1 Benerembah Street
(P.O. Box 485)
Griffith
NSW 2680

Griffith city council

Assessment of Options for Quarry and Land Fill

Revision: 27 September 2006

Date of Printing: Thursday, 23 August 2007

Table of Contents

Revision: 27 September 2006

Date of Printing: Thursday, 23 August 2007

Table of Figures

Options Assessment

Introduction

Council has identified a need to review its current quarry and solid waste disposal strategies for the Griffith Local Government Area. Operations at the current Tharbogang site are constrained by existing approvals and licenses. Current license limits need to be increased to cope with the city's ever increasing demand for road making material and suitable sites for disposal of waste.

Council has invested considerable resources into the exploration and establishment of the current site and there is considerable quantity of material remaining to be excavated. Although the available resource at the existing quarry site is significant, Council has decided that other options should be evaluated before the final site selection is made. This will ensure that Council's funds are allocated in a thorough and justified manner.

It is assumed that the selected site would provide for the anticipated needs of the city for a minimum of 20 years and preferably 40 to 50 years into the future.

This report is an evaluation of identified potential sites identified within the Griffith Local Government area.

The Site Selection Process

Quarry Sites

Figure 1 shows the location of Griffith City Local Government Area within the wider region.

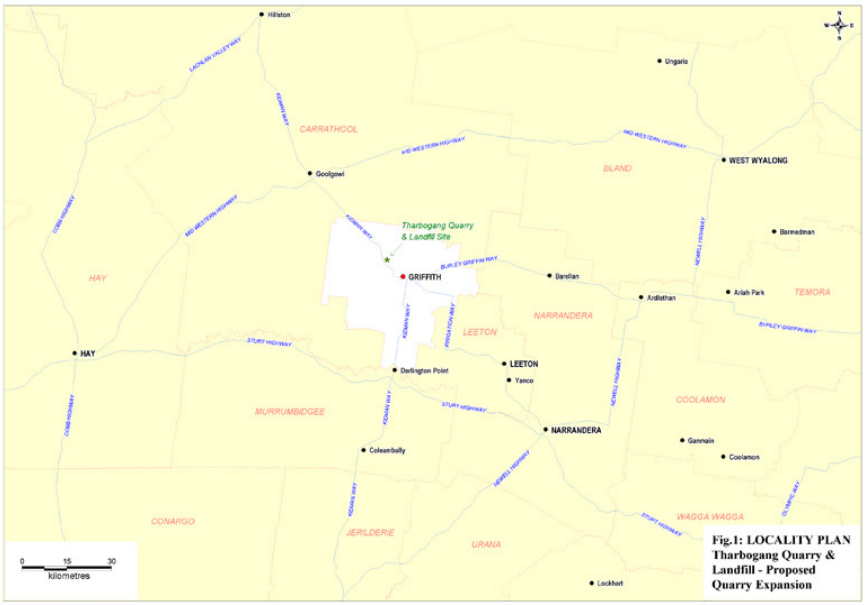


Fig.1: LOCALITY PLAN Tharbogang Quarry & Landfill - Proposed Quarry Expansion

Revision: 27 September 2006

Date of Printing: Thursday, 23 August 2007

Key Site Requirements

The following factors need to be satisfied for any site suggested for evaluation:

- Type of material. Previous research has revealed that material suitable for aggregate for use in concrete or road surfacing is very limited in the Griffith area. There are only a few very small outcroppings of basaltic material that could be used for this purpose and no other outcroppings of suitable material for this purpose.

  The proposed quarry is required to provide gravel suitable for road construction purposes. Gravel suitable for this purpose should:

  Meet test requirements for the purpose, OR

  Be able to be modified at minimal cost to meet test requirements, and

  Be hard and durable in operation, and

  Not be subject to decomposition over time when exposed to the atmosphere.

- Proximity to city and/ or the end-use localities. Haulage of heavy material such as road gravel can be rather costly. Cost is directly proportional to distance hauled and thus the closer the resource is to the end-use area, the better from an economic cost point of view. As well as the direct economic burden, increased transport distance will have a direct impact on green-house gas generation and on local roads. A fully laden truck can have an impact on roads many thousands of times greater than a car. Haulage costs (both direct and indirect) can exceed the cost of extraction if the distance is too great. The end-use in this instance is predominantly road construction associated with land development, industrial development and expansion or road reconstruction. The predominant end-use areas at present are located to the north east of the city centre in the Collina area and at selected industrial sites throughout the area. Future development areas are located to the south and west of the city centre. Industry appears set to continue rapid expansion throughout the area.

  Based on 2006 figures, the cost of delivery for a cubic metre of gravel increases by about $0.31 per tonne km. For every 10 kilometres added to the haulage distance, the cost will increase by about $3.10 /$m^3$.

  As discussed below, up to 1 m^3 of gravel may be required for every 2 m^2 of new road constructed. This translates to an extra $12.40 per metre of new road constructed (8 metre wide pavement) or $200 to $400 per new lot of land for gravel alone.

  The preferred site should be within 10 to 15 kilometres of the city centre.

- Extraction and processing costs. Road and pavement construction utilise large quantities of gravel material. Up to 1 m^3 of gravel may be required for every 2 m^2 of road or pavement surface. Extraction and processing costs will be directly related to the type and hardness of the material extracted. For example if the material can be won simply by ripping and dozing then the costs will be minimal. If blasting, crushing or grading of the material is required, then costs will increase

significantly. Regardless of the degree of difficulty of extraction and processing, the quality of the final product remains paramount.

Preference should be given to sources that satisfy the specification and have lower extraction and processing costs.

- Volumes available and life of the resource. Establishment, operation and closure of a quarry requires a major investment in development and rehabilitation costs. Costs will include preparation of environmental assessment, operational design plans, Environmental Management Plans and Master Plans; establishment costs such as crushers and grading plants; and rehabilitation costs.

  The preferred site should contain sufficient material to defray these costs and minimise the cost of the material to the community. A life of greater than 20 years should be sought and preferably 40 to 50 years.

- Environmental factors. The environmental impacts of a quarry can be significant. Major impacts will include clearing, blasting, noise, dust, traffic and visibility. Significant site characteristics that will influence environmental impacts would include proximity to dwellings or developed areas, vegetative cover of the site and visibility of the operation from the surrounding areas.

  Preference should be given to sites that are at least 500 metres from existing dwellings, do not support unusual or limited ecologies and are not easily visible from surrounding areas.

Table No. 1 below summarises the key characteristics that must be satisfied or considered in selecting a suitable site for a quarry.

Table 1 - Key Characteristic Required

Key Site Requirement	Preferred Property or Value
Location and Planning	Minimal distance to reduce haulage costs and associated damage to existing roads. Preference should be given to maximum haul distances of 10 to 15 kilometres. The development must be permissible within the zone.
Type of Material	Should meet typical specification requirements with proven performance in use.
Volumes Available	Minimum 20 years supply. Preferred 40 to 50 years supply.
Environmental Factors	500 metres from nearest dwelling or residential zone if blasting is involved. 200 metres from the nearest dwelling or residential zone if no blasting is involved. Minimal impact on flora and fauna.

Key Site Requirement	Preferred Property or Value
Extraction and Processing Costs	Rehabilitation or compensatory actions must be possible and acceptable. Not easily visible from surrounding areas Minimal extraction and Processing costs. Manageable requirement for blasting, crushing and grading

Areas of Suitability for a Quarry

Griffith is located on the western plains of NSW. The surrounding country is generally flat with very limited relief. Material that would be potentially suitable for road construction is generally overlain by sedimentary deposits of some considerable depth. Potential quarry sites are restricted to areas of exposure of suitable material.

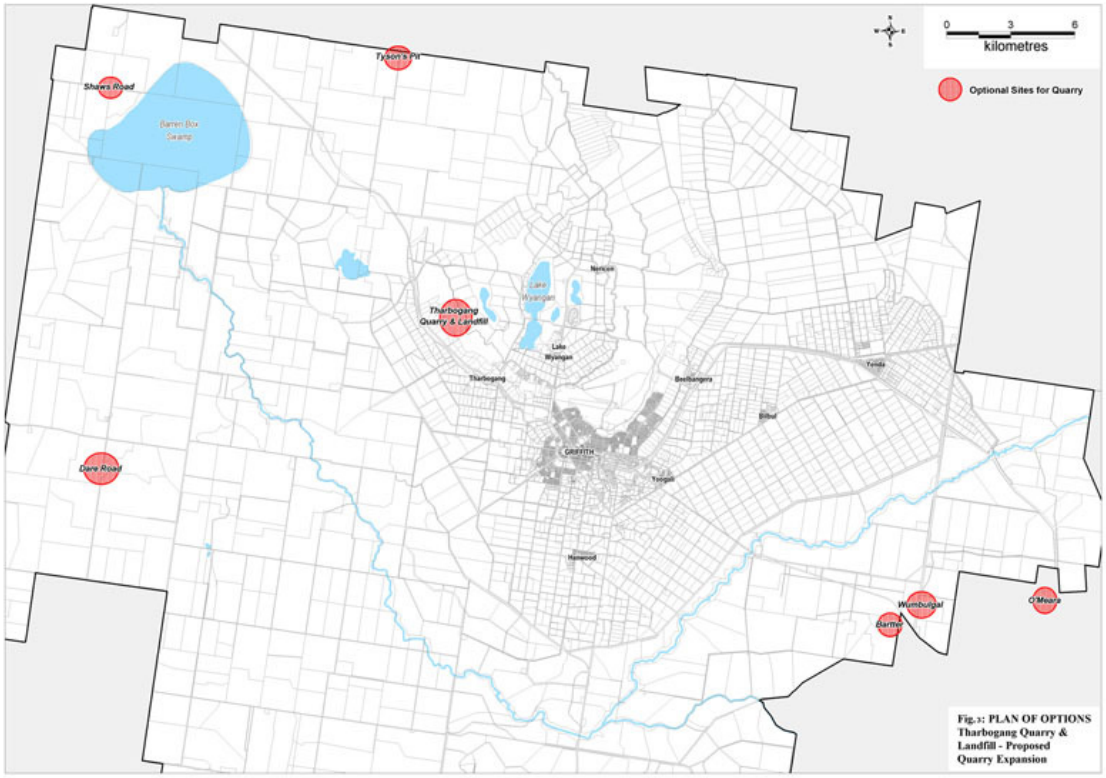
Suitable quarry sites are generally restricted to exposures along several low ranges. These include the Cocoparra Range, the McPherson Range, the Brobenah Hills and a number of minor exposures to the east, north and south east of the city.

The material obtained from these sites is generally a hard sandstone or conglomerate/ sandstone mix. Blasting is often necessary to loosen the material and some crushing and grading of harder material is necessary. The resultant gravel does not always meet standard specifications and benefits from the addition of clay material to raise the Plasticity Index when used for gravel road resurfacing. Grading is sometimes deficient in other sectors as well as fines and this can require special crushing, grading and mixing to achieve a mix that satisfies standard specifications.

This is not the ideal material for the end-use but is the best that is available in the Griffith Region.

Sites Selected for Evaluation

It is not realistic to test and evaluate every potential site. Over the years, a number of quarries have been developed within each outcropping exposure area where suitable material may be obtained. These quarries have generally been located because of the availability of the land and/ or because the material has tested better than immediately adjoining areas.



These existing quarry sites afford a realistic means to evaluate the suitability of material from the outcrop exposure within which they are located. Existing quarry sites have been identified within each exposure and will be used to assess the suitability of that outcrop area as a gravel source for the Local Government area.

The following sites have previously been identified and/ or evaluated for a quarry, have previously been used or are presently used for extractive industry. Figure 2 shows the location of each site within the Local Government Area.

Bartter Quarry – Located west of Irrigation Way on the eastern boundary of the LGA and some 20 kilometres east of the city centre. Currently privately owned and operated. Not available for use by Council.

Wumbulgal Quarry – Located east of Irrigation Way and just outside the eastern boundary of the LGA and some 20 kilometres east of the city centre. Located on private land. Would need to be acquired.

Dalton Road Quarry – Located east of Irrigation Way, some 25 kilometres from the city centre and 4 kilometres east of the eastern boundary of the LGA. Privately owned and awaiting approval for private development. Not available to Council.

Milbrae Quarry – located off Brobenah Hall Road and some 45 to 50 kilometres from the city centre and 25 to 30 kilometres east of the eastern boundary of the LGA. Privately owned and operated. Not available to Council.

Tharbogang Quarry – located off Slopes Road and some 8 to 9 kilometres west of the city centre. Council owned and operated. Potential for expansion.

Dare Road Quarry – Located off Dare Road some 25 kilometres west south west of the city centre. Crown land. Shallow sand deposits not suitable for road construction.

Tyson Quarry – Located at the junction of Dickie Road and Nelson Road some 8 kilometres east of the village of Tabbita and 23 kilometres north west of the city centre. Privately owned and would need to be acquired before development as a quarry.

Shaw Road Quarry – Located off Shaws Road and some 8 or 9 kilometres from Tabbita Village and 23 kilometres from the city centre. Privately owned and leased by a private contractor.

Land Fill Sites

Griffith has utilised a number of sites for waste disposal over the years. Given the generally flat nature of the country, suitable sites have been restricted to old quarries or areas isolated from other activities. Community concerns about odour, noise, smoke, groundwater contamination etc have applied added restrictions over more recent times.

Council is currently utilising waste as land fill in old disused quarry sites (Tharbogang quarry). This has proved beneficial and is expected to aid in site rehabilitation of the

quarry. This practice is likely to continue provided adequate protection is achievable for the wider environment, especially groundwater contamination.

Other options such as trenching and backfill in areas of deep soils would be theoretically possible. Griffith is an irrigation area with numerous irrigation and drainage channels throughout the city area. The area is underlain by highly impermeable strata at a shallow depth. Groundwater depths of as little as 1.5 metres and generally less than 2 to 3 metres occur in areas of high irrigation. Groundwater confined within this upper aquifer stratum is generally highly saline. Lower aquifers frequently provide good quality water which is essential for stock and domestic use in adjoining dry land farming areas. Any contamination of these quality aquifers would have highly unacceptable impacts.

Areas that might be suitable for trenching and backfill would need to be confined to areas of land that are unlikely to result in contamination of groundwater resources in the region or be likely to penetrate the impervious barriers between saline and quality aquifers.

The Yenda landfill site satisfies this criterion, however it is a small site and is located 16 kilometres east of Griffith. In general, land that may satisfy this criterion is also highly productive horticultural land.

Any site to be developed for disposal of organic waste, should be located at least 500 metres distance from any dwelling or residential zone.

Planning for future land fill sites has been confined essentially to existing or future quarry sites.

The Assessment Process

Quarry Sites

The parameters listed in the table below were selected for comparison and assessment of optional sources of road making and pavement material.

To allow comparative evaluation of the various sites, each parameter was allocated a weighting factor. These weighting factors were then assessed for each site and a total weighted value calculated for that site.

Table 2 below shows the selected parameters for evaluation. For each parameter, a brief description has been given and an outline of the weighting assessment is given. Weighting is applied on the basis of suitability or value as a quarry or gravel resource. The higher the value, the more suitable the site is estimated to be for a quarry and gravel supply source.

Table 2 – Assessment Parameters and Weighting

Key Requirement	Preferred Property or Value	Measure	Score
LOCATION AND PLANNING PARAMETERS			
Distance to primary end-users within the city	Haulage distance adds to the cost of the material at user site. Increase is about $0.30 per tonne kilometre. For an annual supply of **200,000** tonnes, the cost to the community would increase by $60,000 for each additional kilometre hauled, or **$600,000** for each 10 kilometres increase in haulage distance.	**Distance** > 25 km >15 km < 25 km >10 km < 15 km < 10 km	 **0** **4** **8** **12**
Zoning and permissibility within the zone	A statement as to whether quarry is a permissible use in the zone. This is a critical factor as the time required to establish consent will increase dramatically if the current zoning does not permit quarry or extractive industry.	**Permissibility** Not permissible Permissible with consent Permissible without consent	 **0** **6** **12**
TYPE OF MATERIAL			
Suitability of material	Standard or typical specifications apply to gravel material that will be used for different purposes. These standards must be satisfied or the material must be able to be modified to meet the standard before the material can be used for a designed purpose. This is perhaps the single most important parameter. Regardless of all other factors, suitability for the purpose is a prime requirement.	**Specification** Unsuitable, cannot be modified Suitable after modification Suitable without modification	 **0** **6** **12**
VOLUMES AVAILABLE			
Volume of material available	If more than one site is required to meet demand over the design period, then costs will most likely increase for establishment and for rehabilitation on completion.	**Volume** < 2,500,000 m^3 > 2.5M m^3 < 5.0M m^3 > 5.0M m^3 <10M m^3 > 10M m^3	 **3** **6** **9** **12**

Key Requirement	Preferred Property or Value	Measure	Score
ENVIRONMENTAL FACTORS			
Proximity to dwellings	Dwellings between 200 metres and 1 kilmetre of the site may apply constraints on the operation of the quarry. Both the distance and number of dwellings will influence this parameter.	**Dwellings within 1 km**	
		> 25	**0**
		< 25 > 10	**3**
		< 10 > 5	**6**
		< 5	**9**
		1 or less	**12**
Flora and Fauna	Although most of the native vegetation within the City area has already been cleared, there are sections of non-arable land that retain some native vegetation. Most of this has been cleared within historical times to remove surface gravels. The existing stands are predominantly regrowth. These remaining areas of vegetation may provide habitat for native fauna. This assessment can only provide a preliminary overview of flora and fauna issues. Detailed study would be required for the preferred quarry site.	**% undisturbed**	
		100% to 75%	**0**
		75% to 50%	**4**
		50% to 25%	**8**
		25% to 0%	**12**
		Habitat Value	
		Excellent	**0**
		Good	**4**
		Fair	**8**
		Poor	**12**
Visual impacts	Quarries located on exposed ridges may be easily visible from surrounding areas. The visual impact of a quarry face may be somewhat subjective but it is normally accepted that visibility from dwellings, traffic routes and residential areas should be minimised as much as possible.	**Visible from dwellings**	
		more than 50	**0**
		between 50 and 25	**4**
		between 25 and 5	**8**
		less than 5	**12**

Key Requirement	Preferred Property or Value	Measure	Score
Noise and vibration	Quarrying operations can cause noise from machinery and noise and vibration from blasting. The frequency of blasting and the proximity of the operation to existing dwellings will determine the adverse impact of the operation. Geological structure and topography may also add significantly to adverse impacts.	**Dwellings within 1 km** > 25 < 25 > 10 < 10 > 5 < 5 1 or less	 **0** **3** **6** **9** **12**
Traffic impacts	Traffic impacts associated with quarries are directly related to the number of vehicles generated by the operation and the type of vehicle used to transport material from the site. The route followed may also be significant. Trucks cause many times more impact on roads than light vehicles such as cars.	**Distance to Arterial Road** more than 5 km 5 km to 1 km less than 1 km	 **0** **6** **12**
EXTRACTION AND PROCESSING COSTS			
Establishment costs	Establishment costs can include removal of overburden, fencing, clearing of vegetation, and construction of site office, magazine etc.	**Comparative cost only** High Medium Low	 **0** **6** **12**
Extraction methods required	Extraction methods might vary from simply ripping and loading onto trucks, through ripping and crushing to blasting. The measure is one of cost – the harder or tighter the material the more expensive it will be to extract.	**Surficial assessment** blasting and crushing ripping and crushing grading only	 **0** **6** **12**

Land Fill Sites

For this assessment, consideration of Land Fill sites will be limited to each of the proposed quarry sites. No consideration will be given to alternative sites not being considered for quarrying.

Assessment of each quarry site will evaluate the following components:

- Potential for groundwater contamination and cost of lining (if required)

- Ability of the quarry working plan to accept land fill without interference
- Availability of suitable cover material
- Odour noise and dust impacts
- Potential for adverse impacts on dwellings or residential areas.

Table 3 – Assessment Parameters and Weighting – Land Fill

Key Requirement	Preferred Property or Value	Measure	Score
Groundwater	Groundwater contamination may occur from infiltrate of land fill leachate or from surface runoff during storm events. Accurate assessment requires detailed site analysis and geotechnical testing of the site. This assessment can only provide a cursory overview based on local knowledge of the area.	**Assessed potential to impact**	
		high	**0**
		medium	**6**
		low	**12**
Compatibility with quarry operation	This is a measure of whether the quarry site has an existing area that can be adapted to land fill without interfering with the quarry operation. Likewise, can the quarry be staged in such a way as to maintain an area suitable for land fill disposal throughout its life.	**Suitability**	
		Not suitable for waste	**0**
		Suitable for waste but operational constraints	**6**
		suitable and staging possible	**12**
Cover material available	As the land fill progresses, significant volumes of cover material are required. This may be available from imported waste but most will need to be obtained from either quarry overburden material or imported from off site. Acquisition of cover material can be a costly exercise. If suitable material can be obtained as a by-product of the quarry operation, then costs can be contained.	**Availability**	
		Not available on-site	**0**
		Available on-site but will need to be imported as well	**6**
		Adequate material available on-site	**12**

Key Requirement	Preferred Property or Value	Measure	Score
Odour noise and dust	Land fill operations may produce noise and odour. Dust may be caused by delivery trucks or machinery associated with the operation. Putrescible waste requires rapid coverage to avoid odour. Noise and dust may be reduced if the waste operation is constrained by quarry faces or vegetation. The nature of the access road may influence dust and noise generation.	**Potential for impact** Odour, dust **AND** noise potential to impact dwellings Odour, dust **OR** noise potential to impact dwellings Site well protected. Impacts likely to be minimal	 **0** **6** **12**
Residential impacts	Residential impacts will be related to a number of factors including proximity to residential areas, methods of operation, prevailing winds and other factors. An over-view assessment only will be provided at this stage. More detailed assessment of preferred sites may be required at a later stage	**Dwellings within 1 km** > 25 < 25 > 10 < 10 > 5 < 5 1 or less	 **0** **3** **6** **9** **12**
Proximity to City Centre	The primary source for waste delivered to the site will be the urban areas of the city. The closer the depot site is to populated areas, the lower will be haulage costs.	**Distance** > 25 km >15 km < 25 km >10 km < 15 km < 10 km	 **0** **4** **8** **12**

Methodology

Assessment has been made at a table-top level.

Where ever possible, available data and testing results have been utilised, however, some sites have limited data available. In these instances, the best professional assessment has been made.

- Planning issues have been assessed by Council's senior planners.
- Distances and physical matters have been assessed by Council's senior engineering staff.

- Establishment and operational costs have been assessed by Council's engineer responsible for quarries.
- Environmental factors have been assessed by Council's senior planners in consultation with experienced persons or organisations.

Evaluation – Quarry Sites

Table 3 sets out the results for those sites selected for evaluation. The score summary for each site is indicated in the list below.

Bartter Quarry	99
Wumbulgal Quarry	108
Dalton Road Quarry	99
Milbrae Quarry	92
Tharbogang Quarry	116
Dare Road Quarry	86
Tyson Quarry	85
Shaw Road Quarry	89

Tharbogang Quarry has the best score by a significant margin. Of the remaining 7 sites, reasons for rejection are discussed below.

Barter Quarry

Presently privately owned but not currently operating. The material exposed in the quarry has an upper member of thin-layered, broken sandstone with clay bands between. This is underlain by sandy silt and claystone that is totally unsuitable for road gravel. Although some hard material was excavated from the upper levels, much of the exposed material in the quarry is claystone or similar. The old quarry excavation is now being used for rice hull disposal. A telecommunications mast is erected on the site and renders it essentially unsuitable for quarry purposes. **This site is not acceptable for Council's requirements.**

Wambulgal Quarry

This quarry was approved in 1995 under the provisions of SEPP 37 for an annual average production capacity of 5,000 m^3 and maximum extraction rate of 39,000 m^3.

This quarry scored well being next in line after Tharbogang. Significant reasons for rejection are distance to end user and the volume of material available for extraction. The resource is at a lower elevation and extraction would create a hole in the ground with attendant problems of drainage and access for heavy vehicles. The land is in private ownership and would need to be acquired by Council. **This quarry may offer an alternative site for development in the eastern section of the city.**

Dalton Road Quarry

This quarry has previously been used for the supply of ridge gravel. Much of the site has been surface excavated and is now covered with regrowth vegetation. The land is owned by Milbrae Quarries. A development application has been lodged by Milbrae Quarries for development of a quarry on nearby land located in the adjoining shire. **This site is not available for acquisition by Council.**

Dare Road Quarry

This quarry was approved in 1995 under the provisions of SEPP 37 for an annual average production capacity of 5,000 m^3 and maximum extraction rate of 39,000 m^3. The material in the quarry is a fine aeolian sand that is not suitable for use as a road gravel but may be suitable as an additive to other materials deficient in fine sand gradings. **This quarry does not meet the requirements for a road gravel quarry.**

Tyson Quarry

This quarry was approved in 1995 under the provisions of SEPP 37 for an annual average production capacity of 5,000 m^3 and maximum extraction rate of 39,000 m^3.

The site is privately owned and would need to be acquired. This site was excluded because of the haulage distance and the need to upgrade some 5.5 kilometres of Nelson Road to a heavy vehicle standard. **This site was rejected for economic reasons including haulage and establishment costs.**

Shaw Road Quarry

This quarry was approved in 1995 under the provisions of SEPP 37 for an annual average production capacity of 5,000 m^3 and maximum extraction rate of 39,000 m^3.

This site is owned by Milbrae Quarries and is currently being operated to provide crushed gravel material for Barren Box Swamp works and for some selected roads within the city area. Haulage costs for most of the city are the highest of all sites (except Milbrae quarry). **This site is not available to Council and would be excluded for economic reasons of haulage and establishment costs.**

Table No. 4 – Evaluation Results - Quarry

Parameter	Quarry							
	Bartter Quarry	Wumbulgal Quarry	Dalton Road Quarry	Milbrae Quarry	Tharbogang Quarry	Dare Road Quarry	Tyson Quarry	Shaw Road Quarry
LOCATION AND PLANNING PARAMETERS								
Distance to primary end-users within the city	21.6 km	18.75 km	23.85 km	> 30 km	11.4 km	26.5 km	25.5 km	41.5 km
	4	4	4	0	8	0	0	0
Zoning and permissibility within the zone	8	8	8	8	12	8	8	8
TYPE OF MATERIAL								
Suitability of material	6	6	6	6	6	0	6	6
VOLUMES AVAILABLE								
Volume of material available ##	less than 1M m^3	3 to 4 M m^3	2M m^3	assumed	20 M m^3	> 1 M m^3	5M to 6M m^3	3M to 4M m^3
	0	8	2	6	12	0	9	5

Revision: 27 September 2006

Date of Printing: Thursday, 23 August 2007

Parameter	Quarry							
	Bartter Quarry	Wumbulgal Quarry	Dalton Road Quarry	Milbrae Quarry	Tharbogang Quarry	Dare Road Quarry	Tyson Quarry	Shaw Road Quarry
ENVIRONMENTAL FACTORS								
Proximity to dwellings	12	12	12	assumed 8	8	12	12	12
Flora and Fauna - Disturbance	12	12	12	12	12	12	10	12
Habitat value	10	6	6	6	8	12	4	6
Visual impacts	12	12	12	assumed 8	8	12	12	12
Noise and vibration	12	12	12	8	8	12	12	12
Traffic impacts	less than 2km 7	Direct access 12	less than 2km 7	Outside City 12	Less than 1km 12	more than 20km 0	More than 5km 0	More than 9km 0
EXTRACTION AND PROCESSING COSTS								
Establishment costs	8	10	8	8	12	6	4	6
Extraction methods required	8	6	10	10	10	12	8	10

Parameter	Quarry							
	Bartter Quarry	Wumbulgal Quarry	Dalton Road Quarry	Milbrae Quarry	Tharbogang Quarry	Dare Road Quarry	Tyson Quarry	Shaw Road Quarry
Total Scores	**99**	**108**	**99**	**92**	**116**	**86**	**85**	**89**

Volumes are based on a simple calculation assuming maximum excavation depth of 15 metres. No allowance has been made for exclusion of unsatisfactory material. **Actual volumes suitable for road construction use may be significantly less.**

Evaluation – Land Fill Sites

Table 4 sets out the results for those sites selected for evaluation. The score summary for each site is indicated in the list below.

Land Fill Site	Score
Bartter Quarry	39
Wumbulgal Quarry	37
Dalton Road Quarry	42
Milbrae Quarry	18
Tharbogang Quarry	44
Dare Road Quarry	24
Tyson Quarry	42
Shaw Road Quarry	38

The score difference between the various sites is not generally significant. The major factor will be compatibility with the quarry operation. From this point of view, Tharbogang scores well. It would be possible to include the landfill operation with several of the quarry sites. **The deciding factor will be the selection of the quarry site**.

Table No. 5 – Evaluation Results - Landfill

Parameter	Land Fill Within Quarry							
	Bartter Quarry	Wumbulgal Quarry	Dalton Road Quarry	Milbrae Quarry	Tharbogang Quarry	Dare Road Quarry	Tyson Quarry	Shaw Road Quarry
Groundwater	3	8	8	6	4	0	6	6
Compatibility with quarry operation	0	6	6	0	12	0	6	0
Cover material available	8	3	6	0	10	0	6	6
Odour noise and dust	12	6	8	6	6	12	12	10
Residential impacts	12	10	10	6	4	12	12	10

Parameter	Land Fill Within Quarry							
	Bartter Quarry	Wumbulgal Quarry	Dalton Road Quarry	Milbrae Quarry	Tharbogang Quarry	Dare Road Quarry	Tyson Quarry	Shaw Road Quarry
Proximity to City centre	**4**	**4**	**4**	**0**	**8**	**0**	**0**	**0**
Total Scores	**39**	**37**	**42**	**18**	**44**	**24**	**42**	**38**

Selection of Preferred Option

The final selection of a preferred site may be influenced by a number of factors. Because both the quarry and the landfill produce a significant financial burden on the community, economic factors will carry significant importance. Likewise, the retention of remaining native vegetation is of high significance in an arid environment.

The weighting of assessment factors is a difficult task and may be somewhat subjective. The following table provides weighting factors that can be applied to each site for this exercise.

Table 6 – Weighting of Factors

Evaluation Factors	Weighting of Factors	Measure and Score
Location and Planning Parameters	These factors will influence ease of gaining approval (zoning) and operational costs (haulage). Haulage is a major economic issue and has the potential to significantly reduce the volume of road work that can be completed within a given budget. Council would be remiss if it selected a location that would increase road construction and maintenance costs beyond the ability of the community to pay.	Score from 1 to 20. Zoning 1 to 5 Economic factors 1 to 15
Type of Material	The selection of a site that provides a material suitable for the purpose is of paramount importance. In this instance, all sites except Dare Road provide similar material and it is the only material available in the city.	Score from 1 to 10
Volumes Available	Establishment costs for anew quarry site would be significant. The volume available at a given site will allow amortisation of establishment costs over a specific period. The more material available, the longer the amortisation period and the lower the cost to the community.	Score from 1 to 20

Evaluation Factors	Weighting of Factors	Measure and Score
Environmental Factors	Flora and fauna have been identified as matters of high importance. This is particularly so for all sites except the Dare Road site. Retention of flora and fauna and regeneration of the site are matters of high significance Potential to adversely impact groundwater resources is a major determining factor for the selection of a suitable landfill site.	Score from 1 to 25
Extraction and Processing Costs	Given that all sites except Dare Road, provide similar material, this measure will be relatively uniform for those sites	Score from 1 to 10
Suitability for Landfill	The association of the landfill with the quarry will assist in site rehabilitation after extraction. It also adds a requirement for cover material that must be gained from the site or imported at additional cost. Potential to adversely impact groundwater will be a major factor in site evaluation.	Score from 1 to 15
Total potential score	(Higher is better)	100

The following table provides an evaluation of the various optional sites and provides a means of assessing the final preferred site.

Table 7 – Selection of Preferred Site

Quarry Site	Location and Planning Parameters	Type of Material	Volumes Available	Environmental Factors	Extraction and Processing Costs	Suitability for Landfill	Total Score
Bartter Quarry	12	6	2	22	8	5	**55**
Wumbulgal Quarry	12	8	4	15	6	8	**53**
Dalton Road	12	8	4	15	6	8	**53**

Quarry Site	Location and Planning Parameters	Type of Material	Volumes Available	Environmental Factors	Extraction and Processing Costs	Suitability for Landfill	Total Score
Quarry							
Milbrae Quarry	8	8	15	10	6	2	**49**
Tharbogang Quarry	20	8	20	10	8	12	**78**
Dare Road Quarry	8	2	2	20	7	2	**41**
Tyson Quarry	8	8	10	10	6	10	**52**
Shaw Road Quarry	8	8	4	15	6	8	**49**

Tharbogang is the preferred site. A detailed environmental assessment now needs to be completed and submitted for approval. This will be a Major Project under SEPP (Major Projects). The EA should cover both components of the development – the quarry operation and the landfill operation.

References

D.J. Douglas & Partners Pty Ltd – Report on Geological Investigation fro Proposed Road Aggregate Quarries Griffith NSW – March 1991

Griffith City Council – Statement of Environmental Effects for Quarries known as Dare Road, Wumbulgal, Tyson and Shaw Road Quarries within Griffith City Council – September 1995

RW Corkery & Co Pty Limited – Statement of Environmental Effects for the Continued Operation of the Griffith Hard Rock Quarry – June 1995