1977/15. Evaluation of proposed rural-residential subdivision areas, Brighton Municipality

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The Brighton Council has undertaken a study of their municipality to determine those areas best suited to rural-residential subdivision. To aid in this study, the Department of Mines was asked to indicate areas within the municipality considered unsuitable for development from geological considerations.

A plan indicating potential rural-residential development areas of immediate interest to the council was supplied as basic data. This report relates essentially to these areas, but also broadly outlines the general engineering geological characteristics of the whole municipality.

OBJECTIVES

The geological investigation of the Brighton Municipality was conducted with reference to the following objectives:

(1) To delineate any natural processes that may adversely effect development (including erosion and/or deposition, slope creep, landsliding, expansive soils, etc).

(2) To determine whether the effects of development may alter the existing regime such that a new set of undersirable processes would result.

(3) To appraise the existing regional groundwater conditions.

(4) To outline areas of natural resources, with particular reference to the availability of construction materials.

(5) To comment on the engineering significance of the major soil and rock types.

PHYSIOGRAPHY AND GENERAL CHARACTERISTICS

The Brighton Municipality is typified by undulating rural land of moderate relief, with isolated areas of mountainous terrain to around 990 m in the Mt Dromedary region. Areas suitable for rural-residential development are restricted to the major valleys and lower slopes of the Jordan and Derwent Rivers, and in the Bagdad-Pontville-Brighton-Tea Tree areas through which the Bagdad, Strathallan and several other major tributaries flow.

The numerous escarpments and the marked SE trend of the major rivers and rivulets, indicates the extent to which the topography is fault controlled. The major rock types, each exhibiting their own characteristics, have also influenced the morphology. Much of the elevated ground is dominated by resistant dolerite bodies, whilst cliff development is common in the Triassic sandstones.

In general, the Brighton Municipality has a low average annual rainfall, varying from about 730 mm in the south-west around Mt Dromedary, to approximately 490 mm in the rain shadow zone near Brighton. The mean average temperature is similar to that of Hobart with isolated snowfalls common in the elevated south-west region of the municipality.

GEOLOGY

The geology of the Brighton Quadrangle has been mapped by Leaman (1975).

The Brighton Municipality covers the greater part of this sheet with the southern boundary extending into the adjoining Hobart Quadrangle.

The oldest exposed rocks are of Permian age and comprise an intermittently fossiliferous siltstone-mudstone sequence with occasional limestone and sandstone units. Triassic sandstone and mudstone, the youngest members of which contain coal, overlie the Permian rocks.

Jurassic dolerite is the dominant rock type and intrudes the Permo-Triassic rocks as an integrated series of intrusions of which dyke and sheet limbs are partially exposed.

Tertiary deposits of silt, sand, gravel and clay unconformably overlie the older rocks and commonly occupy eroded fault-troughs. The Tertiary basalts are represented as flows, dykes and plugs, with some minor pyroclastic deposits.

Quaternary gravels, silts and sand are common in the valley floors of most streams while talus deposits derived from Permian and Jurassic rocks occur on the higher slopes.

A detailed account of the geology of the area is contained in the explanatory notes accompanying the Brighton Geological Sheet (Leaman, 1977).

MINERAL RESOURCES

In the past, important raw materials have frequently been lost to the ever increasing sprawl of urban development. However, through proper planning it is possible to preserve these resources whilst maintaining compatibility with the surrounding land use. This concept is particularly important to the extractive industry where the economic viability of an operation is geared to the location, existance and availability of suitable resources close to the urban market.

Maintaining a satisfactory balance between urban development and resource preservation for future utilisation has been of little concern to the Brighton Council up until recently. The changing land use pattern, from agricultural to residential/industrial development, is beginning to place constraints on existing natural resources. For example, a potential source of fine aggregate derived from sub-basalt Tertiary sands is now covered by part of the Bridgewater housing estate. More importantly, serious consideration must be given to factors such as providing the Bridgewater quarry with an adequate buffer zone against encroaching residential development. This quarry represents the major source of hard rock supplying the Hobart market and must receive protection so as to maximise the proper utilisation of this important natural resource.

A detailed account of the mineral resources existing within the Brighton Municipality is contained in the explanatory notes for the Brighton Geological Sheet (Leaman, 1977). No metallic mineral deposits of any consequence occur within the area. Deposits of sand and gravel are limited but aggregate utilised for road making and concrete manufacture is available over much of the area.

Sand

Sand, derived from weathered Triassic sandstone, occurs as small localised deposits at the base of the sandstone hills. In addition, pre-basalt sands are known to exist in the Bridgewater area. A disused sand pit at S1 (fig. 1) is now backfilled and covered by a housing estate.

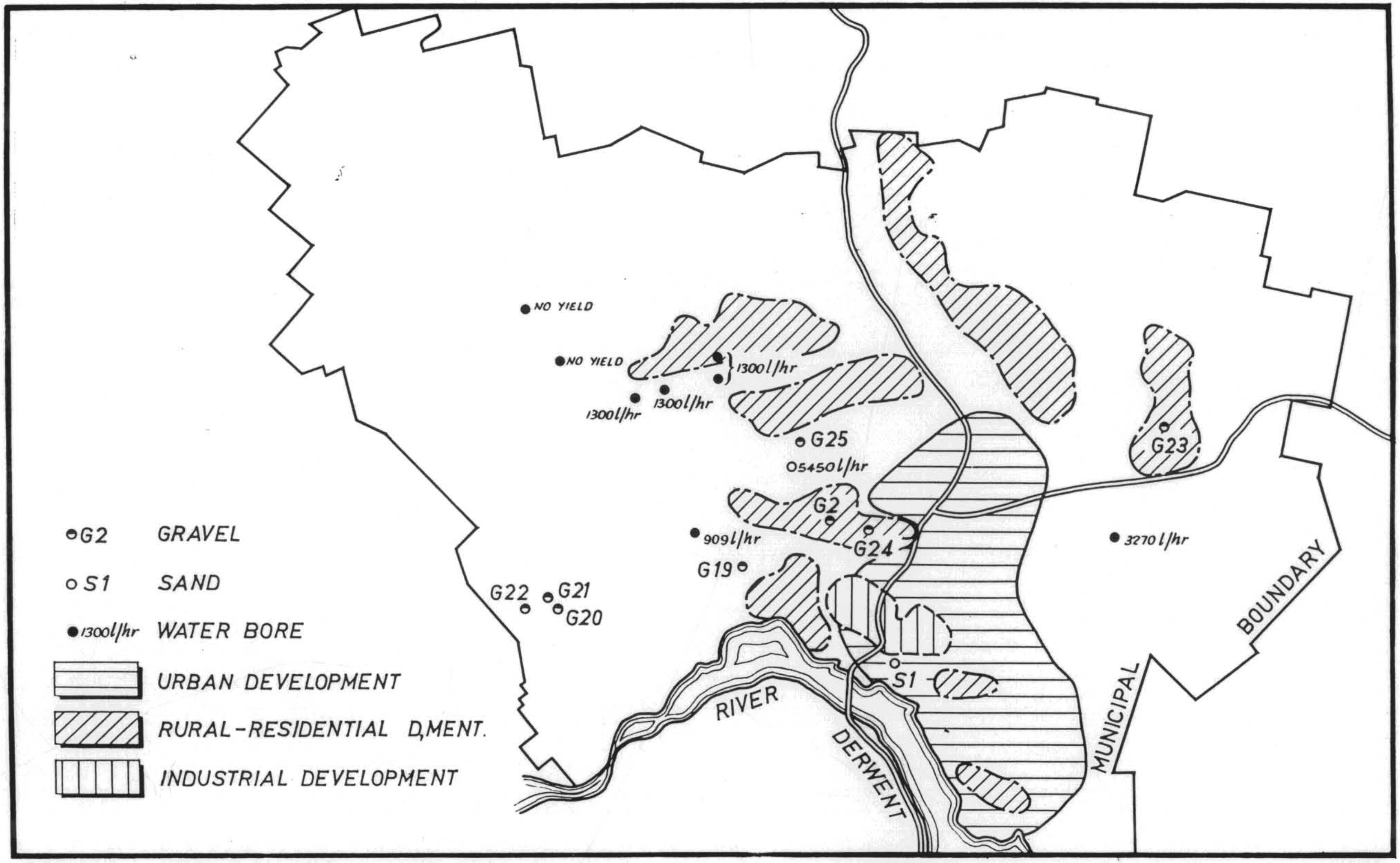

Figure 1. *Development areas, gravel pits, and water bores, Brighton Municipality.*

5 cm

Gravel

Poorly sorted alluvial and colluvial gravel occurs along the major water courses but is of limited use due to the extreme range of particle size, resulting in excessive amounts of both coarse and fine grades.

Aggregate

Coarse aggregate and crushed rock material for construction purposes are quarried to a greater extent then any other product in the Brighton area. The main materials used are the Jurassic dolerite, Permian siltstone and Tertiary basalt.

Dolerite is abundant throughout the municipality and numerous quarries have been opened up, but are generally unsatisfactory when used alone as road making material, due to their high clay content making them too plastic.

The Permian siltstone also provides a crushed aggregate source. In contrast to the dolerite, the siltstone has a low clay content and is therefore generally non-plastic. Satisfactory blendings of dolerite and siltstone can be achieved for use in road making.

The Tertiary basalt currently excavated by Hobart Quarries Pty Ltd at Brighton is a fresh clean material and makes an excellent aggregate. Most of this material is used for concrete production. Scoriaceous material can be utilised as a road base aggregate and can also be blended with the basalts to produce crushed rock material.

In summary, good road making aggregate is limited despite the fact that the parent materials cover extensive areas throughout the municipality.

Existing Public Works Department quarries are situated along the Elderslie Main Road (G2, G24)* and along the Merriworth Road (G23) and all lie within the proposed rural-residential development areas (fig. 1). The planning authorities must give consideration as to the likely future requirements from these sources and provision then made to adequately protect them by use of buffer zones.

Clay

Clay deposits are derived from weathered Triassic mudstone and are utilised in brick manufacture, but no large deposits are known to occur within the Brighton Municipal boundary. The Hobart Brick Company currently holds adequate reserves of brick making materials in areas of Triassic mudstone outside the Brighton area.

Building stone

Triassic sandstone was used extensively for buildings during early settlement and quarries were numerous. At present, Etna Stone Pty Ltd at Pontville is the only commercial source of sandstone production in the Brighton Municipality, producing sawn and bolstered blocks for building and sandstone for paving and walling. Reserves of building stone are enormous, but there is considerable variation in the quality of the Triassic sandstone. A detailed testing programme should result in a good quality stone being marketed ensuring a healthy future for the industry.

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*Quarry numbers after Threader *in* Leaman, 1977.

Limestone

No economically viable deposits of limestone occur within the Brighton boundaries, although in the past limestone was mined for agricultural purposes in the Mt Dromedary area from the Permian Cascades Group.

Gemstones

Varieties of chalcedony, including wood opal and agate have been located in the Mangalore-Bridgewater region. They are derived by silicification of material overlain by basalt.

GROUNDWATER

The Brighton Municipality is situated in a region of low average rainfall. With the change in population from essentially rural, to rural-residential and the high cost of servicing a rural-residential community with a reticulated water supply, the underground water resources of the area require evaluation.

Details of water boring within the Brighton Municipality are limited. Detailed information on the groundwater resources of the Coal River Basin, immediately to the east, are published (Leaman, 1971*a*). It is reasonable to assume that the rock water characteristics pertaining to a particular rock type in the Coal River Basin should generally apply for that same rock type occurring in the Brighton Municipality. The following general comments are thus based partly on information obtained from the Coal River Basin study, and partly from the few bores put down in the Brighton area.

Good quality groundwater may be expected from fractured Permian sediments with yields of 910-2274 *l*/hr obtained from wells of moderate depth. Reasonable water yields of 910-1820 *l*/hr of quite good quality can be extracted from the Triassic quartz sandstones. Yields of approximately 1300 *l*/hr are fairly common at depths less than 30 m. The Jurassic dolerite and Tertiary basalt are fairly extensively jointed and consequently, any contained water is found in these fractures. Generally, the dolerite occupies unfavourable topographic situations for water at shallow depths. Nevertheless provided bores are well sited, yields of 2000 *l*/hr of good quality water may be expected. The Tertiary sediments, dominantly clay with intercalated sand and gravel, have variable yields, with water been recovered only from the sand and gravel. Water quality in the Tertiary sediments is not good. Quaternary alluvial deposits in the major river valley floors may be expected to be excellent suppliers of water providing they are sufficiently thick for a water table to exist within them.

ENGINEERING GEOLOGY

The engineering geology of the Brighton Municipality is relatively uncomplicated in terms of engineering problems likely to be associated with the small number of rock types present, although each possesses distinctive physical properties.

The rock types occurring within the Brighton Municipality are comparable with those in the Hobart Metropolitan area (Hobart Quadrangle), the general rock properties and problems of which are described in the Hobart Engineering Geology Map Series (Leaman, 1971*b*). All general comments made in the Hobart study apply to the Brighton area.

The comments below are given in a regional context and are only intended as a guide to the likely engineering geological conditions to be encountered with the region. Detailed site investigation studies will still be required for proposed major construction sites including bridges, cuttings and buildings.

Soils

A soil distribution map covering the Brighton Quadrangle (Dimmock, 1957) shows that the soil boundaries generally approximate the rock boundaries as depicted on the Brighton geological sheet. Hence, the majority of soils are residual, being the direct product of weathering of the underlying parent rock.

Soil development is generally poor and soil mechanics problems are few. The soils are generally thin (<1 m) on Permian rocks and dolerite, but are up to 2 m thick on the basalts in the Bridgewater area and less than 3 m on Triassic rocks.

Shrinkage characteristics

Soil shrinkage/expansion problems are encountered in the black soils on both the basalt and dolerite. These soils form a black granular clay that is sticky when wet and cracks severely when dry. The Tertiary clays also require special consideration as they are subject to compaction and settlement under load.

Rock weathering characteristics

The degree and depth of weathering is variable, but is usually only a few metres thick. Irregular weathering is characteristic of the dolerite and basalt, both in depth and lateral extent. The Permian rocks are relatively unweathered at shallow depths, whilst the Triassic rocks often exhibit a thick (5-6 m) gradational weathering profile.

LAND STABILITY

Mass movement, whether it takes the form of erosion, soil creep, landslides or rock falls is not a major problem. Factors such as poor soil development, low rainfall, moderately flat lying rocks and lack of groundwater problems, ensures that the rock materials and their soils generally possess a high degree of natural stability.

Erosion

Erosional effects are prevalent in Tertiary sediments and in deeply, weathered Triassic rocks. Erosion gullies at Baskerville are an example of this process.

Soil creep

Soil creep can be expected on most steep slopes exhibiting a moderate-deep soil profile. Creep cannot in itself be regarded as an engineering hazard, but where present, caution should be exercised as it is an indication of the nature of the subsurface materials. Creep is more prone in soils which have a tendency to expand and contract; for example, the dolerite soils.

Landslips

The Jurassic dolerite, and the dolerite derived talus and scree deposits, are most subject to landslips. Extensive mass movement has taken place in the Dysart-Kempton region causing major failures on the Midlands Highway.

The dolerite talus is the presently active material.

Ancient large deep seated rotational slumping is evident in the Jurassic dolerite rocks, for example, on the steeper slopes between Broadmarsh and Elderslie. These have long since stabilised.

Of greater concern to development are the earth flow type slips which can occur on moderate slopes (>13°) where thick soils are present and water conditions are such that the subsurface soil is saturated. Insufficient examples are available to specify with any accuracy the lower slope limits on which movement is likely to occur. However, slopes less than 12° appear to be safe. Typical active earth flow type failures can be seen along the Elderslie Main Road between Broadmarsh and Elderslie, Milvale Creek Road and Jews Hill east of Brighton.

DISCUSSION

A slope category map prepared for the proposed rural-residential subdivision areas showed that the majority of land has a slope of less than 20% (11.5°), the suggested practical upper limit for subdivision development and a figure generally adopted by planning authorities. This figure seems reasonable especially if future development is to take place on dolerite soils. It is probably a fairly conservative upper limit figure for development on Permian and Triassic rocks.

An examination of areas steeper than 20% slope within the boundaries of the proposed subdivision areas showed no obvious signs of instability. This is due to poor soil development, and in most instances, solid rock suitable for foundations existed at shallow to moderate depths. It is concluded that these steeper slopes are suitable for rural subdivision provided adequate precautions are taken to site a dwelling on suitable foundation material. Provision should also be made for effective removal of domestic effluents so as not to adversely affect the existing groundwater regime.

INDUSTRIAL DEVELOPMENT

As depicted in the accompanying map of proposed development areas (fig. 1) the area delineated for industrial purposes essentially occupies an area of Tertiary basalt to the north of Bridgewater. The basalts are extremely variable, ranging from a solid, fresh, massive material, to a very patchy and scoriaceous rock. Sub-basalt Tertiary sand and gravel are present and volcanic Breccia occurs adjacent to the River Derwent. Recent excavations show these to be generally fragmented and, in part, friable.

Due to the great diversity in materials likely to be encountered, the variation in the engineering rock properties will also vary both in lateral and vertical extent. Therefore excavations for industrial sites should be preceded by geophysical work followed by drilling or excavation pits.

An adequate buffer zone should exist around the Bridgewater Quarry to ensure no objectionable noises or vibrations occur which may result in placing restrictions on the quarry's operations.

CONCLUSIONS

In line with the objectives of this report, the following conclusions have been reached.

In general, mass movement processes are not a major problem. Landslips are known to have occurred in dolerite soils on slopes as low as 13°.

Expansive soils may create problems to dwellings if adequate precautions have not been taken to key dwellings into a solid foundation. Poor soil development, low rainfall intensity and moderately flat lying rocks ensure that in general, the rock materials and their soils possess a high degree of natural stability.

Any change in land use, especially to urban development, will alter the natural balance of an existing regime. However, with proper planning these changes can be minimised. The establishment of rural-residential populations scattered throughout the municipality is not likely to result in any major undesirable natural processes adversely affecting the environment. Where possible, natural vegetation should remain, and disturbance of the ground by excessive cut and fill should be minimal despite the materials high natural stability when exposed. Groundwater conditions may be adversely affected if bores are extensively utilised. Care must be exercised to ensure that domestic effluent and sewage does not pollute the groundwater.

Reasonable yields of quite good quality water may be expected from most rock types except the Tertiary sediments where water quality is poor. This applies to those areas where relief is not excessive and a bore hole should never be sited in difficult topographic situations.

Economically viable deposits of sand, gravel and clay are not likely to be found within the municipality. Reserves of these materials exist elsewhere and are currently being worked. Large reserves of good quality building stone are available, but a detailed testing programme is required to delineate marketable stone. Good quality aggregate utilised for road making and concrete manufacture is in relatively short supply, despite the fact that the parent materials cover extensive areas throughout the municipality.

Engineering problems relating to soil and rock mechanic properties are minimal. Generally the soils are thin and the underlying rock materials are relative stable when exposed in excavation.

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