

Construction Aggregate Resources in the Federal Territory and Central Selangor

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Abstract

The Federal Territory of Kuala Lumpur and Selangor have produced 29% of the total crushed rock production in Malaysia. The average consumption per capita in 1998 was 3.74 tonnes of aggregates. It is estimated that the current rock reserve in this area can only cope with the demands of this region for the next 30 years. Thus, the exploitation of aggregate resources must be planned carefully and integrated with other types of landuse.

Sumber Agregat Pembinaan di Wilayah Persekutuan dan Selangor

Abstrak

Wilayah Persekutuan Kuala Lumpur dan Selangor telah menghasilkan 29% daripada jumlah pengeluaran batu hancur di Malaysia. Jumlah penggunaan agregat per kapita pada tahun 1998 adalah 3.74 ton. Dianggarkan simpanan batuan sedia ada di kawasan ini hanya boleh memenuhi keperluan rantau ini untuk 30 tahun akan datang. Maka, eksploitasi sumber agregat mestilah dirancang dengan teliti dan disepadukan dengan jenis gunatanah yang lain.

INTRODUCTION

Coarse aggregate is one of the most accessible natural industrial material and a major basic raw material used by the construction industry. It consists of crushed stone, which is defined as “the product resulting from artificial crushing of rock, boulders, or large cobblestones, substantially all faces which have resulted from the crushing operation” (Langer, 1988 cited in ASTM, 1980).

AGGREGATE RESOURCES IN THE FEDERAL TERRITORY AND CENTRAL SELANGOR

The remarkable growth in the Federal Territory of Kuala Lumpur and Selangor for the past 10 years and the recent setting up of mega-projects such as Putrajaya, Cyberjaya and highways within the central study area has resulted in the increased use of construction aggregates. The Federal Territory and Selangor, combined together, are the largest aggregate producer in Malaysia. In the year of 1998, this region produced 29% of the total crushed rock production in Malaysia, 16.8 million tonnes out of 58.9 million tonnes of the total production of aggregate in Malaysia. (GSM, 1997). The aggregate needs of the region is presently supplied by about 33 natural rock aggregate quarries (Figure 1). It is estimated that the annual production is about 25 millions tonnes.

The Supply

Out of the 33 active quarries, 30 are working on granite, two are working on marble and only one is working on quartzite. The District of Hulu Langat has 13 quarries,

and provide plentiful construction aggregates to the Hulu Langat - Semenyih area. The areas around the Lagong Forest Reserve in the District of Gombak has currently attracted a lot of quarry operators. One granite quarry in Bukit Lanchong is strategically located in a highly populated area. However, it is currently being threatened by the surrounding development. The districts of Kuala Langat and Sepang, mainly consisting of low lying alluvium overlying marble and granite bedrocks, have currently become the new source of rock supply. At present, there are three quarries working on bedrock of granite and marble in these districts. They are one of the major source supplying to the south and southwest of Selangor.

Supply circles reflect radial distances of rock supply from the centre of quarries. Figure 2 shows the supply circles of construction aggregates in the region. There are nine supply circles in the area of study; 5 are major supply circles, which include Sg. Buloh, Rawang, Hulu Langat, Semenyih and the Puchong-Ayer Itam areas. The four smaller supply circles include the Ampang, Damansara, Kapar, Serendah and Selayang. These supply circles are adequate to cope the with the demand for construction aggregates in the Federal Territory and Selangor. Although aggregate resources are widespread and in adequate supply nationally, sometimes local shortages may exist. Local aggregate resources may not meet the quality requirements for some uses. This happened in the intensively developing Pulau Indah, which is lacking in quality rock reserve. Pulau Indah has to import construction aggregates from the Puchong – Kuala Langat area, a distance of about 40 km. The price of crusher run delivered to the area from Puchong is about RM13.0 per tonne, with the transportation cost

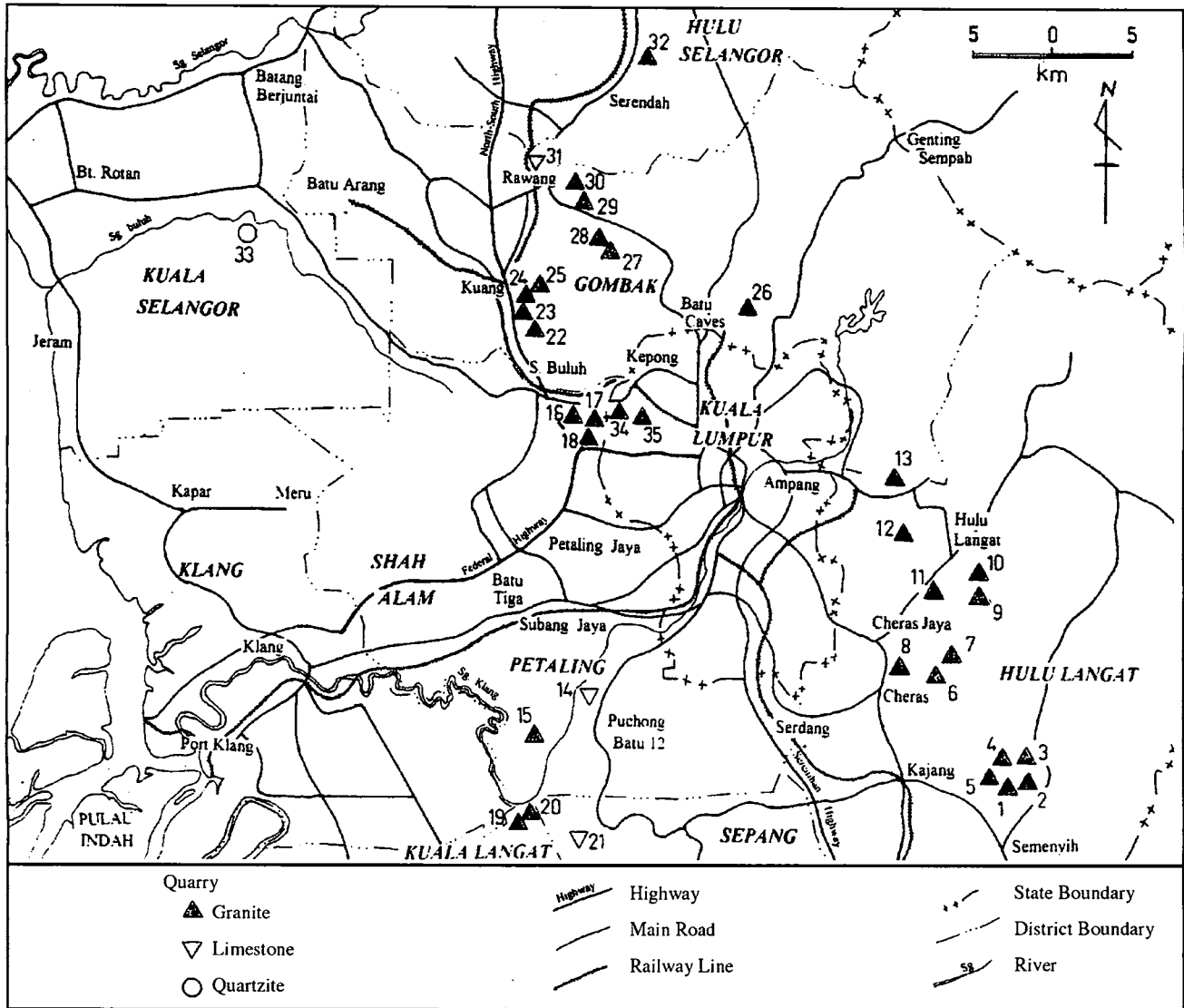


Figure 1: Map of Selangor and Federal Territory Kuala Lumpur showing the location of quarries. The quarries are: District of Hulu Langat– 1: Sungei Way Industries, 2: Metro Kajang, 3: Hume, 4: Kajang Granite, 5: Kajang Rocks, 6: Dayalam, 7: Cheras, 8: Sungei Way, 9: Sungai Long, 10: Dolomite Industries, 11: Kenneison, 12: Wiramuda, 13: Golden Plus; District of Petaling– 14: Unitex, 15: Puchong, 16: Hume Damansara, 17: Pati Technologies, 18: Damansara Rocks, District of Kuala Langat– 19: Swasta Rasmi, 20: Dayapi, District of Sepang– 21: Mariju Sama, District of Gombak– 22: Sungei Way Industries, 23: Sekimas, 24: Perkuat, 25: Pati Technologies, 26: Jumantan, 27: Sungei Way Industries, 28: Permata, 29: Bukit Kanching, 30: FT Rocks, 31: APMC, District of Hulu Selangor– 32: Gemilang, District of Kuala Selangor– 33: Fokustek, Federal Territory– 34: Heng Huat No. 1, and 35: Heng Huat No. 2. (Sources: Minerals and Geoscience Department Malaysia and Institute of Quarrying Malaysia).

amounting to RM5.5 per tonne. Given the fact that the construction aggregates are high bulk-low cost commodity, the transportation cost comprises 73% of the product ex-quarry price.

Pricing and Transport Cost

The location of aggregate resources is the main factor which controls pricing of the material. Aggregate resources are generally low in value, high in bulk, and abundant. Thus, quarry operators prefer to have their quarries as close as possible to the market.

The pricing of construction aggregates and transportation rates are shown in Tables 1 and 2. Compared to the period before 1997, the average post-1997 price of

both the aggregate and transportation rate has decreased by 25% to 30%.

The Demand

In 1998, the average per capita consumption of construction aggregates in the Federal Territory and Selangor was 3.74 tonnes per year or about 10.2 kg every day. A strong economy and expanding population are driving forces for the increase in the consumption of aggregate materials in the region.

The Reserve

Rock reserve estimation was carried out on 18 of the 33 quarries using the sectional volume method on the

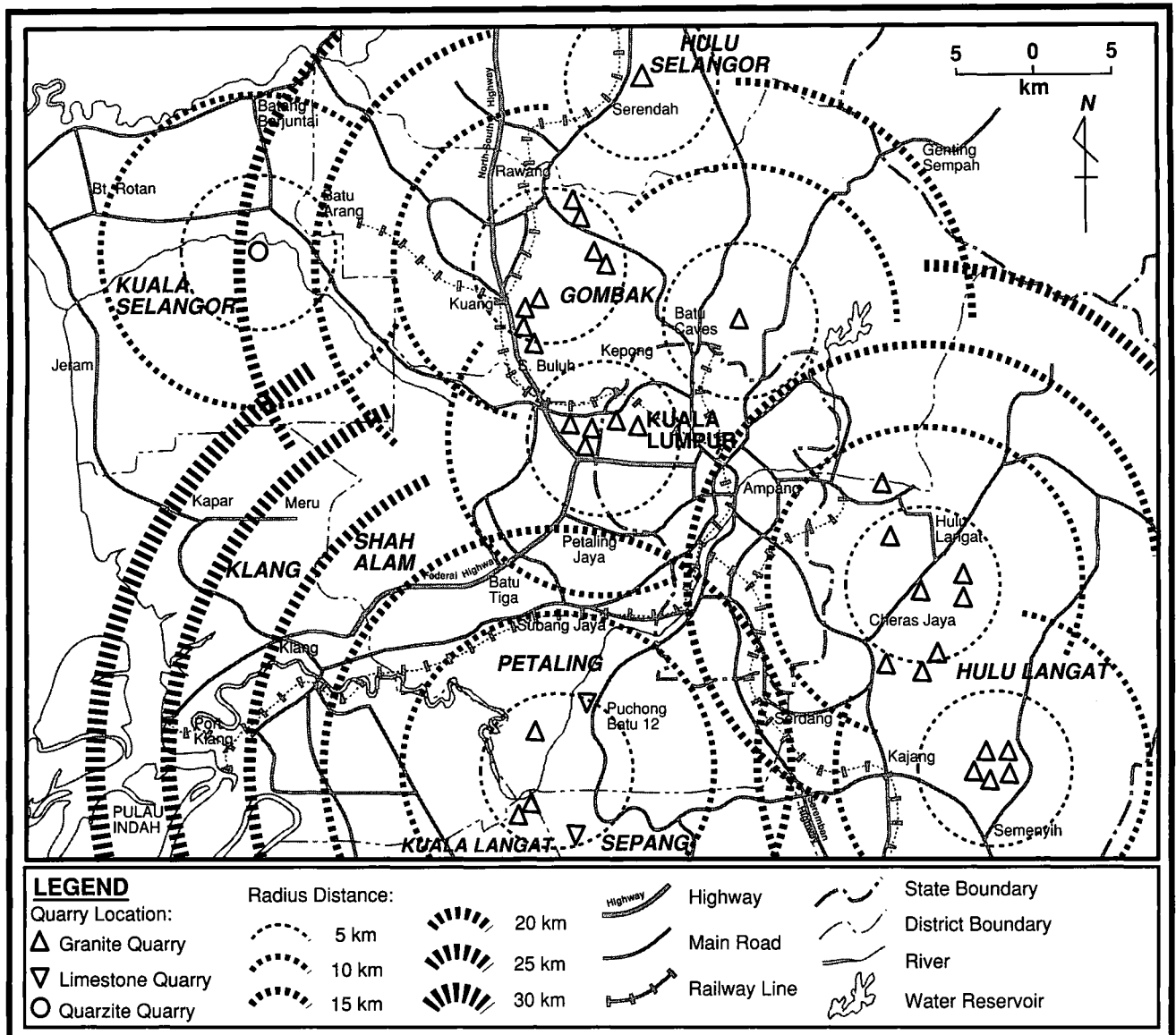


Figure 2: Map of Selangor and Federal Territory Kuala Lumpur showing the supply circles of quarry products.

surveyed base maps of the quarries, which were obtained from the Minerals and Geoscience Department and quarry operators (Figures 3 and 4). The limitation was set by assuming that the rock extraction will cease when the flat ground level is reached and that no extraction will be made below the general subsurface level. The total calculated reserve of the 18 quarries is 619 million tonnes. This will give an average reserve of 34.4 million tonnes for the 18 quarries. Based on the assumption that the quarries are producing the same average amount of construction aggregates, the total reserve of the 33 quarries in the area of study is estimated at about 1,135 million tonnes. The highest recorded consumption rate of aggregates is 37.7 million tonnes (GSD, 1996). Based on these values, the present rock reserve in the Federal Territory and Central Selangor area can only cope for the next 30 years. Aggregate resources are finite and non-renewable. The depletion of this resource around the area of study as well as its increasing

unavailability due to land uses that prohibit mining is an issue that should be urgently looked into.

URBANIZATION AND LANDUSE CONFLICTS

Land-use generally deals with culture and settlement patterns as well as environmental characteristics (Meinig, 1968; Rappaport, 1968; Bennett, 1976; Robbins *et al.*, 1983). Generally, urbanization reflects changes in patterns of population. Populated centers have spread, forming metropolitan areas that include formerly peripheral land that was a source of aggregates for the urban core. (Poulin *et al.*, 1994).

Figures 5, 6 and 7 show the urban areas in the years of 1966, 1975 and 1995. Urbanization of the rural landscape represents the major land-use conversion since the last decade. Since the Federal Territory and Central Selangor

Table 1: Comparison of quarry products pricing of the seven supply circles in Selangor and Federal Territory before and after 1997.

	Before 1997 (RM)						
Supply Circle Quarry Product	Gombak	Kuala Selangor	Batu Caves	Kuala Lumpur	Petaling-Kuala Langat	Hulu Langat- Cheras	Semenyih- Kajang
Crusher Run	9.0-11.0	9.0-11.0	9.0-11.5	9.0-11.5	10.0-12.0	9.0-11.0	9.0-11.0
Quarry Dust	6.0-7.0	-	6.0-7.0	6.0-7.0	6.0-7.0	6.0-7.0	6.0-7.0
3/8" Aggregate	19.0-23.0	-	19.0-24.0	19.0-24.0	20.0-24.0	19.0-23.0	19.0-23.0
3/4" Aggregate	18.0-22.0	-	18.0-23.0	18.0-23.0	19.0-23.0	18.0-22.0	18.0-22.0
1" Aggregate	17.0-21.0	-	17.0-22.0	17.0-22.0	18.0-22.0	17.0-21.0	17.0-21.0
2x3" Aggregate	16.0-20.0	-	16.0-21.0	16.0-21.0	17.0-21.0	16.0-20.0	16.0-20.0
6x9" Block	15.0-18.0	-	15.0-19.0	15.0-19.0	15.5-20.0	15.0-18.0	15.0-18.0
	1997 - 2000 (RM)						
Supply Circle Quarry Product	Gombak	Kuala Selangor	Batu Caves	Kuala Lumpur	Petaling-Kuala Langat	Hulu Langat- Cheras	Semenyih- Kajang
Crusher Run	6.5-8.0	6.5-8.0	6.0-8.5	6.0-8.5	6.5-9.0	6.5-8.0	6.5-8.0
Quarry Dust	4.0-5.0	-	4.0-5.0	4.0-5.0	4.0-5.0	4.0-5.0	4.0-5.0
3/8" Aggregate	13.0-16.0	-	13.0-16.5	13.0-16.5	14.0-16.5	13.0-16.0	13.0-16.0
3/4" Aggregate	12.0-15.5	-	12.0-16.0	12.0-16.0	13.0-16.0	12.0-15.5	12.0-15.5
1" Aggregate	12.0-15.5	-	12.0-16.0	12.0-16.0	13.0-16.0	12.0-15.5	12.0-15.5
2x3" Aggregate	11.5-15.0	-	11.5-15.5	11.5-15.5	12.5-15.5	11.5-15.0	11.5-15.0
6x9" Block	11.0-14.0	-	11.0-14.5	11.0-14.5	11.5-15.0	11.0-14.0	11.0-14.0
	The difference in price before and after 1997 (%)						
Supply Circle Quarry Product	Gombak	Kuala Selangor	Batu Caves	Kuala Lumpur	Petaling- Kuala Langat	Hulu Langat- Cheras	Semenyih- Kajang
Crusher Run	-27.5	-27.5	-29.3	-29.3	-30.0	-27.5	-27.5
Quarry Dust	-30.8	-	-30.8	-30.8	-30.8	-30.8	-30.8
3/8" Aggregate	-31.0	-	-31.4	-31.4	-30.7	-30.9	-30.9
3/4" Aggregate	-31.2	-	-31.7	-31.7	-30.9	-31.3	-31.3
1" Aggregate	-27.6	-	-28.2	-28.2	-27.5	-23.6	-23.6
2x3" Aggregate	-26.4	-	-27.0	-27.0	-26.3	-26.4	-26.4
6x9" Block	-24.2	-	-25.0	-25.0	-25.4	-24.2	-24.2

Table 2: Comparison of transportation cost of the seven supply circle in Selangor and Federal Territory, before and after 1997.

	Before 1997 (RM)						
Supply Circle Quarry Product	Gombak	Kuala Selangor	Batu Caves	Kuala Lumpur	Petaling-Kuala Langat	Hulu Langat- Cheras	Semenyih- Kajang
5km or Less	2.5-3.5	2.5-3.5	3.0-4.0	3.0-4.0	2.5-3.5	2.5-3.5	2.5-3.5
5km-10km	3.5-4.0	3.5-4.0	4.0-5.0	4.5-5.5	3.5-4.0	3.5-4.0	3.5-4.0
10km-15km	4.0-5.0	-	5.0-6.5	-	4.0-5.0	4.0-5.0	4.0-5.0
15km-20km	5.5-6.0	-	-	-	5.0-6.0	5.0-6.0	-
20km-25km	6.0-6.5	-	-	-	6.0-7.0	-	-
25km-30km	-	-	-	-	7.0-8.0.5	-	-
	After 1997 (RM)						
Supply Circle Quarry Product	Gombak	Kuala Selangor	Batu Caves	Kuala Lumpur	Petaling-Kuala Langat	Hulu Langat- Cheras	Semenyih- Kajang
5km or Less	2.0-3.0	2.0-3.0	2.5-3.5	2.5-3.5	2.0-3.0	2.0-3.0	2.0-3.0
5km-10km	3.0-3.5	3.0-3.5	3.5-4.5	3.5-4.5	3.0-3.5	3.0-3.5	3.0-3.5
10km-15km	3.5-4.5	-	4.5-5.0	-	3.5-4.5	3.5-4.5	3.5-4.5
15km-20km	4.5-5.5	-	-	-	4.5-5.5	4.5-5.5	-
20km-25km	5.5-6.0	-	-	-	5.5-6.0	-	-
25km-30km	-	-	-	-	6.0-7.5	-	-

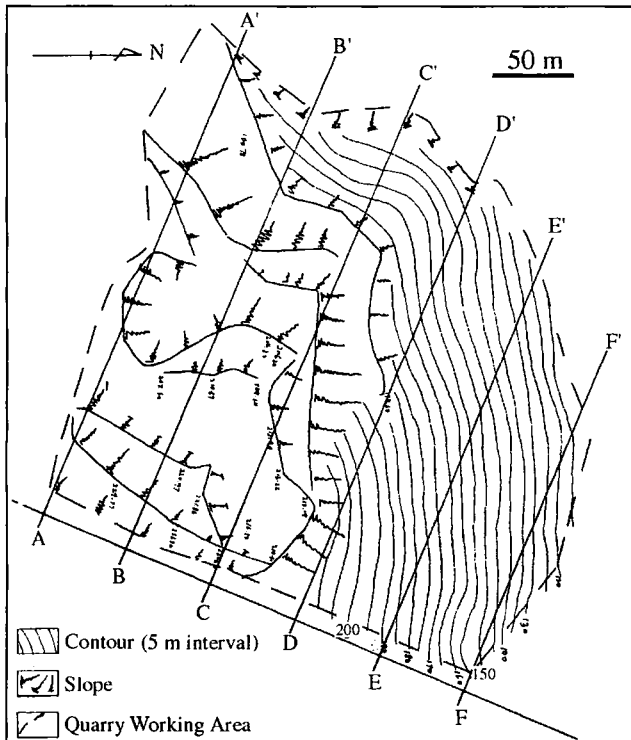


Figure 3: Topography of the phase 1 working area of Perkuat Quarry, Rawang, Selangor.

Table 3: Summary of the computation of extractable rock reserve in Phase I of the Perkuat Quarry, Rawang, Selangor. Note: Total sectional volume of fresh granite reserve is 4,287,640 m³. Total volume of granite reserve is 4,287,640 m³. Using the formula of density = specific gravity / 1.025, and assuming of porosity of about 2.5%, and average tested SG of 2.60, the calculated density factor is 2.53. Using a density factor of 2.53 tonnes/m³, the extractable rock reserve is 10,847,700 tonnes.

Cross-Section	Sectional Area (m)	Average Sectional Area (m)	Distance Between Sections(m)	Sectional Volume (m)
A - A'	20,034	—	—	—
—	—	20,108	56	1,126,048
B - B'	20,182	—	—	—
—	—	20,713	56	1,159,928
C - C'	21,244	—	—	—
—	—	18,390	56	1,029,840
D - D'	15,536	—	—	—
—	—	12,016	56	672,896
E - E'	8,496	—	—	—
—	—	5,338	56	298,928
F - F'	2,180	—	—	—
Total				4,287,640

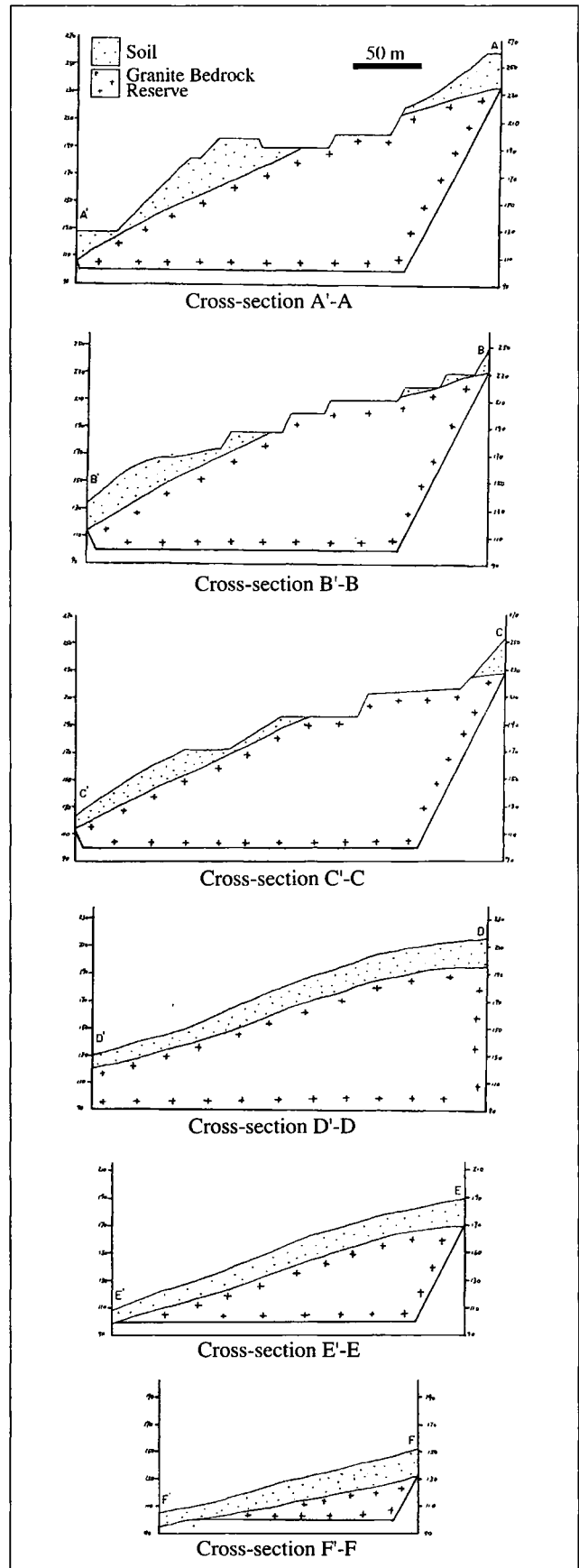


Figure 4: True scale geological cross-section along A-A' to F-F' of the phase 1 working area of Perkuat Quarry, Rawang, Selangor. Note: horizontal scale=vertical scale.

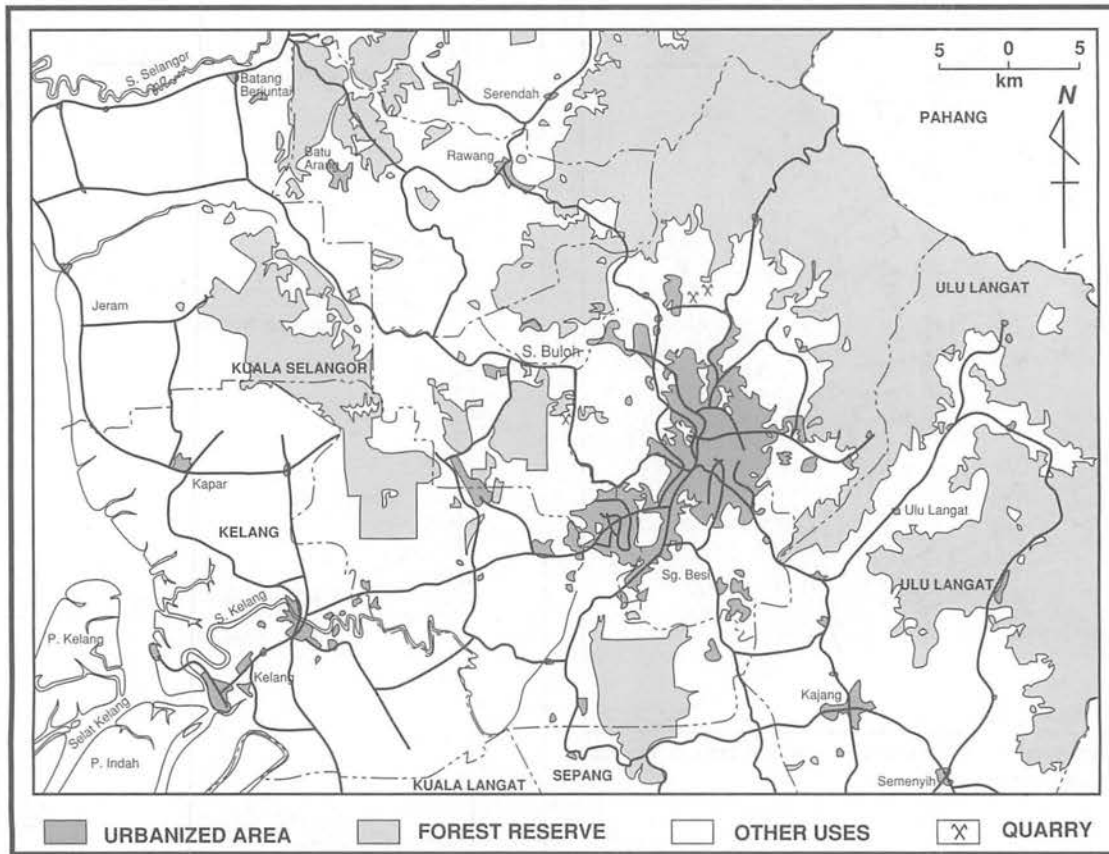


Figure 5: Map showing the urbanized areas in Federal Territory and Central Selangor in the year 1966.

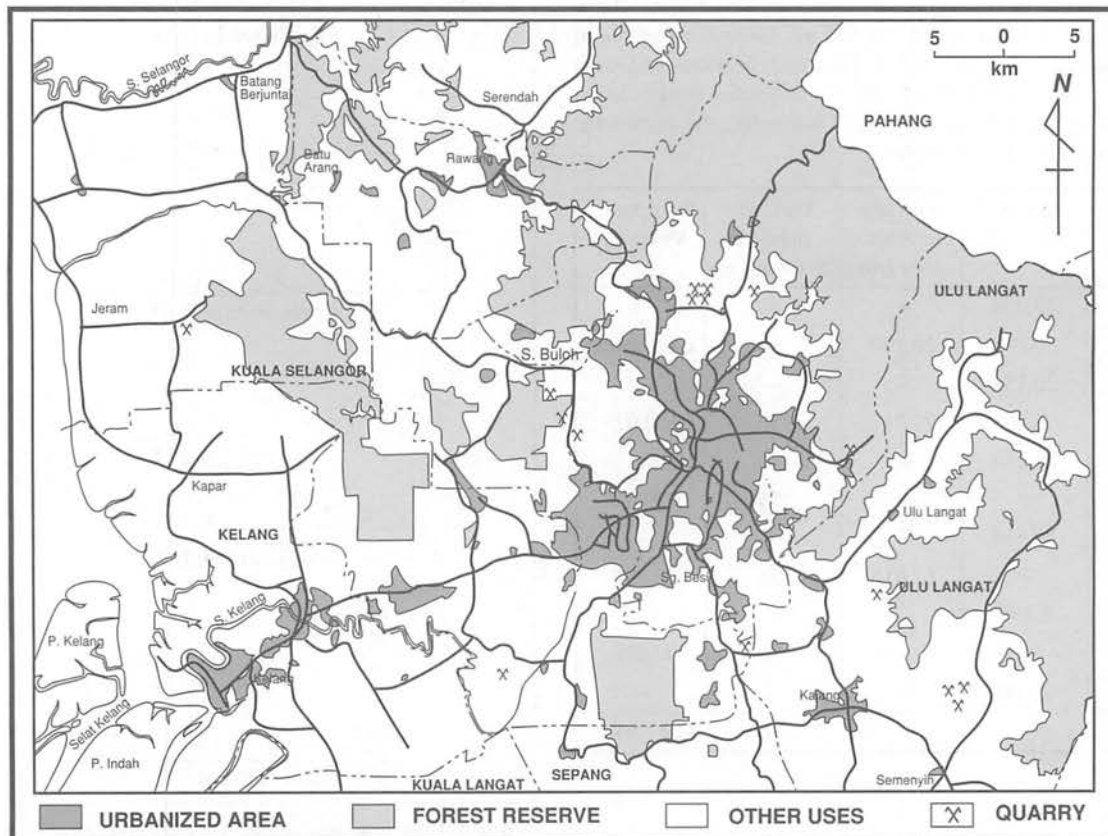


Figure 6: Map showing the urbanized areas in Federal Territory and Central Selangor in the year 1975.



Figure 7: Map showing the urbanized areas in Federal Territory and Central Selangor in the year 1995.

areas are a highly populated region, land use conflicts and environmental problems associated with rapid urban expansion are major factors contributing to the shortage of natural aggregate resource.

Aggregate Sterilization

Sources of construction aggregates commonly occur in areas that are also favorable for a variety of other land uses. Once other development such as construction of houses takes place, the value added due to the improvements will probably permanently preclude any further development of natural aggregates at that location (Hayden *et al.*, 1999). Overall urbanization leads to land sterilization, resulting in the loss of valuable primary construction materials. This problem has happened since 1981 in Batu Caves where three quarries with an average annual crushed rock production of 512,500 tonnes were forced to close (Aw, 1982). Quarries in areas undergoing intensive development are currently still facing the same problem. Hume Damansara and Pati Technologies have ceased operation in 1997, due to intensive housing development and exhaustion of raw material. The District of Petaling, where intensive development is going on, faces the problem of reduction in the numbers of quarry. Sungai Way Quarry, Puchong Quarry

and Batu Tiga Quarry have ceased blasting operations in the 1998-1999 period. The two remaining quarries, Damansara Rock Products and Unitex, are threatened by encroaching housing development in the region. Quarries have been established in most of the areas with proven product quality. Consequently, any new quarry location that becomes operational, will generally be located further away from market areas. As a result, the transportation cost of the products will be high, and there will be less choice in terms of aggregate products.

The distribution of quarry locations in 1975 and 1995 show marked differences. This is the result of enforced quarry sterilization, which happened in the Batu Caves area. Quarry operators consequently shifted their operations to Ulu Langat. New quarries have emerged in the outskirt areas such as Rawang, Sungai Buloh, Semenyih and Puchong.

Future Resource Requirements

Understanding the trend of urbanization in this region provides a useful reference to outline future resource needs. Therefore, to ensure that our future building and construction resource needs are met, it is essential that potential sites of construction material resource are identified. The

exploitation of the aggregate resources must be planned and integrated with other land uses. Well-reasoned decisions about land-use are crucial if infrastructure resources are to remain economically available.

CONCLUSION

The Federal Territory and Selangor are the largest aggregate producers in Malaysia and have produced 29% of the total crushed rock production in Malaysia. In 1998 the average per capita consumption of aggregate materials in the Federal Territory and Selangor was 3.74 tonnes. The 33 quarries in this area can be divided into 9 supply circles out of which five can be considered as major suppliers of aggregates. Based on these supply circles, it is clear that there is still potential for setting up quarries which are classed as small supplier of aggregates. The total reserve of the 33 quarries in the region of study is estimated about 1,135 million tonnes. Based on the highest recorded consumption rate of 37.7 million tonnes, the estimated rock reserve in the Federal Territory and Central Selangor area can last for 30 years. Urbanization has drastically restricted the availability of construction materials to sustain increased expansion of operations. The exploitation of aggregate resource in the Federal Territory and the Central Selangor area must be planned and integrated with other land uses so that aggregates can still be produced and sold at a reasonable price for urban development.

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