



Geological investigation of the proposed Pontville–Mangalore water supply pipeline route

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INTRODUCTION

A geological investigation was undertaken of the route of the proposed new Pontville–Mangalore water supply pipeline.

GEOLOGICAL INVESTIGATION

The proposed new pipeline, commencing from the end of the existing line at chainage 2160 m, extends northwards along the Midland Highway to the Mangalore reservoir. The pipeline is the continuation of the Cobbs Hill–Pontville line which was the subject of a previous Department report (Donaldson, 1986).

The geological investigation of this 5.5 km section sought to provide basic information on the nature and range of subsurface materials likely to be encountered to a depth of 2–3 m (average excavation depth) along the route with specific reference to rippability and soil corrosiveness.

The investigation, carried out over a four-day period, involved geological route mapping and a continuous traverse resistivity survey, followed by seismic refraction surveys at selected locations.

SURVEY DETAILS

Seismic Refraction

Ten spreads were fired at locations selected on the results of the geological mapping and resistivity survey. These were designed to determine a typical range of excavation conditions likely to be expected from the major rock types. Traverses were carried out both in areas of outcrop or sub-outcrop and soil cover only.

A Nimbus 12-channel seismograph was used; spread lengths of 24.0 m were employed with 2.0 m geophone spacings. Shots were fired from both ends. Calculations were made by the critical distance, intercept time, and where appropriate, the reciprocal time methods.

Resistivity

Continuous resistivity traversing was carried out along the entire route in order that a guide to the soil corrosivity could be determined. The traversing was done using the constant electrode spacing Wenner

configuration; electrode spacings of 4.0 m were employed.

RESULTS

Every effort has been made to predict, as accurately as possible, the likely nature and range of materials to be encountered along the proposed routes. It is stressed that in any investigation employing geophysical methods, the results are an interpretation (based largely on experience) of the physical properties measured. No amount of investigative work at this preliminary survey level can accurately predict the extremes or rapid variability of materials (both laterally and vertically) that may exist over short distances.

In short, contractors should view the results only as a guide to the conditions likely to be encountered and judgements made accordingly following a field inspection, preferably backed up with trial test pits.

ROUTE GEOLOGY

Outcrop along the route is very sporadic and mapping was therefore based largely on surface soil information. Fortunately, it is considered most of the soils are residual and reflect the underlying parent bedrock. In several places soil boundaries were indistinct and overlapped, which accounts for the slight differences between the route map (fig. 1) and the published 1:50 000 scale Brighton geological map sheet (Leaman, 1975).

The proposed route is underlain by four distinct rock types of different geological ages, origins and physical characteristics.

At bedrock level, the route is underlain by Tertiary sand and clay deposits (45% of the route), Triassic sandstone (35%), Jurassic dolerite (10%) and Permian siltstone and mudstone (10%). The degree and depth of weathering of these rocks can be expected to be variable and excavation will be largely confined to these weathered in situ materials.

EXCAVATION CONDITIONS

The mapping and seismic refraction survey results (Table 1) suggest that the excavation phase of the project will, over the vast majority of the route, involve the removal of the weathered materials overlying

bedrock. These materials will range from unconsolidated sand and clay through to highly to slightly weathered jointed rock.

In general terms, the Tertiary deposits will mainly comprise sand/clay materials grading downwards into low strength mudstone and sandstone. These materials are not expected to cause any difficulties with respect to ease of excavation. The Triassic sandstone is likely to exhibit a gradational weathering profile that usually produces sandy soils with clay sub-soils, grading into a highly-weathered low strength rock. These weathering profiles are commonly of the order of several metres depth.

Irregular weathering is characteristic of the dolerite, both in depth and lateral extent. These rocks tend to produce brown and black high plasticity clay soils overlying bedrock which will vary from being highly weathered to only slightly weathered. Permian sedimentary rocks (siltstone-mudstone sequence) invariably have shallow weathering profiles and 'rock' conditions must be expected in part where these materials are encountered.

The majority of 'rock', where encountered, whilst it may be only slightly weathered and of high strength, should be sufficiently open jointed at the 2.0–3.0 m excavation depth to be either worked with the bucket of a large excavator or removed with the aid of a hydraulic impact rock breaker.

Velocities in excess of about 2500 m/s (dolerite) and 3000 m/s (Permian and Triassic sedimentary rocks) are considered to represent material that would probably require blasting. Whilst these velocities were seen in the seismic spreads, they were, with the exception of spread 4 (Table 1), well below the excavation limit.

From the information available, it is considered that very little blasting should be necessary along the 5.5 km route. The anticipated areas of 'hard rock' should be restricted to zones within the dolerite and Permian siltstone. These rock types combined constitute about 20% of the total route. However the attitude and general fracture spacing (jointing) observed in some of these 'hard rock' outcrop areas suggest that only isolated sections may require blasting.

The resistivity traverse results (fig. 2–4) tend to show a broad correlation between high resistivity values and either outcrop or areas of float. These results may be used, with caution, to indicate areas of possible bedrock close to the surface. However one should not draw the conclusion that areas of low resistivity preclude hard rock conditions.

SOIL CORROSIVENESS

The series of plots (fig. 2–4) resulting from the resistivity survey are essentially self explanatory and need little comment.

Based on a set of figures supplied by the Board relating soil corrosivity to resistivity, the plots suggest that the Tertiary and Triassic sediments (80% of the route) lie in the corrosive to moderately corrosive (500–2000 Ωcm) range whereas the Permian sedimentary rocks and dolerite are basically only mildly corrosive (2000–10,000 Ωcm). No comment is made on the degree of protection required to ensure the longevity of the pipes.

SUMMARY

A variety of rock types with different weathering characteristics and physical properties will be encountered during the excavation for the proposed 5.5 km water supply pipeline.

The most variable and therefore unpredictable conditions will be associated with the dolerite; the depth and degree of weathering, both laterally and in profile, can vary rapidly. This makes any reliable estimate of excavation conditions most difficult. The results suggest that most of the 'hard rock' encountered should be sufficiently well jointed and weathered to allow the material to be loosened with a hydraulic impact rock breaker. Minor blasting may be required over short sections.

Shallow soil depths can be expected over much of the Permian sedimentary rocks. Rock conditions will be encountered but the rock mass appears to be well jointed, allowing the material to be loosened more readily. As with the dolerite, minor blasting may be required over short intervals.

The Triassic sandstone is considered to have a sufficiently thick weathering profile such that it is unlikely explosives will be required, except perhaps in isolated locations.

The Tertiary deposits are not expected to present any 'hard rock' conditions requiring explosives.

The resistivity results show about 80% of the route has corrosive to moderately corrosive soils.

Contractors should view the results of the investigation as a guide to the conditions likely to be encountered and a judgement made accordingly following an on-site visit, preferably backed up with trial test pits.

REFERENCES

- DONALDSON, R. C. 1986. Geological investigation of proposed pipeline Cobbs Hill to Pontville. *Unpublished Report Department of Mines Tasmania* 1986/89.
- LEAMAN, D. E. 1975. *Geological Atlas 1:50 000 series. Sheet 75 (8312N). Brighton.* Department of Mines, Tasmania.

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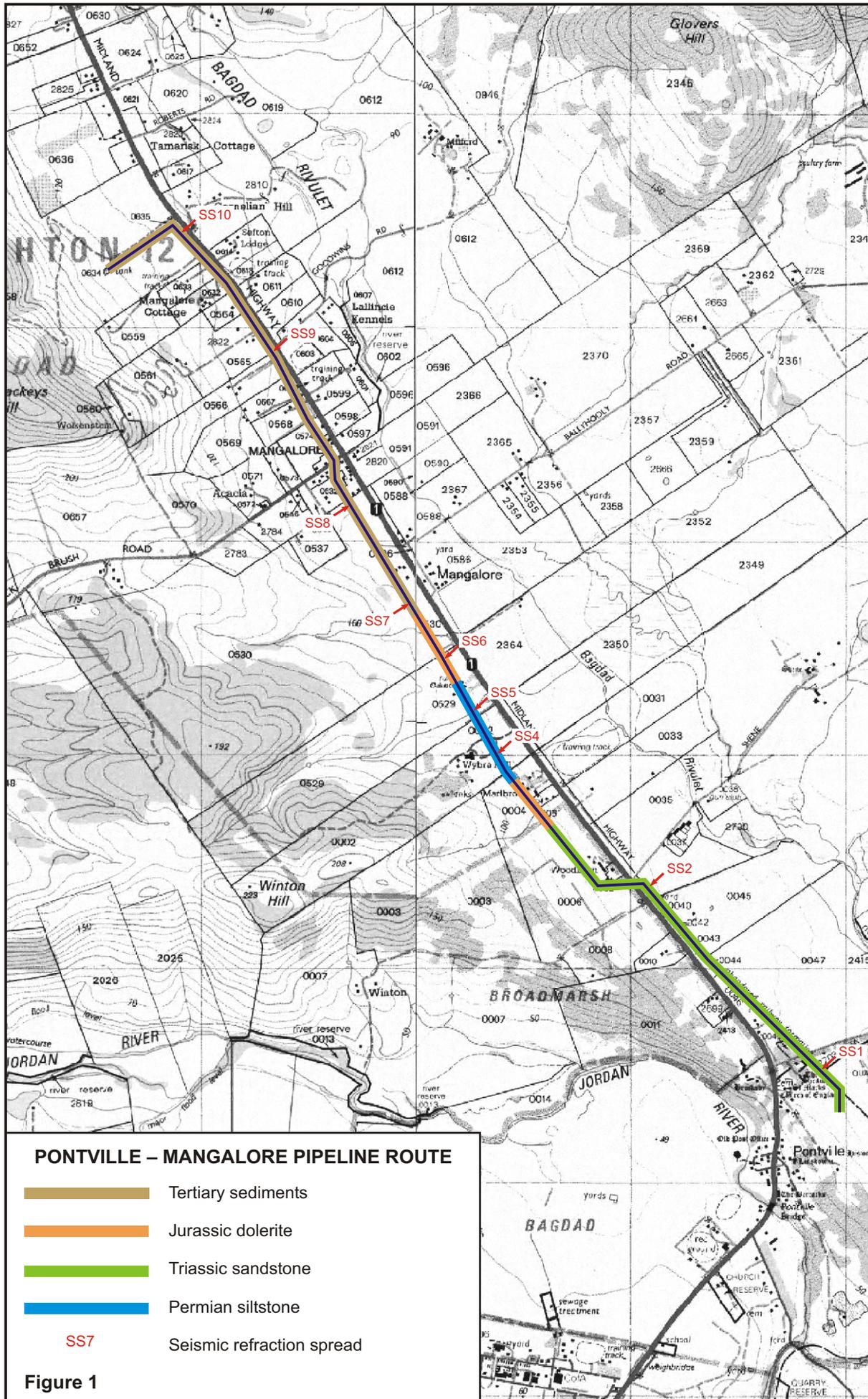


Table 1
Seismic refraction survey results

Spread No.	Chainage (m)	Rock type	Layer			Geological Interpretation
			Velocity(m/s)	Depth (m)	Thickness (m)	
1	2400–2424	Sandstone (Triassic)	V ₁ : 520–615 V ₂ : 1150–1330	2.0–3.5 7.5–8.0 ⁺	2.0–3.5 4.5–5.5 ⁺	Unconsolidated sandy clay (SC–CH) Residual clay grading into EW rock
2	3510–3534	as above	V ₁ : 450–500 V ₂ : 615–695 V ₃ : 860*	0.6–0.7 4.5	0.6–0.7 3.9	Unconsolidated sandy clay (SC–CH) Residual clay (unsaturated) overlying bedrock As above
3	4296–4320	Dolerite (Jurassic)	V ₁ : 330–450 V ₂ : 1330 V ₃ : 3000*	0.5–0.6 5.4	0.5–0.6 4.8	Unconsolidated surface clay (CH) Residual clay grading into EW to HW rock SW–FR rock; tightly jointed
4	4536–4560	Siltstone (Permian)	V ₁ : 570–660 V ₂ : 1330* V ₃ : 2288–4000	0.6–0.9 2.3	0.6–0.9 1.7	Unconsolidated silty clay (ML–MH) Residual clay grading into EW rock SW–FR rock; joints open to tight
5	4764–4788	as above	V ₁ : 300–530 V ₂ : 730–890 V ₃ : 2000	0.6–1.0 2.5–3.2	0.6–1.0 1.9–2.2	Unconsolidated silty clay (MH) Residual clay (unsaturated) SW rock; joints open
6	5064–5088	Dolerite (Jurassic)	V ₁ : 310–330 V ₂ : 1500–1800 V ₃ : 3000+	0.8–0.9 4.7–7.3	0.8–0.9 3.9–6.4	Unconsolidated surface clay (CH) HW–SW rock; joints open, some clay filled FR rock; joints closed
7	5400–5474	Tertiary sediments	V ₁ : 550–615 V ₂ : 940–1040	0.9–1.6 8.00 ⁺	0.9–1.6 6.4 ⁺	Deposits of clay (CH) with sand and gravel bases becoming more consolidated with depth
8	5904–5928	as above	V ₁ : 330–340 V ₂ : 930–1000 V ₃ : 1330–1430 V ₄ : 2000	1.3–2.1 3.2–3.6 6.7–7.3	1.3–2.1 1.5–1.9 3.5–4.1	Similar to above materials saturated in V ₃ layer SW rock
9	6708–6732	as above	V ₁ : 315–330 V ₂ : 615–705 V ₃ : 800–940 V ₄ : 1330	1.8–1.9 4.1–4.3 6.6–6.8	1.8–1.9 2.2–2.5 2.3–2.7	Similar to above, materials saturated in V ₄ layer

Spread No.	Chainage (m)	Rock type	Layer			Geological Interpretation
			Velocity(m/s)	Depth (m)	Thickness (m)	
10	7340–7368	as above (possibly Triassic sedimentary rocks)	V ₁ : 330–350 V ₂ : 1330–1600 V ₃ : 2000*	1.5–1.6 4.6	1.5–1.6 3.0	Unconsolidated clay (CH) Residual clay grading into EW rock HE–SW rock

* Velocity recorded from one end only.

+ minimum layer depth assuming V₃ = 2000 m/s

FR = Fresh

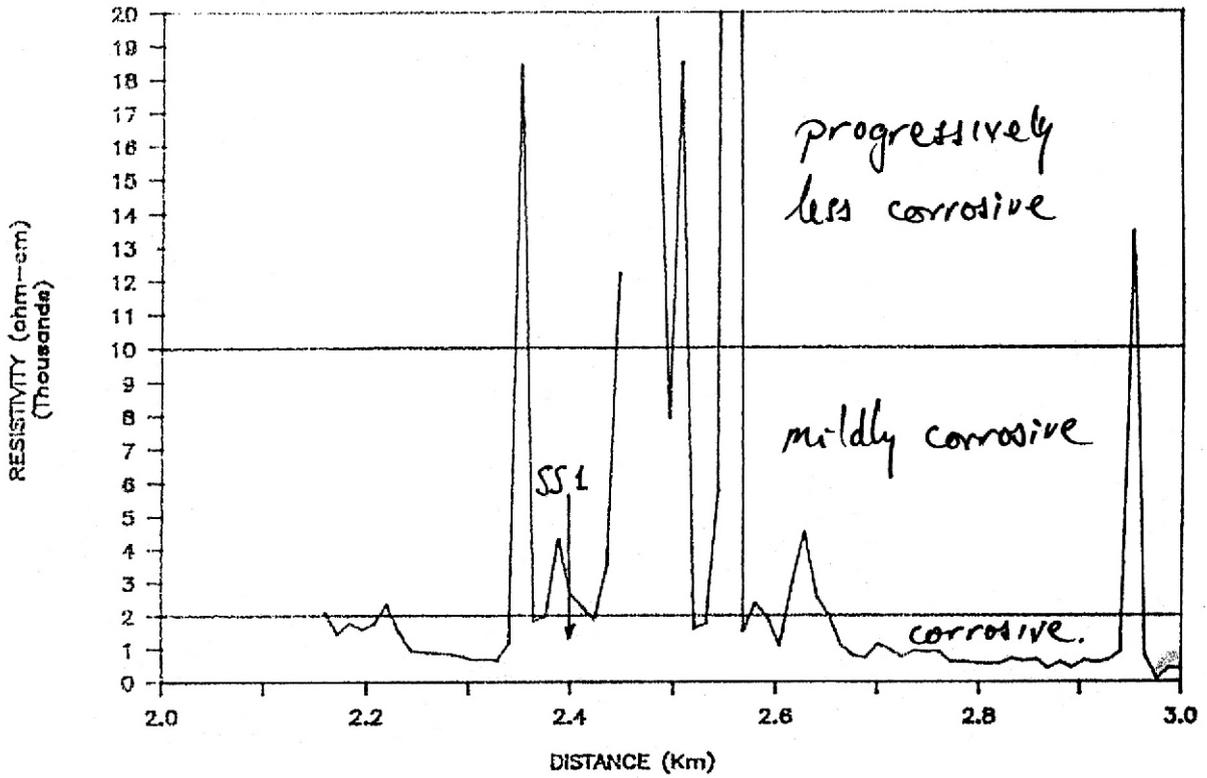
SW = Slightly weathered

HW = Highly weathered

EW = Extremely weathered

PONTVILLE - MANGALORE PIPELINE

RESISTIVITY SURVEY



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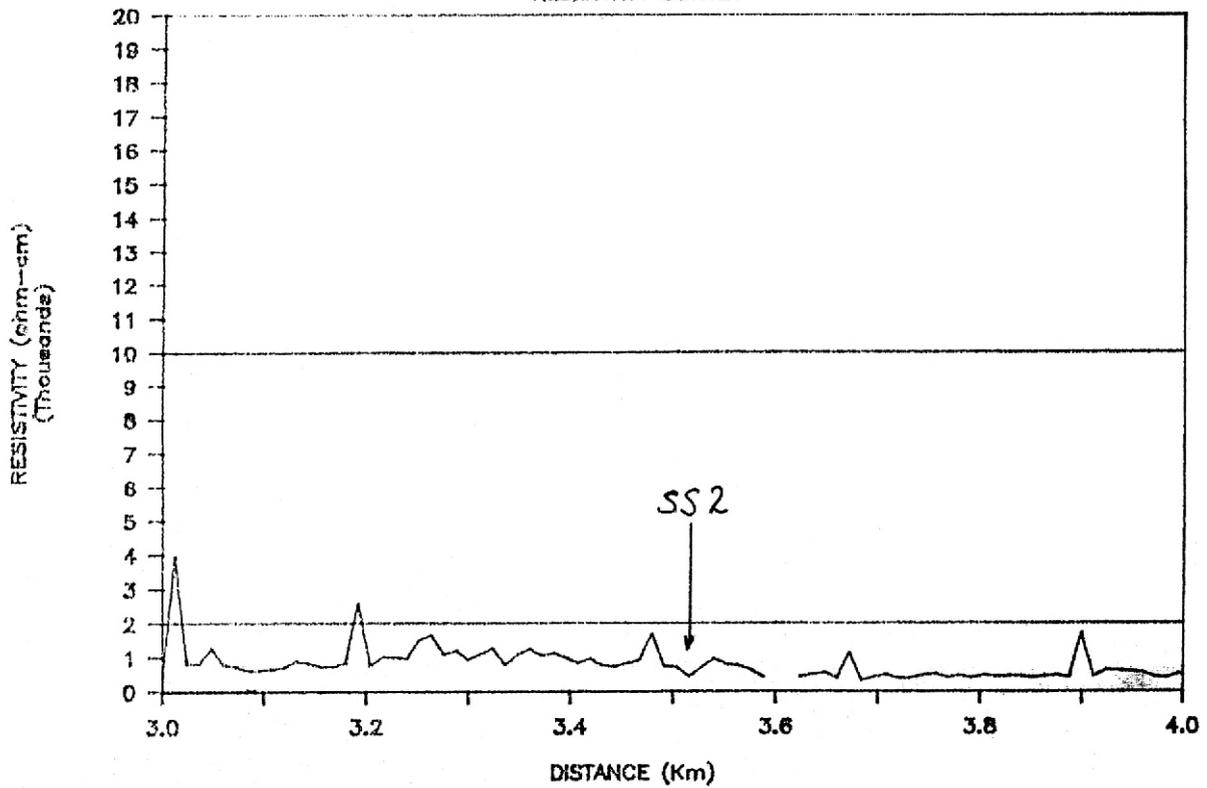
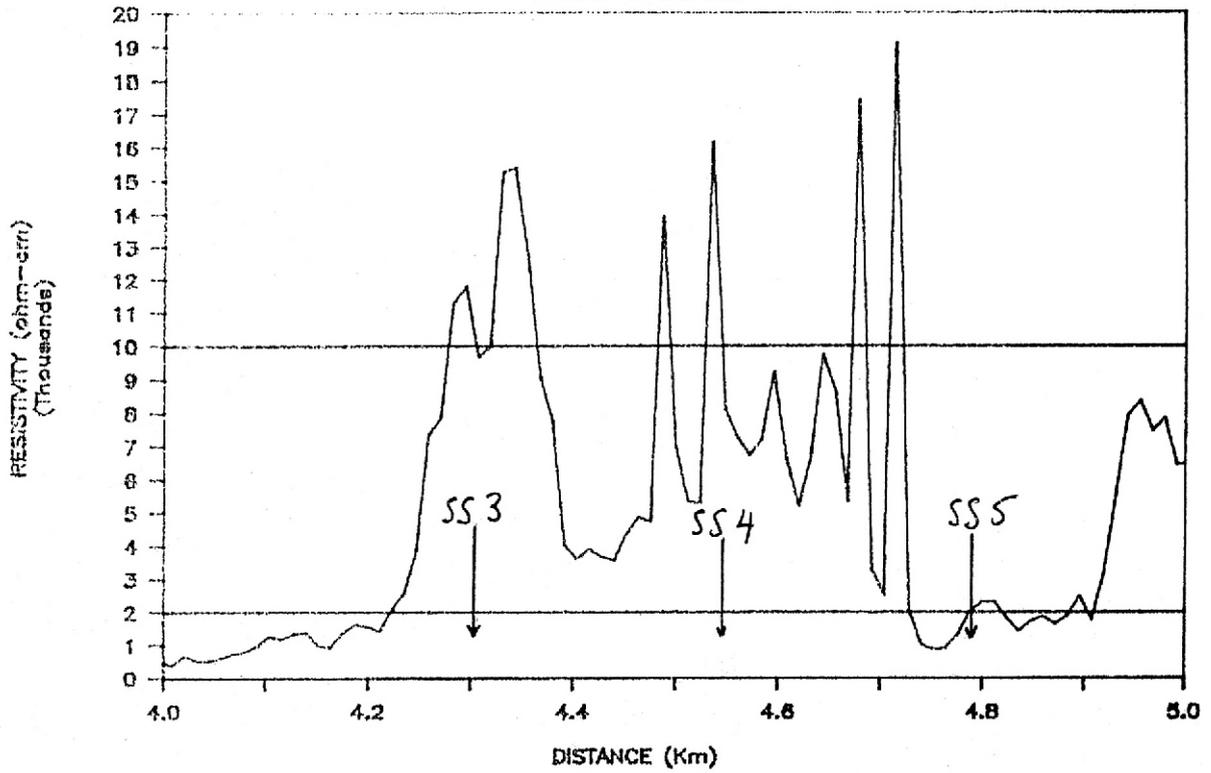


Figure 2

PONTVILLE — MANGALORE PIPELINE

RESISTIVITY SURVEY



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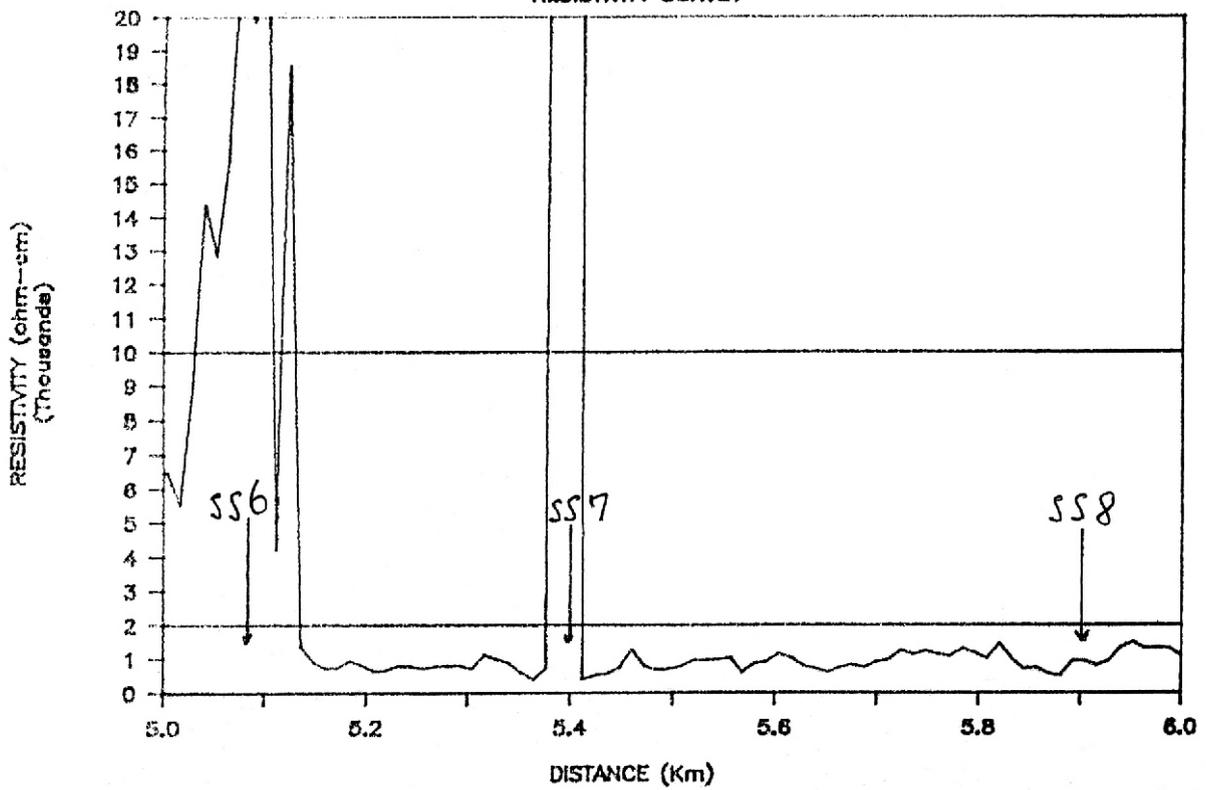
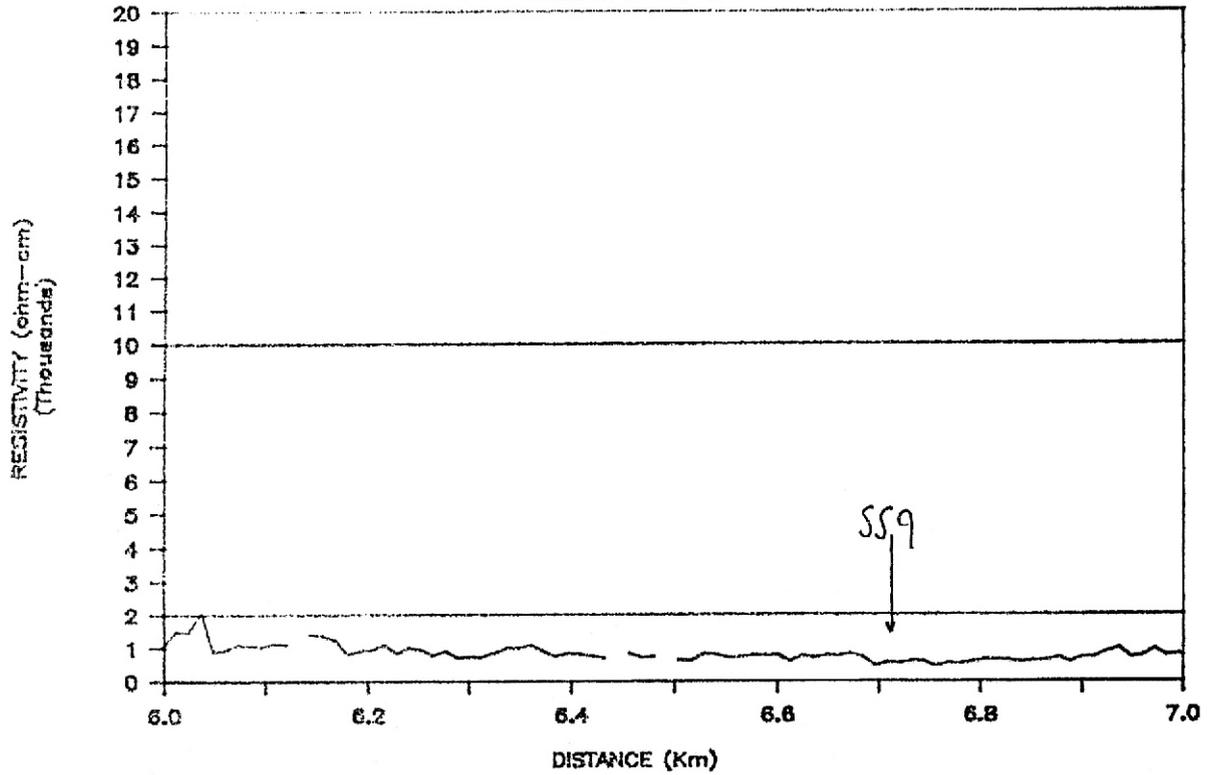


Figure 3

PONTVILLE - MANGALORE PIPELINE

RESISTIVITY SURVEY



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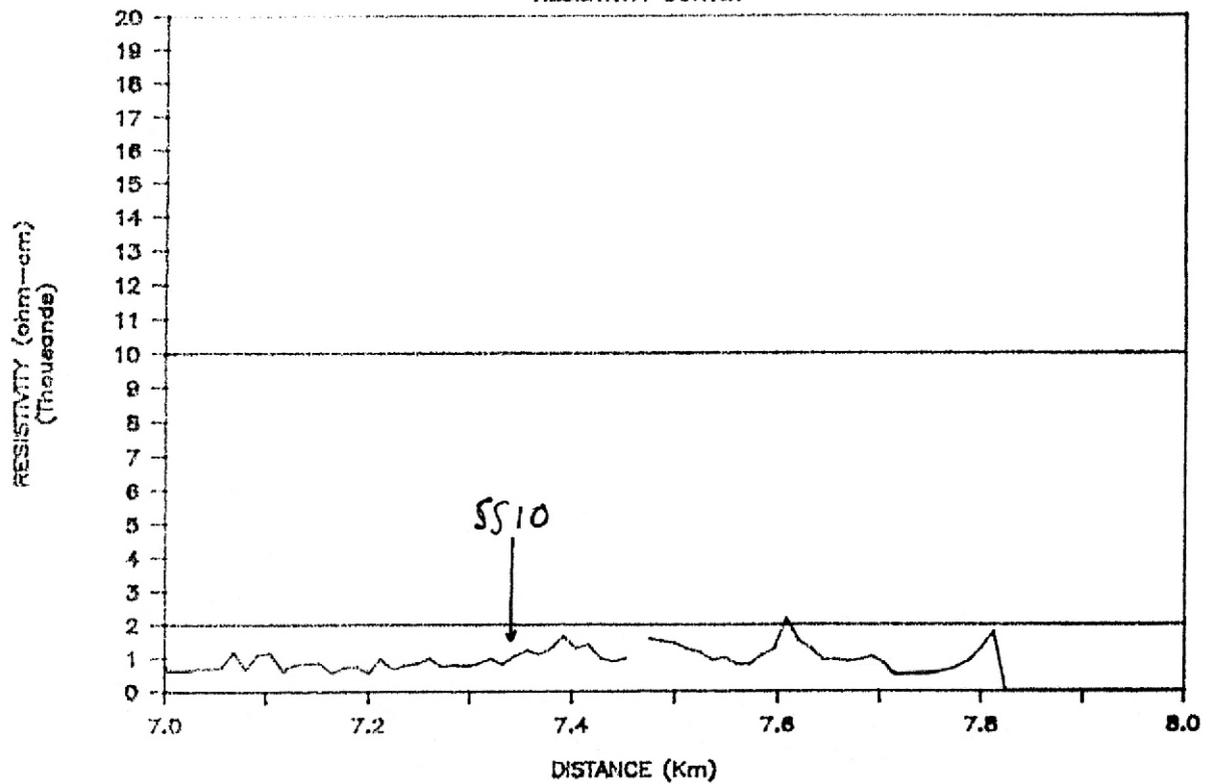


Figure 4