

Concrete (1744), the West Mount Cotton quarry of Karreman Brothers (2046), the Stapylton quarries of Stonemaster's Pty Ltd and BMG Resources (2434 and 2531 respectively), and the West Burleigh quarries of the Gold Coast City Council and M & M Enterprises Pty Ltd (4191a & b). In recent years, some operations with quartzite bands of more consistent quality have been successful in producing aggregate suitable for concrete use, through quarry management. Quartzite from the Pine Mountain quarry of BMG Resources (0856) is now extensively utilised as a source of concrete aggregate for the company's concrete plants. Smaller quantities of crushed quartzite from the West Mount Cotton quarry, the Stapylton quarries, the Calamvale quarry and the West Burleigh quarry of M & M Enterprises are utilised for concrete aggregates largely for landscaping usage and the domestic market.

The quartzites consist of recrystallised, grey, blue, white, black and minor green cherts and some red and red-brown jasper, often occurring as steeply dipping bands which may be closely fractured and cleaved or occasionally massive. Thin interbeds or laminae of argillaceous material marking the original bedding result in contamination of the aggregate with clay fines. Martin (1981) discussed this problem of Neranleigh Fernvale quartzites along with other shortcomings of poor aggregate shape, high production costs due to excessive abrasiveness and some suspect alkali reactivity results which he suggests deserve further investigation. Willmott (1979b) also refers to potential reactivity problems with cement. However, BMG Resources' extensive use of quartzite from the Pine Mountain quarry in concrete aggregate would appear to belie these comments, although strict quality control would appear necessary.

Reserves in the existing quartzite quarries close to Brisbane (Pine Mountain quarries, Karreman Brothers at Mount Cotton, and Northern Certified Concrete at Daisy Hill) are limited with closure of the Daisy Hill and BMG Pine Mountain quarries possible in the next five years. Several potential deposits of quartzite are present on the south side of Brisbane in the Mount Cotton and Mount Petrie areas. These may be suitable as a source of crushed rock for concrete aggregate and screenings but further investigation is necessary to ensure that relatively argillite free bands are present. Their potential for future exploitation may already be limited by the widespread rural residential development in the last decade and land tenure problems of land acquisition.

Deposits of greywacke, quartzite, and possibly greenstone may occur in the belt of Neranleigh Fernvale beds forming the D'Aguilar Range northwest of Brisbane. However, problems of access and rural residential development reduce the potential of deposits on the eastern sections of the range. Haulage distance along the Brisbane Valley Highway is a major constraint to the exploitation of deposits in the western section of the belt.

such as power lines, water supply catchments, and land status such as State Forests, and National and Environmental Parks.

The environmental impacts of quarrying include increased noise, dust, truck traffic, and disturbance to the landscape. Flyrock and shockwaves resulting from blasting may cause increased hazards. The impact of noise resulting from crushing and other equipment is generally localised around the quarry site if the operation is adequately buffered from housing development. However, the distance which constitutes adequate buffering depends on factors such as the local ambient noise level, local wind or topographic conditions, and the level of noise dissipation by vegetation and other features. In addition, truck traffic along access routes may add significantly to the noise level some distance from the extractive site. The noise levels in quarries and in adjacent residential areas may be minimised by various inhibiting devices on trucks and equipment, by the use of delay detonators, by controlling the size and frequency of blasting and by tree screening from residential areas. In the final analysis planning which ensures adequate buffering from residential development is more effective than remedial measures. Noise levels in quarrying operations are controlled under the Noise Abatement Act 1978 and monitored by the Noise Abatement Authority.

Increased dust resulting from plant, drilling equipment, trucks, and blasting represents a potential health hazard for both workers and affected residents. Under normal weather conditions the effects are generally localised provided adequate measures have been taken to minimize dust generation, such as dust inhibiting equipment, special crushers and watering of haul roads within the site. However, in high winds dust blown from spoil heaps and other denuded areas may affect residents some distance from the site. Heavy truck traffic along unsealed access roads may result in undesirable dust levels for residents flanking the route and other traffic. This problem may be rectified by the quarry company contributing to road sealing as a condition for the grant of an extractive permit. Dust levels in and adjacent to major quarries are controlled under the Clean Air Act 1963-78, and monitored by the Air Quality Control Council.

Excessive siltation of nearby creeks and dams may result from runoff passing through the quarry excavations and overburden areas and entering adjacent watercourses and dams. Remedial approaches range from extreme measures such as the exclusion of quarries from the catchment areas of water supply dams to conditions on the positioning of overburden and the construction of bund walls and settling dams.

Blasting produces shock waves which are transmitted through the ground and air to nearby residents. The noise of the air blast, vibration from the ground wave, and on some

occasions flyrock are the major impacts. Severity of effects vary with distance, size of charge and geological characteristics of the rock but can be mitigated by blasting techniques such as the use of delay detonators. The environmental impact of blasting is generally localized and only rarely produces any real hazard or damage to nearby property. However, it is capable of causing considerable anxiety to residents and understandably generates strong opposition to quarrying. As with other impacts the most effective remedy is to ensure that an adequate buffer zone is maintained between the working faces and adjacent houses and highways from the outset. A distance of 400-500 m is considered a minimum desirable for housing although lesser distances may be tolerated on faces through control of the blast size. The time, size, and frequency of blasting may be controlled through the Mines Regulation Act 1964-1985 and through the by-laws gazetted by the Local Authority.

The impact of increased heavy truck traffic along often inadequate access routes results in increased road hazard and loss of amenity and is one of the major causes of community opposition to quarrying. Speeding, aggressive driving, and spillage from overloaded trucks do much to damage the image of extractive industry. Increased dust, noise, and road deterioration also contribute to a poor public image. In some cases the impact of truck traffic is the single most important factor in arousing opposition. For instance, the major group opposing the establishment of a quarry near Upper Brookfield (STOMP - Stop the Trucks On Moggil Road Protest) comprised residents several kilometres from the proposed site who were opposed to increased truck traffic along the proposed access route.

Remedial measures in relation to trucking are more difficult to institute and often beyond the control of the quarrying company or the local authority. Considerable planning is often needed in the selection of the best access route. Conditions may be imposed by the local authority on the permitted level of truck activity through gazetted by-laws. Road improvements may be required as part of the permit conditions and overloading may be strictly controlled by the quarry operators. However, once outside the quarry site, the behaviour of trucking contractors is largely under the control of other authorities.

Unightly hillside scarring and hazardous abandoned pits are also significant factors in arousing public opposition to existing or proposed quarries. High vertical faces of fresh rock will not revegetate naturally on a human time scale and unless rehabilitated or screened will remain unightly long after the quarry has been abandoned. A number of options may be exercised to reduce the "visual pollution" during and after the extraction phase. These include the planned use of techniques such as the retreating tree line where the crest of a hill is gradually lowered behind a reducing screen of trees. The formulation of

a development plan for future land use after extraction is of paramount importance. In most cases several options are available depending on topography and include:

- The complete removal of the hillside to surrounding ground level for levelling or recontouring and development into residential or industrial or public open space.
- Excavation below ground level for uses such as a solid waste disposal site followed by public open space.
- Restoration and revegetation of the faces followed by usage as an outdoor auditorium, or public open space.

Social impacts

The adverse social impacts of quarrying arise from the environmental impacts and the community's perception of them. Residents adjacent to quarries may suffer some if not all of the environmental effects of dust, noise and truck traffic to varying degrees, resulting in loss of amenity, psychological aggravation, and property devaluation. In many cases, quarrying has been the prior land use and housing development has spread toward the extractive site through poor planning followed by sometimes imprudent purchases by residents attracted by apparently reasonable real estate prices which are already depressed by the quarry. In some cases residents have purchased property on the basis of assurances that quarries faced imminent closure. Others have purchased property in full knowledge of a prior quarrying application but prepared to oppose the quarry if approval is given.

The reaction of nearby residents to an existing or proposed quarry is to form community groups to pressure the local authority to modify operating conditions or to reject a quarrying application. In some cases these groups have a legitimate complaint about an existing or proposed operation. However, in a number of cases the pressure group is a vehicle to eventually close extractive site that predated residential development or to exclude quarrying from important potential deposits which could be worked in an acceptable fashion. The reaction of the community to quarrying is ambivalent and best expressed by the State Development Committee (1964) of Victoria, "In short, the products of the (extractive) industry are wanted, but their presence is not."

A social trend which has had a major impact on the quarrying industry has been the desire to get back to land and to live in unpolluted rural surroundings sufficiently close to commute to city jobs. This is evidenced by the upsurge in popularity of rural residential or hobby farm type subdivisions since the late sixties and early seventies. The trend has