.37E+01	03,01/12/01	(475300, 6218658,	0.0)
5	6.36E+01	22,03/11/01	(475300, 6218658,	0.0)
6	6.25E+01	21,17/02/02	(475300, 6218658,	0.0)
7	6.23E+01	20,17/09/01	(475300, 6218658,	0.0)
8	6.18E+01	21,18/05/01	(475300, 6218658,	0.0)
9	6.11E+01	01,26/07/01	(475300, 6218658,	0.0)
10	6.11E+01	19,01/08/00	(475300, 6218658,	0.0)
11	6.11E+01	24,28/11/01	(475300, 6218658,	0.0)
12	6.00E+01	21,17/05/01	(475300, 6218658,	0.0)
13	5.99E+01	24,29/09/00	(475300, 6218658,	0.0)
14	5.99E+01	20,14/09/01	(475300, 6218658,	0.0)
15	5.95E+01	01,09/01/02	(475300, 6218658,	0.0)
16	5.92E+01	22,01/08/00	(475300, 6218658,	0.0)
17	5.86E+01	18,28/06/01	(475300, 6218658,	0.0)
18	5.85E+01	02,29/03/01	(475300, 6218658,	0.0)
19	5.84E+01	23,29/09/00	(475300, 6218658,	0.0)
20	5.82E+01	20,08/05/01	(475300, 6218658,	0.0)
21	5.82E+01	19,08/05/01	(475300, 6218658,	0.0)
22	5.82E+01	04,19/05/01	(475300, 6218658,	0.0)
23	5.82E+01	19,04/04/01	(475300, 6218658,	0.0)
24	5.76E+01	06,25/06/01	(475300, 6218658,	0.0)
25	5.75E+01	21,20/05/01	(475300, 6218658,	0.0)
26	5.75E+01	19,26/06/01	(475300, 6218658,	0.0)
27	5.75E+01	20,03/11/00	(475300, 6218658,	0.0)
28	5.68E+01	02,09/01/02	(475300, 6218658,	0.0)
29	5.65E+01	23,19/10/01	(475300, 6218658,	0.0)
30	5.65E+01	20,18/05/01	(475300, 6218658,	0.0)
31	5.65E+01	21,27/12/01	(475300, 6218658,	0.0)
32	5.65E+01	21,17/01/02	(475300, 6218658,	0.0)
33	5.65E+01	22,08/10/00	(475300, 6218658,	0.0)
34	5.64E+01	20,13/07/00	(475300, 6218658,	0.0)
35	5.63E+01	21,08/05/01	(475300, 6218658,	0.0)
36	5.60E+01	20,01/08/00	(475300, 6218658,	0.0)
37	5.60E+01	18,18/05/01	(475300, 6218658,	0.0)
38	5.60E+01	05,02/04/01	(475300, 6218658,	0.0)
39	5.60E+01	18,29/08/01	(475300, 6218658,	0.0)
40	5.60E+01	23,08/01/02	(475300, 6218658,	0.0)
41	5.60E+01	20,15/03/02	(475300, 6218658,	0.0)
42	5.60E+01	20,29/01/02	(475300, 6218658,	0.0)
43	5.57E+01	22,17/09/01	(475300, 6218658,	0.0)

44	5.57E+01	20,25/02/01	(475300, 6218658,	0.0)
45	5.53E+01	02,01/12/01	(475300, 6218658,	0.0)
46	5.53E+01	02,23/01/02	(475300, 6218658,	0.0)
47	5.53E+01	23,16/12/01	(475300, 6218658,	0.0)
48	5.50E+01	22,16/07/00	(475300, 6218658,	0.0)
49	5.50E+01	24,16/07/00	(475300, 6218658,	0.0)
50	5.50E+01	24,26/11/01	(475300, 6218658,	0.0)
51	5.50E+01	01,27/11/01	(475300, 6218658,	0.0)
52	5.50E+01	20,13/11/01	(475300, 6218658,	0.0)
53	5.41E+01	19,09/07/00	(475300, 6218658,	0.0)
54	5.41E+01	24,21/11/01	(475300, 6218658,	0.0)
55	5.39E+01	20,17/02/02	(475300, 6218658,	0.0)
56	5.35E+01	23,18/05/01	(475300, 6218658,	0.0)
57	5.27E+01	01,30/09/00	(475300, 6218658,	0.0)
58	5.27E+01	22,09/02/01	(475300, 6218658,	0.0)
59	5.24E+01	18,17/06/01	(475300, 6218658,	0.0)
60	5.21E+01	18,09/07/00	(475300, 6218658,	0.0)
61	5.20E+01	20,01/04/01	(475300, 6218658,	0.0)
62	5.15E+01	02,30/11/00	(475300, 6218658,	0.0)
63	5.12E+01	20,29/07/01	(475300, 6218658,	0.0)
64	5.05E+01	02,02/08/01	(475300, 6218658,	0.0)
65	5.05E+01	03,02/08/01	(475300, 6218658,	0.0)
66	5.01E+01	06,05/05/01	(475300, 6218658,	0.0)
67	5.01E+01	01,17/09/01	(475300, 6218658,	0.0)
68	4.95E+01	19,19/05/01	(475300, 6218658,	0.0)
69	4.95E+01	06,02/04/01	(475300, 6218658,	0.0)
70	4.95E+01	22,10/05/01	(475300, 6218658,	0.0)
71	4.95E+01	20,29/08/01	(475300, 6218658,	0.0)
72	4.95E+01	22,04/04/01	(475300, 6218658,	0.0)
73	4.92E+01	23,01/08/00	(475300, 6218658,	0.0)
74	4.92E+01	22,11/08/00	(475300, 6218658,	0.0)
75	4.91E+01	22,18/05/01	(475300, 6218658,	0.0)
76	4.90E+01	23,07/11/01	(475300, 6218658,	0.0)
77	4.89E+01	01,04/11/00	(475300, 6218658,	0.0)
78	4.89E+01	24,16/09/01	(475300, 6218658,	0.0)
79	4.89E+01	02,03/02/02	(475300, 6218658,	0.0)
80	4.89E+01	24,30/12/01	(475300, 6218658,	0.0)
81	4.89E+01	18,02/04/01	(475300, 6218658,	0.0)
82	4.89E+01	24,17/04/01	(475300, 6218658,	0.0)
83	4.88E+01	05,24/02/01	(475300, 6218658,	0.0)
84	4.87E+01	23,28/11/01	(475300, 6218658,	0.0)
85	4.87E+01	02,05/01/02	(475300, 6218658,	0.0)
86	4.87E+01	07,05/05/01	(475300, 6218658,	0.0)
87	4.87E+01	20,28/01/01	(475300, 6218658,	0.0)
88	4.86E+01	19,29/08/01	(475300, 6218658,	0.0)
89	4.86E+01	03,08/03/02	(475300, 6218658,	0.0)
90	4.84E+01	23,08/05/01	(475300, 6218658,	0.0)
91	4.84E+01	21,09/05/01	(475300, 6218658,	0.0)
92	4.83E+01	23,12/11/01	(475300, 6218658,	0.0)
93	4.83E+01	22,08/05/01	(475300, 6218658,	0.0)

94	4.83E+01	22,15/07/01	(475300, 6218658, 0.0)
95	4.83E+01	24,03/04/01	(475300, 6218658, 0.0)
96	4.82E+01	19,10/07/00	(475300, 6218658, 0.0)
97	4.82E+01	23,16/07/00	(475300, 6218658, 0.0)
98	4.82E+01	02,04/11/00	(475300, 6218658, 0.0)
99	4.82E+01	20,03/10/00	(475300, 6218658, 0.0)
100	4.82E+01	19,14/02/01	(475300, 6218658, 0.0)