

1977/55. Investigation of proposed pipeline route, Devonport to Latrobe.

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The North West Regional Water Authority commissioned Gutteridge, Haskins and Davey, consulting engineers, to carry out the design for the proposed pipeline between Williams Reservoir and Victoria Bridge and East Devonport and Latrobe. As part of the design, information was required on the stability of the land through which the pipeline would pass and advice was sought on any special construction methods that may minimize the effects of any potentially unstable areas. Concern was also expressed on the location of the proposed reservoirs with regard to landslip possibilities. The general layout of the proposed water pipeline system is shown in Figure 1.

#### GEOLOGY

Jurassic dolerite, Tertiary sediments, Tertiary basalt, Quaternary alluvium and talus deposits will be encountered in the construction of the proposed pipeline. Whilst each rock type exhibits a characteristic set of engineering properties, there will undoubtedly be considerable variation and diversity in the properties of the material within the proposed limits of excavation; differential weathering in the near sub-surface (2-3 m) will present extremes in rock properties.

This feature is particularly apparent in the dolerite and basaltic rocks, where the degree, depth and lateral extent of weathering and soil development is highly irregular and often unpredictable from surface indications. This situation is demonstrated in the cuttings along the Bass Highway in the vicinity of the Middle Road overpass, where zones of fresh dolerite pass laterally into deeply weathered soil profiles.

Nevertheless, despite these variable weathering characteristics, the basalt and dolerite appear to be typically deeply weathered and can be expected to present little problem during excavation. Boulders of fresh rock up to 1.0 m in diameter are likely to be encountered within the soil profile, especially in the dolerite. The use of explosives is anticipated to be minimal but their use should not be discounted.

The Tertiary sediments are represented by the Wesley Vale Sands, a formation of predominantly sand or weakly indurated sandstone, intercalated with clay. Recent excavations in the course of development of the Ambleside Park subdivision indicate that the main problem associated with excavation is that of potentially unstable trenches, which are liable to collapse, especially in zones of predominantly unconsolidated sand.

A sequence of late Tertiary terrestrial sand, clay and buckshot gravel overlie the Jurassic dolerite on Dooleys Hill and occupy the proposed site of Latrobe reservoir. Characteristics of these sediments are discussed under reservoir sites.

#### DISCUSSION OF STABILITY

Areas of potential instability associated with the proposed pipeline route are restricted to the section between the Victoria Bridge and Latrobe [Contract 17-80-5].

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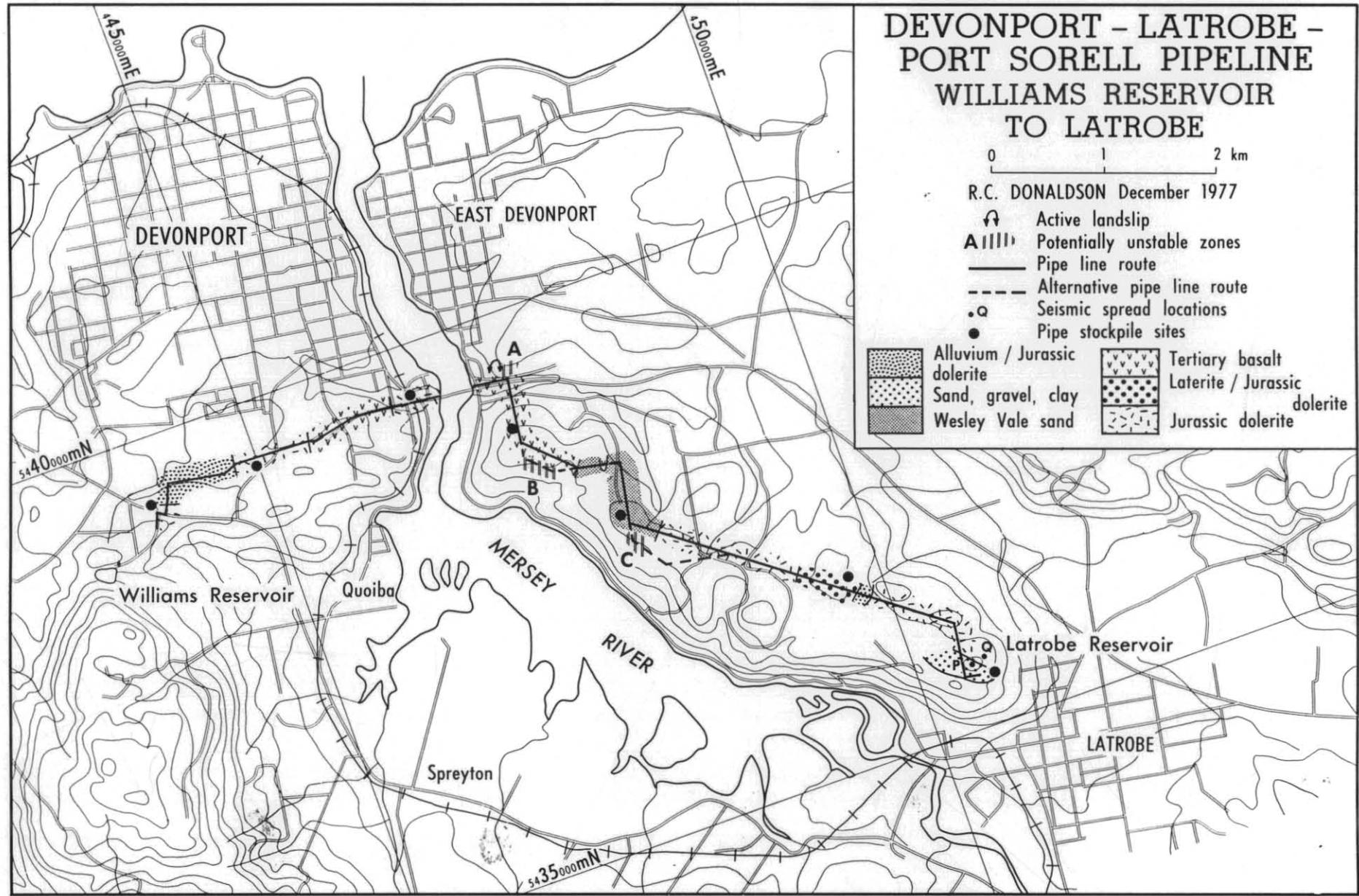


Figure 1.

5 cm

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Unstable conditions in the Devonport-Latrobe area, as with many areas along the north-west coast, are associated with the movement of water through weathered and unconsolidated materials on the steeper slopes. This situation is particularly prevalent on the steeply sloping land rising from the Mersey River between Devonport and Latrobe. Fortunately, the majority of the proposed pipeline route along this section is sited on the dissected plateau beyond the slope and presents no apparent stability problems. However, three potentially unstable zones warrant further consideration (Figure 1; zones A, B and C).

*Zone A.* The pipeline is charted as passing across the bottom of the slope of zone A, an area of potential instability immediately to the east of Victoria Bridge. The slope above this section of the route exhibits an irregular surface, suggesting evidence of a period of past instability. The pronounced characteristic features associated with landslip zones have been subdued and modified to the point where one cannot be definite from surface evidence whether the slope has previously failed or whether the current form is entirely due to natural processes of weathering and erosion of the basalt. It should however be regarded as a potentially unstable slope due to the proximity of the active landslip area further around the same hillslope. Remedial measures have been undertaken by the Department of Main Roads to stabilise this active area.

It is considered that the effect of a pipeline sited at the base of the slope should not greatly modify the current stability regime. To minimise the effect of this artificially placed structure, it is recommended that the trench be backfilled with suitable materials and compacted to a practicable maximum density.

*Zone B and C.* These zones represent areas of potential instability and affect the proposed pipeline only if the alternative route is finally adopted. The original pipeline route has been altered where indicated, because of recent proposals for high density residential subdivision development, designed to encompass all that land down to the alternative route.

It is stressed that the original proposed pipeline route is, in both instances, far preferable as it does not cut across zones of potential instability. However, the problem remains; can a pipeline be sited with safety along the alternative routes?

With respect to instability associated with zone B, the alternative pipeline route is located across the head region of a potentially unstable zone which incorporates sections of the Ambleside subdivision further down-slope. Whilst there are no obvious surface indications of active mass movement, the land surface exhibits the characteristic signs of old landslip structures. This factor alone increases the risk factor of assured long term stability of the pipeline, but by an unknown amount.

The land appears to be currently "stable" under its present land use, but has the potential to re-activate. This situation could arise if the pipeline trench (estimated to be between 2-3 m deep at this location) were to act as a collector drain for both surface run-off and sub-surface waters, diverting, concentrating and channelling water into the head region of this potentially unstable zone. This problem could be largely overcome if an effective drainage system were installed at the base of the trench in an attempt to disperse excess water away from the unstable area. A system incorporating P.V.C. ag-pipe could probably be installed.

There is also the risk of a leaking water main, which would add additional water to the system, again reducing the present stability of the slope.

In summary, the original pipeline route located on flatter ground further upslope is considered preferable. However with careful installation, minimal disruption to the surrounding surface and the installation of an effective sub-surface drainage system, the alternative pipeline route should not by itself, under normal circumstances, greatly alter the stability of the slope.

The question should be raised as to whether the area of land located between the original and alternative pipeline routes would be suitable for high density residential subdivision in light of the potential detrimental affect it may have on the stability immediately downslope. High density housing estates can create problems when permitted in close proximity to potentially unstable areas.

In the case of zone C, slumping has occurred towards the top of the gully, and again this zone appears to be currently non-active. The same set of arguments apply with respect to problems and solutions as discussed above.

#### RESERVOIR SITES

Despite the variable range of geological conditions, there are no apparent stability problems associated with the proposed reservoir locations, which include the pipe stockpile sites.

A seismic refraction survey was carried out at the site of the proposed Latrobe reservoir in order to determine the nature of the foundations. Two sites, approximately 100 m apart, were delineated by Gutteridge, Haskins and Davey as possible sites, with preference for site P (fig. 1). The survey at each site comprised two cross spreads, with geophone intervals of 3.0 m and were located within the bounds of a series of recently excavated test pits.

The results of the survey (table 1) indicate that the seismic velocities fall into three distinct groups which are considered to correlate with velocities expected from the materials exposed in the test pits.

The spreads were interpreted as:-

##### Site P.

*Spread 1.* A thin veneer of grey sandy top soil overlies a relatively uniform thickness of dry unconsolidated sand, clay and buckshot gravel. An unknown thickness of compacted clayey sediments can be expected below about 7 m.

*Spread 2.* Up to 1 m of surface sand and soil overlie a layer of unconsolidated sediments which tend to thicken slightly to a maximum of 8.4 m towards the south-east.

##### Site Q.

*Spread 3.* A deeply weathered dolerite profile comprising mottled red/brown clay, extremely weathered-rock and boulders of relatively unweathered dolerite can be expected to depths between 8-10 m, below which an unknown

thickness of weathered and fractured dolerite approaching the upper limits of excavation, will be encountered.

*Spread 4.* A gradational and variable weathering profile as in spread 3, however, the bottom refractor layer was not seen at the north-west end of the spread.

#### CONCLUSIONS AND RECOMMENDATIONS

The proposed water pipeline from Williams Reservoir, Devonport to Latrobe passes through up to three potentially unstable zones in the section between the Victoria Bridge and Latrobe. These areas show no obvious signs of recent movement but must be regarded as having the potential for re-activation.

Two of these zones (B and C, fig. 1) can be avoided if the original pipeline plan is finally adopted, being the preferable of the two alternatives.

In the event of the alternative pipeline route being chosen, it is imperative that several precautions be taken across the potentially unstable zones. It is recommended that provision be made for the installation of a drainage system at the base of the trench to divert any excess waters that may collect, as water is a major factor influencing the stability of a slope. In addition, the trench should be backfilled and compacted to a practicable maximum density in order to restore the disturbed ground to near its original properties. This will also help avoid the trench acting as a collector drain.

It is not anticipated that stability problems will arise from the installation of any of the proposed reservoirs. With respect to the Latrobe reservoir sited on Dooleys Hill, solid rock foundations do not exist in the near sub-surface.

[15 December 1977]

Table 1. SUMMARY OF SEISMIC REFRACTION SURVEY

Site	Spread No.	Orientation	Velocity layer	Seismic velocity (m/s)	Average layer thickness (m)	Geological Interpretation
P	1	NE-SW	1	300-400	0.4-0.7	Grey sand/top soil.
			2	700-750	6.4-6.9	Dry unconsolidated sand, clay and buckshot gravel.
			3	1200-1350	-	Compacted clayey sediments.
	2	NW-SE	1	300	0.7-1.0 )	As above.
			2	575-800 )		
			3	1100-1750 )		
Q	3	NE-SW	1	300-360	0.9-1.0	Red-brown clays/top soil.
			2	550-1000	8.2-10.3	Extreme weathered dolerite, clay and associated boulders.
			3	1700-2175	-	Weathered, fractured dolerite.
	4	NW-SE	1	450-500	0.6-0.8 )	As above.
			2	650-1000 )		
			3	1650 )		

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