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Geological investigation of a proposed pipeline between Cobbs Hill and Pontville

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INTRODUCTION

A geological investigation was undertaken of the route of a proposed water pipeline between the Cobbs Hill reservoir, two kilometres northwest of Bridgewater (517540 mE, 5270140 mN) and a point approximately two kilometres north of Pontville (520700 mE, 5275900 mN). The proposal calls for a 600 mm diameter pipe (excavation depth 2.0 m) from Cobbs Hill, reducing to a 375 mm diameter pipe (excavation depth 1.6 m) where the line branches north to Pontville. Information was sought on the nature of the subsurface materials through which the pipeline would pass.

The investigation of this nine kilometre segment of the proposed new pipeline was carried out over a two-day period and involved detailed geological mapping. It was initially envisaged that some seismic and/or auger drilling would supplement the mapping, but the mapping indicated that seismic would be of limited use given the high percentage of surface/near-surface float material, the rapid variability of materials both laterally and vertically, and the shallow depth from which information was required. Auger drilling was also considered unsuitable because of the high proportion of surface material (boulders etc.). It was considered that both of these investigative methods would prove to be of little practical use in the final interpretation.

RESULTS

General

A summary of the results of the mapping along the pipeline route is shown on Figure 1. The mapping shows that the construction of the pipeline will involve excavation in a number of rock types of differing ages, origins and physical characteristics.

The route is underlain by an intercalated sandstone/mudstone sequence of Triassic age (40%), Jurassic dolerite (35.5%), Tertiary basalt (16.5%), Permian siltstone (5.5%) and Quaternary alluvial deposits (2.5%). Soil development is generally poor. The soils appear to be thin (< 0.1 m) over the Permian rocks, and highly variable but generally thin (<1.0–2.0 m) on the dolerite, basalt and sandstone.

The weathering and strength characteristics of the rock will ultimately determine the amount of blasting and ripping required in the excavation phase of the project. The degree and depth of weathering can be expected to be variable, and is rarely more than a few metres thick. Irregular weathering is characteristic of the dolerite and basalt, both in depth and lateral extent. The Permian siltstone is invariably relatively unweathered even at shallow depths, whilst the Triassic sandstone may exhibit a gradational (over several metres) weathering profile.

The comments above are given in a general context only and are only intended as a guide to the conditions likely to be encountered.

ROUTE DETAILS

Chainage 00–510 m: Permian siltstone

This section of the proposed route is devoid of outcrop and is characterised by grey sandy silt (SM) and silty clay (ML–MH) soils with associated scattered float comprising quartz siltstone rock fragments. The section exposed in the cut behind the existing reservoir at Cobbs Hill shows that the rocks dip at a low angle, have a high strength but are well jointed which should allow for ease of excavation and ripping to a depth of about 2.0 m over the section under discussion.

Chainage 510–3000 m (approx.): Jurassic dolerite

Of this 2500 m section, some 200 m consists of either direct outcrop or sub-outcrop, with a further 300 m+ of >30% float which can probably be regarded as suspected near outcrop. Based on surface evidence alone, it is probable that at least 20% of this section will encounter hard-rock conditions at depths of less than two metres. This figure may well be higher because some of the land along this section has been cleared of surface rocks by land owners.

Because of the variability in weathering characteristics of dolerite over short lateral distances, no reliable information relating to blasting/ripping estimates can be given. A more reliable figure may be possible following on-site ripping tests.

The dolerite seen in outcrop is typically fresh to slightly weathered, of very high strength, with closely spaced tight joints. It is anticipated that a combination of blasting and ripping will be necessary over much of this dolerite section.

Chainage 3000–3520 m: Triassic sandstone

This section is characterised by grey and brown sandy silt (ML) and sandy clay (CH) with some scattered sandstone/quartzite float. A yellow-brown medium strength quartz sandstone was observed in the spoil heap of the HEC pole at 3150 metres. The final 10 to 15 metres of this section comprises quartzite (sub-outcrop). This material is of EH

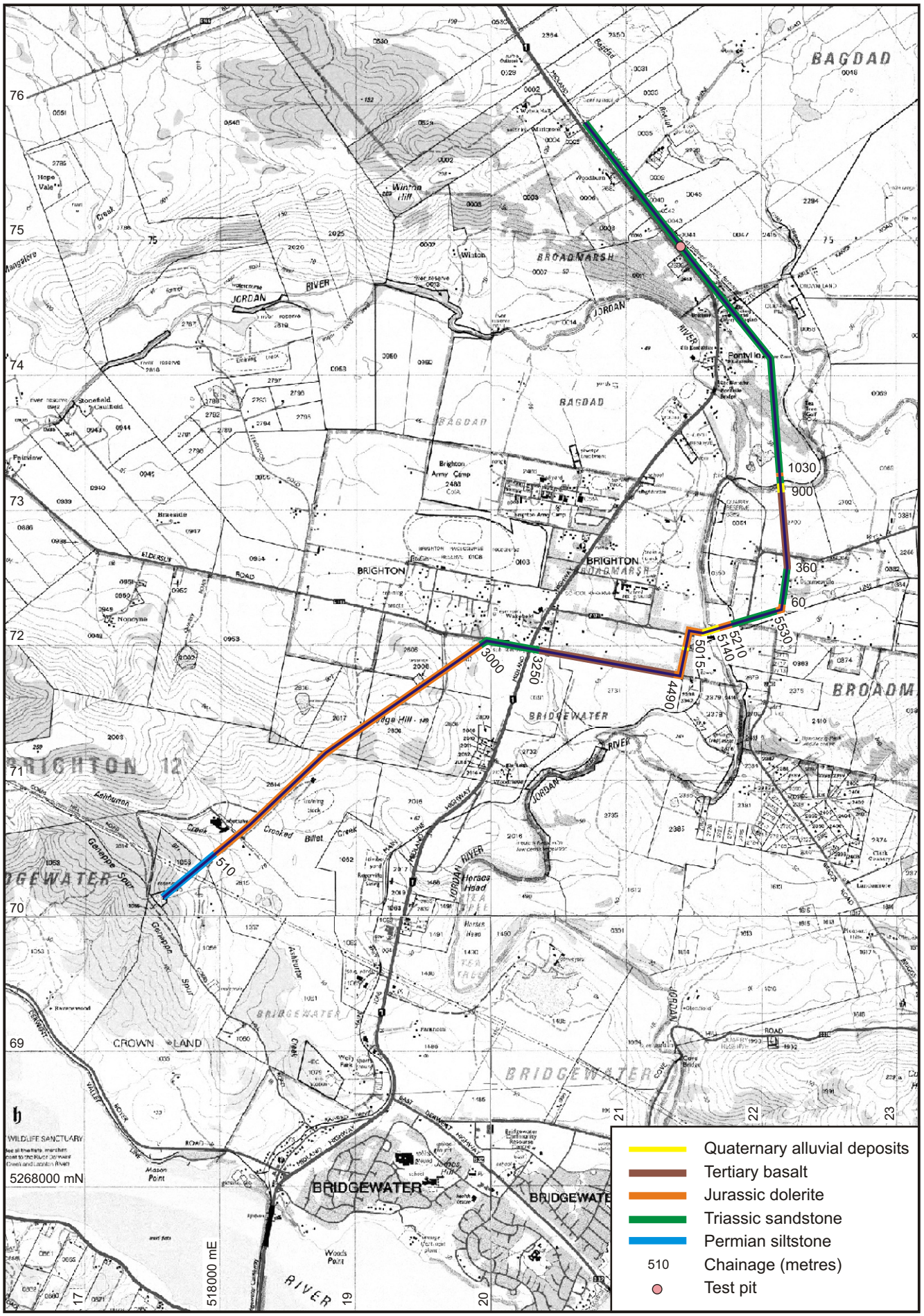

Figure 1

Location of proposed pipeline and geology

strength and is considered to represent the baked (metamorphosed) contact with the basalt. This is probably the only segment within this section that may require blasting. The sandstone over the remaining section should be able to be ripped without undue difficulty.

The materials exposed in the road cutting on the Midland Highway (200–300 m south of Elderslie Road) will give the contractor a good indication of the type of materials to be expected. The sandstone/mudstone sequence has a general (10–15°) southerly dip; the materials are slightly to highly weathered and of medium to low strength. Soil cover varies from 0.5 to 2.0 metres.

Chainage 3520–4490 m: Tertiary basalt

There is virtually no outcrop over this section. The land has been largely cleared of float (boulders etc.) although some segments have up to 20% float still remaining. There appears to be a tendency for the float to be dominantly vesicular over the initial 100–150 m and then become more massive. Basalt was noted to sub-outcrop over the final twenty metres; the rock was slightly weathered, of extremely high strength and massive. Materials such as these encountered along the route would almost certainly require blasting. The soils vary from red/brown clay (CH) to black clay (CH).

As with the dolerite, the weathering profile in basaltic terrain is typically variable, both in depth and lateral extent. This makes any reliable estimate of excavation conditions most difficult. An inspection of the materials exposed in the road cutting on the Midland Highway (same cutting as described above) will be of benefit to contractors, with both vesicular and massive basalt varieties being present. The rock varies from slightly to highly weathered, and is generally of high to extremely high strength. The soil/rock interface is irregular (0.5–2.0 m) with a tendency for the rock near the interface to be of a rubbly nature. The joint frequency is highly irregular and joints are mainly tight. There is evidence of pre-splitting over some sections of the cutting.

Chainage 4490–5015 m: Dolerite

The pipeline is to be laid beneath the road along this section. Because of residential development, exposure of natural materials is extremely poor. An isolated exposure occurs on the roadside drain at the corner of William and Munday streets where a 0.5 m thick profile is seen, with slightly to highly-weathered dolerite underlying some 200 mm of topsoil. The dolerite was closely jointed (50–100 mm spacings) and could be easily ripped. A narrow strip, about 30 m wide, of alluvial material (sandy clay CH) can be expected in the dip along Munday Street.

Chainage 5015–5140 m: Quaternary age alluvial deposits

The materials across the Jordan River flats comprise an intercalated sequence of clay, silt, sand and gravel. Bedrock was not observed in the river and it is expected that the alluvial deposits are several metres deep.

Chainage 5140–5210 m: Dolerite

There is sporadic sub-outcrop over most of this section. The rock is blue-grey, fresh to slightly weathered, and has extremely high strength. The jointing is close and tight. Soils are red and brown clay (CH). It is envisaged that some blasting will be required.

Chainage 5210–5530 m: Sandstone

Soils are yellow-brown sandy clay (CH) and clayey sand (SC) with sparse sandstone float. There is no outcrop along this section although a 100 m long, four metre deep cutting excavated for a now abandoned railway line (chainage 5260 m) exposes a typical sequence of rocks that can be expected to be encountered along this section of the pipeline. The cutting shows a range of materials, from a slightly weathered quartz sandstone of medium strength at near outcrop to grey-brown fissile mudstone of very low strength. The sequence dips at 10–15° to the south, the jointing is irregular and generally tight. The strength of the materials is such that it is anticipated they can be ripped. Again this is an ideal location for contractors to observe the materials and assess the type of materials likely to be encountered.

Chainage 5530–5610 m and 0–60 m (northern branch): Dolerite

The soils are dominantly black clay (CH) with some float. The float is either basalt or fine-grained dolerite, more probably the latter. Part of the float is composed of white calcium carbonate fragments associated with hydrothermal solutions. It is not uncommon for the rock to be highly weathered at shallow depths when associated with these solution features and it is likely that much of this section will not require blasting.

Chainage 60–360 m: Sandstone

This section is characterised by yellow-brown sandy clay (CH), clayey sand (SC) and silty sand (SM) with associated sandstone float. In addition sandstone rock crops out over some 60 m or 20% of this segment. The bedrock is typically a medium to coarse-grained quartz sandstone with a generally shallow dip to the south. It varies from slightly to highly weathered, is of low to medium strength while jointing is tight but irregular. The material exposed should be rippable with large machinery.

Chainage 360–900 m: Basalt

Most of this section is characterised by red and brown clay (CH) soils with some scattered basalt float (boulders). Basalt occurs in sub-outcrop over about the final 90 m, the result of the incising of the Jordan River. The soil cover along the flanks of the Jordan River valley is typically shallow, often between 0 and 1.5 metres. The underlying rock is only slightly weathered and of extremely high strength. Blasting must be expected along parts of this section.

Chainage 900–990 m: Alluvial deposits

The materials and excavation conditions across these river flats are expected to be similar to those further downstream (chainage 5015–5140).

Chainage 990–1020 m: Sandstone

This section incorporates the northern bank of the Jordan River. The area is steep, comprising a series of small sandstone cliffs. The sandstone is medium to coarse grained, has medium to high strength, and is slightly to highly weathered.

Chainage 1020–1030 m: Dolerite

Dolerite float was noted over this small chainage and represents the edge of a small isolated pod of rock of only several hundred square metres.

Chainage 1030–3500 m (approx.): Sandstone

The near subsurface conditions are likely to be variable over this 2500 m section of the pipeline, although certain generalisations can be formed. The surface soils along the entire section vary from sand (SP), silty sand (SM) and sandy clay (CH). There is only minor float (sandstone rock fragments) over much of this section, except for some 400 m (chainage 1400–1800 m approx.) where there is a high percentage of float (>30%) associated with areas of sub-outcrop.

An inspection of the workings at the Etna quarry (located some 100 m west of chainage 1200 m) showed the soil to be of the order of 0.5–1.0 m thick and underlain by sandstone. The sandstone was typically slightly weathered (some highly weathered) adjacent to bedding and joint planes, medium strength and essentially massive. Discussions with quarry personnel indicated that the sandstone could be ripped by suitably large machinery and blasting was not required.

At the time of the field work, pegging of the route had progressed to chainage 2160 m only; a general alignment was taken for the remaining segment.

Subsurface information from excavations associated with the grave diggings at the Pontville Cemetery (chainage 2400 m approx.) indicated that sandstone was present and was excavatable, presumably to a depth of two to three metres. The final piece of subsurface information available was noted in two recently excavated test pits at chainage 3000 m (approx.). The profile showed approximately 1.0 m of a stiff sandy clay (CH) grading down (over 0.5 m) to a weathered sandstone/quartzite.

It is envisaged that some ripping will be required along a fair percentage of this section and blasting will be minimal.

SUMMARY

Some 52% of the route is underlain by dolerite and basalt. The weathering and strength characteristics of these materials are inherently variable and therefore unpredictable, both laterally and in depth, even over short distances. Blasting must be expected, especially in areas of near outcrop.

Triassic sandstone underlies 40% of the route. This rock can be expected to be encountered at depths from 0.5–1.5 m and it is anticipated that this can be excavated by ripping. Blasting should be minimal.

Permian siltstone will be encountered over the initial 500 m (5.5%) of the route. The soils are likely to be 1.0 m deep, and whilst the rock substrate has a high strength, the rock mass incorporates defects which makes it blocky and should be able to be ripped.

Contractors should be encouraged to view the road/railway cuttings as detailed in order to be in a better position to appreciate the type and variability of materials that will be encountered during the excavation phase.

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