Department of Mines
South Australia

PRELIMINARY GEOLOGICAL REPORT
on the
SALT CREEK SITE
for a
PUMPED STORAGE ELECTRICITY GENERATION SCHEME

by

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URANIUM & FUEL SECTION
GEOLOGICAL SURVEY

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ABSTRACT

Salt Creek traverses Kanmantoo Group greywackes and arkoses striking north and south and dipping 25° east. Patches of Permian sands and clays occur in irregular Permian valleys. At the proposed dam site and to the west the rocks are heavily jointed and cut by minor faults. No major faults were observed. Water depositing carbonates is seeping from joint cracks at the lower dam site and carbonate bearing members are present in the arkose/greywacke sequence. Weathering appears to be shallow but the water table is low and solution of the calcareous members may have formed cavities. Drilling to test this possibility is recommended.

INTRODUCTION

Subsequent to the compilation of a preliminary report on the Yankalilla River site for a pumped storage project and the commencement of the recommended drilling the Electricity Trust advised that an alternative site had been chosen on Salt Creek near Cape Jervis, and that some geological investigations would be required there.

Following a number of brief inspections by the writer, which revealed calcareous rocks in the vicinity of the dam sites, discussions were held and at a conference between officers of the Electricity Trust, the Engineering and Water Supply Department and the Mines Department it was decided to explore one abutment of the proposed lower site by means of an adit 200 feet long.

It was hoped to get an early positive answer from this exploratory adit as to the possibility of solution channels and enlarged joint cracks occurring in the calcareous members of the rock succession at the dam site and in the reservoir rim. It having failed to do this it is now considered necessary to obtain the assurance required by means of drilling.

This report briefly describes the geology of the area, discusses the engineering geology of the various parts of the project and recommends a preliminary drilling programme.

If this drilling reveals no solution cavities or large open joints then no excessive amount of remedial treatment will be required to make the dam foundations and the reservoir watertight. In contradistinction, should cavities or large open cracks be intersected, then the cost of making the reservoir water tight is likely to be very large. Extensive exploration by means of drilling would also be necessary to define the limits of the leakage paths.

Apart from this, and subject to the usual limitations of opinions based on a brief examination of surface geology, there appear to be no geological features which will prevent successful completion of the project at the Salt Creek Site. It will of course be necessary to make much more detailed geological investigations prior to design of the structures and preparation of specifications, there being many geological features which will have a considerable influence on design and construction.

LOCATION AND TOPOGRAPHY

Salt Creek is the name given to the main trunk of a small drainage system with numerous tributaries which has an outlet to the sea in St. Vincent Gulf approximately 4 miles north-east of Cape Jervis. The main trunk has its source in a divide between Salt Creek and Yohoe Creek, along which the Delamere/Cape Jervis road runs. From this divide the stream flows westerly for 2½ miles, with tributaries joining it like branches of tree. Near Salt Creek Hill the Creek turns and flows due north in a narrow and rapidly deepening gorge with three major tributaries joining it on the eastern side and only a few short gullies draining from the west.

The headwater tributaries of Salt Creek flow in relatively broad V-shaped valleys with a steep bed gradient. These coalesce in an area underlain by soft Permian glacial sediments to form a wide flat bottomed basin-like valley across which the main stream meanders in a trench cut through its own aggradational deposits. A major part of the water storage behind the proposed dam would be in this basin.

Downstream of the basin the bed gradient of Salt Creek increases abruptly and the stream drops in a series of rapids and waterfalls through a vertical distance of approximately 105 feet in a distance of 30 chains. At both dam sites the valley profile is a flaring Vee shape with steep sides up to 200 feet above the stream bed and gentler slopes above this level.

The topography is characteristic of an area elevated to high levels in relatively recent geological times and eroded by active streams with a large run-off in relation to the size of their watersheds.

A series of cliffs carved out in an earlier cycle of marine erosion forms the sea front to the west of Salt Creek. These cliffs are mantled with talus, narrow coalescing alluvial fans, and piedmont deposits, which are being eroded by the sea into a second lower series of cliffs. In places a wave cut bench, 15 to 20 feet above present sea level, indicates a geologically recent rise in the land surface or drop in sea level. Fresh cliffs are also being formed in the resistant headlands of the older sea coast.

GEOLOGY

CAMBRIAN

In broad outline the geology of the Salt Creek area is rather simple. The bulk of the area is underlain by greywackes and arkoses belonging to the Kanmantoo Group of early Cambrian age. These are disposed in a series of folds of varying intensity, trending north and south. The principal part of the Salt Creek watershed and the country to the west, as far as the coast, lies on the westerly limb of a rather broad synclinal fold whose north-south axis is situated 1 mile east of Salt Creek Hill.

West of this axis to the coast the Kanmantoo beds dip eastwards at an average angle of 25°. Salt Creek flows parallel to the strike of the beds in the lower half of its course.

The Kanmantoo greywackes and arkoses are physically extremely tough and moderately hard rocks. Mineralogically they are composed of interlocking grains of quartz, felspar and biotite in varying proportions with minor amounts of pyrite, zircon, rutile, apatite and tourmaline.

Some beds contain calcite and dolomite. Detailed petrological descriptions are given in Appendix "A" together with analyses of the carbonate content of those specimens found to contain calcite and magnesium carbonate. The highest total percentage of carbonate so far determined is 13.55%.

Interbedded with the greywackes and arkoses are quartzites and biotitic shales. Westwards towards the coast and lower in the stratigraphic succession more shales appear and occasional phyllites.

The Kanmantoo beds range in individual thickness from a few inches up to several feet, with the thicker beds predominating along the lower valley of Salt Creek. The more arkosic and quartzitic members are coarser grained and noticeably cross bedded. Some of the calcareous beds are massive and weather to spheroidal boulders.

According to early regional mapping by Campana and Wilson and recent revision mapping by Thomson no major faults occur in the Salt Creek area but this may be due to the monotonous nature of the arkose/greywacke succession and the difficulty of mapping in the absence of easily traceable marker beds. Certainly there are a number of observable minor faults in the outcropping rocks along the valley of Salt Creek and on the coast and the rocks are heavily jointed, cleaved and sheared.

Minor faults observed near the junction of Plough and Salt Creeks have attitudes as follows:-

(i)	Strike	90°	M
	Dip	30°	S
(ii)	Strike	35°	M
	Dip	85°	SE

On the sea coast a series of thrusts were observed, en echelon, and branching, with an average strike 20° M.
dip 52° E.
or almost parallel to the bedding.

Along Salt Creek joints are numerous and closely spaced. The sets observed had the following attitudes:-

(i)	Strike	45° M	
	Dip	Vert. or 85° NW	
(ii)	Strike	156° M	
	Dip	Vert.	
(iii)	Strike	140° M	
	Dip	Vert.	
(iv)	Strike	74° M	
	Dip	37° South-south-west	
(v)	Strike	95°	probably fracture cleavage
	Dip	52°S	

The most prominent are sets (i) and (ii) and these are spaced 1 foot to 6 feet apart.

On the sea coast the joint sets are as follows:-

(i)	Strike	55° M
	Dip	60° NW
(ii)	Strike	125° M
	Dip	70° SW
(iii)	Strike	105°
	Dip	Vert.
(iv)	Strike	74° M
	Dip	38° North-north-west.
		(This set normal to (ii))

A change in attitude is thus evident between Salt Creek and the sea, and possibly some major thrust structure or other type of fault parallel to the bedding may occur.

Weathering in the valley of Salt Creek is difficult to assess in the absence of drill hole information. In the bottom of the valley at the lower dam site and for 100 feet up the slopes it appears to be shallow. Above this height soil covers most of the rocks and as the badly weathered beds in a succession of non-uniform rocks are invariably concealed beneath soil, drilling will be required to finally determine the depth of the near surface zone of weathering and the presence or absence of deeply weathered zones along favourable beds or down faults.

Some difference in weathering will be apparent in opposite banks of Salt Creek due to the easterly dip of the rocks which make the west or left bank a dip slope. Both recent and ancient landslides can be observed on the left bank in the stretch between the two alternative dam sites. In the recent slides (probably occurring in the 1955/56 wet seasons) up to 10 feet vertical thickness of soil and talus has slipped off clay covered bedding planes in the greywackes. The older slides have involved bedrock as evidenced by the cavity which was disclosed in excavations for the turnaround area at the bottom of the adit access road. In this slide a large massive bed of greywacke has been displaced up to 2 and 3 feet horizontally. Other old slides were cut by the road excavations higher up the gully.

Depth of weathering is also influenced by the position of the water table. Present evidence indicates this to be at a low level in the interstream divides. Deep weathering is then made possible along zones where meteoric waters charged with active weathering agents have easy access to the rocks on their way down to the water table.

One further occurrence of significance in the weathering behaviour is the seepage of lime bearing waters from joint cracks in the valley sides of Salt Creek. These seeps deposit a soft tufa-like material consisting principally of calcium carbonate (see analysis in Appendix C). It is thought that the material originates from weathering of the carbonate bearing greywacke beds, and the accompanying solution may result in the formation of cavities, or the widening of joint cracks. Such solution could be most active below the existing water table where larger volumes of water normally circulate than above the water table.

PERMIAN

Permian glacigene sands and clays with boulders occur in patches of greatly varying size sporadically distributed over the whole of the Fleurieu Peninsula. In the Salt Creek area the main mass extends from the ridge between Plough Creek and New Yohoe Creek southwards across Salt Creek and up into the headwater valleys of the various tributaries of Salt Creek. The deepest part of the old Permian glacial valley is probably beneath the basin-like section of the Salt Creek valley 1 mile east of Salt Creek Hill. From this area a considerable thickness of glacigene sediments have been removed by Salt Creek. The sediments consist mainly of silty clays, soft clayey silts and current bedded sand-stones. Sparse rounded boulders are found on the valley slopes and occasionally can be observed embedded in the silts.and clays.

One other small patch of glacigene sediments occurs on the main Salt Creek Hill ridge ½ mile north of the trig. station.

TERTIARY AND RECENT

Sands and silts with boulder beds form the flat bottom of the basin-like section of Salt Creek Valley. These deposits are mainly re-worked Permian sediments. Sand resulting from reworking of the glacigene sediments also occurs as a mantle over the saddle in the divide between Salt Creek and Tea Tree creek, and it is possible that some of the underlying clays and silts attributed to the Permian glaciation are in reality much later deposits.

Other unconsolidated deposits which are of importance to the project are the talus and alluvium on the coast and the sand at the mouth of Salt Creek.

The alluvium consists of clay and boulders which form a thick and irregular, wedge shaped mantle at the base of the cliffs facing the sea. This mantle is really a piedmont deposit or a series of coalescing alluvial fans and cones formed in an earlier more arid era by the existing creeks. The surface of the piedmont extends up the present creek valleys and the creeks have incised themselves down through it, in places to the old wave cut bench.

Of more recent origin is the talus which overlies the pied-mont and is being renewed by scree from erosion of the existing cliffs. In places short steep gullies have been cut in the talus revealing bedding planes dipping seaward at angles up to 20^{o}.

ENGINEERING GEOLOGY

LOWER DAM SITE

The principal factors to be considered at this preliminary stage of the investigation are the ability of the rocks to bear the stresses which will be imposed on them by the type of dam to be built at the site and the water tightness of the main and abutment foundations.

As regards the structural integrity of the foundation rocks we have to rely on visual observations of their outcrops plus the information obtained from the adit.

Intrinsically the various rock types observed to be expected, within the compass of the lower site should all be competent to withstand the stresses likely to be imposed by a concrete dam 250 to 300 feet high. They are slightly metamorphosed hard tough rocks, as demonstrated by the driving of the adit and though their strengths in shear and compression should be tested as a precaution they should give a comfortable safety margin over the required values for either a gravity or arch section.

The rocks, consisting as they do of quartz felspar and biotite in an interlocking granular crystalline texture will not have their intrusic strength affected by prolonged soaking in either fresh or salt water.

The competency of the foundation rocks will be adversely affected by the presence of clay seams formed by deep weathering along fault or shear zones or beds especially susceptible to weathering influences and although these may be amenable to treatment their presence should be known before the dam is designed or detailed estimates of cost attempted.

As regards faulting reassurance in the most critical area, the valley bottom, is given by a continuous section of outcropping rock in the creek bed and for some distance up each side of the valley below the waterfall. This shows that no fault parallel to the creek occurs within the limits of the outcrop.

Faults in other directions however have been observed and the exploratory adit was driven along one. These appear to be of minor nature in the magnitude of their effects on the rock. That intersected by the adit has caused very little crushing and only thin lenticular clay seams are present along the fault surface.

Higher up the valley sides extensive areas are covered by soil and these may conceal bedding faults which are particularly difficult to detect in the absence of drilling. As the rocks strike approximately parallel to the creek bedding faults converted to clay would exercise an especially unfavourable influence on the stability of the foundations in that they would facilitate sliding downstream of the dam. It will be wise therefore to test the foundation rocks for these features by drilling as early as possible.

The abundant jointing was described in an earlier section. This is not especially deleterious in itself to structural integrity providing the joints are tight and not clay filled. However, they do provide easy access for meteoric waters and thus make possible deep weathering. They also allow bedrock to be involved in landslides. This has happened in slides immediately upstream of the proposed site on the left bank and the possibility of similar occurrences in the upper part of the left abutment, where outcrops are obscured by soil cannot be entirely ruled out.

On the right bank the adit has tested a considerable part of the succession of beds which will form the dam foundations and has shown them to be sound and free from all but minor defects. These beds will constitute the lower part of the abutment foundations and above them there is quite a thickness which at present remains untested.

In spite of uncertainties, which must be removed by testing, it seems unlikely that there are geological features in the foundations which could not be treated in a satisfactory manner to restore the integrity of the foundations.

The other major factor to be considered is the possibility of leakage under the foundations. Mention has been made of the lime-bearing waters seeping from joint cracks and minor fault planes in both sides of the gorge and depositing calcium and magnesium carbonates. This phenomenon must be due to solution of greywacke and arkose beds which contain carbonates and could give rise to the formation of cavities and enlargement of joint cracks and fault planes. It was hoped that the adit would give a positive answer to this problem. It not having done so it will be necessary to investigate the problem further by drilling. The adit traversed predominantly non-carbonate bearing rock and cut relatively few joints and other cracks.

ALTERNATIVE UPPER DAM SITE

This site involves a main dam in the creek valley and a subsidiary bank on a saddle in the divide between Plough Creek and the upper part of Salt Creek.

The main dam site will have many similarities to the lower site as largely the same succession of beds occur in the foundations. The difference is one of greater uncertainty due to more soil cover. There appears to be less jointing at the upper site and the surface zone of weathering may be deeper.

The subsidiary bank will be founded on glacial deposits and these would need to be tested for depth, presence of permeable beds, and stability when soaked with sea water.

RESERVOIR AREA

The principal problem involved is possible leakage northwards through the ridge between Plough Creek and the headwater valleys of New Yohoe Creek and an unnamed tributary of Salt Creek. The calcareous members of the arkose and greywacke sequence strike northwards through this divide and if they have been dissolved by groundwater to any extent will provide substantial leakage paths out of the reservoir. This will need to be tested by drilling.

A minor problem is the presence of glacial deposits underlying a saddle in the divide between Salt Creek and Tea Tree Creek. In this saddle the glacial deposits are below stored water on the Salt Creek side of the divide but on the other side the contact between glacial sediments and Cambrian rocks may be above high water level. Should this be proved by accurate contouring then no problem exists. Some drilling may be required at a later stage.

The reservoir area assumed in this discussion is that formed by a dam at the lower site. The problems for a reservoir formed by a dam at the upper site are identical except that the leakage paths would be through the divide between Plough Creek and the upper part of Salt Creek.

TUNNEL ROUTES AND POWER STATIONS

Both tunnel routes would traverse mainly the same succession of rocks and encounter similar lithological conditions. What other conditions would be encountered it is impossible to say with any certainty. The rocks are heavily jointed and as the tunnels would be driven normal to the strike the backs would tend to slab off in large pieces along the flatly dipping bedding planes.

Nothing is known of the depth and degree of weathering nor of groundwater conditions. Strong water flows seem likely should the tunnel go below the permanent water table and faults are almost certain to be met.

Detailed mapping of the tunnel route and testing by drilling is considered necessary before design and preparation of the specification.

Similarly it is only possible to offer brief general comment on the power station sites at this stage.

The northern site is situated on a narrow steeply sloping piedmont strewn with talus. Along the existing beach a low cliff has been cut which reveals that the alluvial material overlies an irregular surface of greywacke, varying in height above sea level from 10 to 20 feet. This bedrock surface probably represents a wave-cut bench and may be overlain by a thin cemented beach conglomerate. The lower half to two-thirds of the power station excavation should be in comparatively fresh greywacke. Faults are present in the coastal outcrops and may be hidden under the alluvial cover. Drilling will be required to test the condition of the greywacke at depth.

The southern site is on a more extensive piedmont in which the alluvial material is finer grained and thinner. Here the majority of the excavation would be in greywacke or similar rocks. The piedmont was formed in a wider embayment in the coast and hence pre-piedmont conditions are more difficult to assess and drilling is even more imperative than at the northern site.

MATERIALS OF CONSTRUCTION

No detailed search was made for sand, or sources of coarse aggregate for concrete, earth and soil for a rolled earth dam, or rock for a rock-fill dam.

The greywacke and arkose in the unweathered condition are hard tough rocks. They have broken out from the adit in fragments of reasonable shape and if crushing tests show that the particle shapes obtained are satisfactory then these rocks will make a good coarse aggregate for concrete. Shaly micaceous beds occur in the greywacke/arkose succession and these may crush to flaky particles. The drilling proposed in the abutments will explore the succession and show where such beds occur. Otherwise sufficient quantities should be obtained close to the dam site.

Sand for concrete will be harder to obtain. It seems unlikely that crushing of the arkose and greywacke will yield a sand suitable for concrete making and a wider search will be necessary. No obvious sand sources can be seen on the Jervis 1 mile geological map and sand may have to be obtained from as far afield as Normanville or Victor Harbour.

The greywacke and arkose should prove suitable for the bulk of material for a rock fill dam. The chief problem would be the depth and amount of weathering. If the weathering is moderate sufficient quantities of rock fill will be available at high level on either abutment. Some drilling will be required to check depth of weathering in the quarry areas.

Material for a rolled earth dam is a bigger problem. The only material available in quantity is the glacigene clays and sandy clays forming the upper part of the Salt Creek valley. This may not be suitable for the bulk of the dam and is also 1 mile away from the lower dam site. A small amount of glacial sediments forms a low saddle in the ridge ½ mile north of Salt Creek Hill Trig. and a few hundred feet north-west of the lower site. This may prove useful for the impermeable membrane in a rock fill dam.

At a later stage more investigation into sources of construction materials will be required.

FUTURE EXPLORATION

Geological exploration and investigation of an engineering project can be divided into two phases. The first is that necessary to ensure that no major geological defects go undiscovered which might radically alter the preliminary layout of the project and also to provide a basis of comparison between alternative sites for the project. The second phase gives the information required for the detailed design of various parts of the project, for preparation of estimates and specifications, and to reveal any features which may require special treatment. It also provides a basis of comparison for alternative sites, within the same general project area, for the various parts of the project (e.g. dam sites, tunnels etc.).

It is the first phase with which we are concerned in this report. The adit having failed to give the positive answer it was hoped it would provide it is now necessary to get some further assurance on the possible occurrence of leakage paths around the abutments and through the reservoir rim. This is definitely a first phase exploration as prevention of leakage through such a large area as the divide between Plough Creek and the headwaters of New Yohoe Creek would be a remedial treatment of major proportions.

The drilling programme recommended is as follows:-

(i) Left Abutment

3 holes to go to a level 100 feet below stream bed	sub total	750 feet

(ii) Right Abutment

2 holes to the same level	sub total	550 feet

(iii) Divide between Plough Creek and New Yohoe Creek

3 holes to go to RL 300 to 350

	sub total	1050 feet

(iv) Stream bed

1 hole to R.L. 200

	sub total	150 feet
	Grand Total	2500 feet

Of these holes the deepest one in each abutment and the three in the divide may give sufficient assurance on the possibility of leakage and should be drilled first. These holes would give an absolute minimum of 1,750 feet of drilling.

CONCLUSIONS AND RECOMMENDATIONS

The important rocks in the area of the Salt Creek Project belong to the Kanmantoo Group of Cambrian age. These are predominantly slightly metamorphosed greywackes and arkoses with some quartzitic, shaly or calcareous members. They are hard tough rocks which are competent to support any type of dam or other engineering structure provided they are not adversely affected by weathering and faults.

Along the lower portion of the valley of Salt Creek the greywackes and arkoses strike roughly parallel to creek and dip at shallow angles to the east. They are cut by numerous joints and minor faults. No evidence of major faults was found in the brief examination given the area.

Weathering in the lower part of the gorge appears to be shallow but at higher levels soil cover is more extensive and may conceal deeper zones of weathering. Water seeping from joint cracks in the lower part of the valley is depositing carbonates and may be evidence of solution of the calcareous members of the greywacke/arkose sequence. The water table in the divides between streams appears to be low and in a high rainfall area this is usually due to high permeability.

Materials of construction, except those for a rock fill dam, are scarce at or near the site.

It is concluded that if no leakage channels in the shape of solution cavities or enlarged joint cracks, occur, then the site should not involve any excess amount of remedial treatment.

The exploratory adit did not yield sufficiently positive evidence as to the possible occurrence of solution cavities and it is recommended that further exploration, in the form of the drilling programme set out above, be done to give the required assurance on this critical problem.

WJ:CERF
24/9/69

Signed W. JOHNSON
SENIOR GEOLOGIST

APPENDIX A

PETROLOGICAL REPORT ON ROCKS FROM SALT CREEK PUMPED STORAGE PROJECT

Mineralogy & Petrology Section

Report No. M.R. 207

MATERIAL:	Rock samples
SUBMITTED BY:	W. Johnson, Department of Mines
DATE RECEIVED:	13th August, 1959
MARKS OR NOS:	P.379/59 - P. 390/59
SOURCE or LOCALITY:	3½ miles S.W. of Delamere Hundred of Yankalilla, Sections given below.
INFORMATION REQUIRED:	Petrological description
METHODS OF EXAMINATION:	Thin section

RESULTS OF EXAMINATION:-

P. 379/59 - W.J. 34 (T.S. 4963): Section No. 58

A fine-grained recrystallised subgreywacke consisting of interlocking grains of quartz, occasional grains of felspar (albite-oligoclase), and abundant biotite and sericite. The biotite occurs as poorly defined laths in a sub-parallel arrangement, and the sericite as fine wisps interstitial between the interlocking quartz grains. Small grains of opaque iron minerals are disseminated throughout the rock. Some have a square outline and are probably pseudomorphs after pyrite. Other accessory minerals present are zircon, apatite, rutile and tourmaline. No carbonates were detected in the rock.

P. 380/59 - W.J. 36 (T.S. 4964): Section No. 58

A fine-grained recrystallised subgreywacke, very similar in composition and texture to W.J. 34. The only noticeable differences are that this rock contains a minor amount of interstitial poikiloblastic calcite, the grain size is slightly finer, and the lineation of the micas is rather more pronounced. Accessories are the same as in W.J. 34.

P. 381/59 - W.J. 37 (T.S. 4965): Section No. 59

A fine-grained recrystallised subgreywacke showing current bedding. The general composition is again similar to W.J. 34, but bands of the rock are heavily impregnated with secondary calcite. The main constituents of the rock are interlocking quartz grains, biotite, sericite, and occasional felspar grains (heavily sericitised), The calcite occurs in bands through the rock. Bands with very little calcite alternate with bands fairly heavily impregnated. Heavy mineral layers mark the current bedding, and consist of zircon, apatite, opaques and biotite.

P. 382/59 - W.J. 38 (T.S. 4966): Section No. 57

A fine-grained recrystallised greywacke consisting of quartz, felspar (albite-oligoclase), biotite, sericite, and a minor amount of secondary calcite. Felspar is more common than in the previous specimens and the rock can therefore be called a greywacke. The texture is again interlocking, and the micas show a distinct lineation. Accessory minerals include opaques, apatite, zircon, and sphene (showing alteration to leucoxene).

P. 383/59 - W.J. 39 (T.S. 4967): Section No. 57

A fine to medium-grained recrystallised arkose, tending towards a greywacke. The main constituents are quartz, felspar (albite-oligoclase and ?orthoclase), and micaceous minerals. The mica content is considerably lower in this rock. Muscovite and sericite are the main micaceous minerals present, but biotite and chlorite (penninite) occur in small amount. Occasional accessories are present, and include opaques, sphene, apatite, and zircon. No carbonates were observed in the rock.

P. 384/59 - W.J. 40 (T.S. 4968): Section No. 1490

A fine-grained recrystallised arkose, tending towards a greywacke. The composition is similar to that of W.J. 39 except for the presence of calcite, which occurs fairly abundantly as rather vague poikiloblastic patches. The mica content is similar to W.J. 39. The texture is mosaic rather than interlocking as in the previous samples. Accessories include zircon, sphene, and opaques.

P. 385/59 - W.J. 41 (T.S. 4969): Section No. 1490

A fine-grained recrystallised greywacke with a mosaic texture. The main constituents are quartz, felspar (albite-oligoclase, rather decomposed), biotite, sericite, and calcite, which is unevenly distributed throughout the rock. The calcite appears to be confined to rather indefinite bands, but is not abundant. Accessory minerals present are pyrite (visible in hand specimen), zircon, apatite, tourmaline, and sphene.

P. 386/59 - W. J. 42 (T.S. 4970): Section 1490

A fine-grained recrystallised greywacke of similar composition to W.J. 41 except for the presence of fairly abundant calcite. The texture is interlocking, with fine wisps of sericite interstitial between the interlocking grains of quartz and felspar. Biotite forms ragged laths with a poor lineation. Calcite is present as vague poikiloblasts enclosing quartz and felspar. Small cubes of limonite, pseudomorph after pyrite, occur disseminated throughout the rock. Pyrite is visible in small amount in the hand specimen. Zircon and tourmaline are also present as accessories.

P. 387/59 - W.J. 43 (T.S. 4971): Section No. 1490

A fine to medium-grained recrystallised arkose tending towards a greywacke. The composition is similar to W.J. 43 except that there is less biotite present and calcite is not very abundant. The calcite forms poikiloblastic patches but is unevenly distributed, being more abundant in some parts of the rock than others. The texture is mosaic. Accessories include pyrite (visible in hand-specimen), apatite, and zircon.

P. 388/59 - W.J. 44 (T.S. 4972): Section No 1490

A fine-grained recrystallised greywacke consisting of quartz, felspar (albite-oligoclase) biotite, sericite, and calcite which is present in bands in the rock. The rock has a mosaic texture and the mica flakes show a sub-parallel arrangement. Interstitial secondary calcite is abundant in some bands but almost absent in others. Accessories are apatite, sphene, zircon and opaques.

P. 389/59 - W.J. 45 (T.S. 4973): Section No. 1491

A recrystallised arkose tending towards a greywacke. The texture is fine-grained, interlocking. The composition is similar to W.J. 44 except for a lower biotite content. Calcite is again more abundant in some layers than in others and occurs as secondary interstitial patches. Accessories are similar to those in W.J. 44.

P. 390/59 - W.J. 46 (T.S. 4974): Section No. 1491

A fine-grained recrystallised subgreywacke consisting of interlocking grains of quartz, felspar (albite-oligoclase, and ?orthoclase), biotite, sericite, and calcite. The rock is strongly biotitic but contains very little felspar, and is therefore classified as a subgreywacke. Calcite is present as small interstitial patches in some parts of the rock. Small grains of opaques are disseminated throughout the rock, and other accessories include zircon, apatite, and sphene. The rock has a heteroblastic texture and the biotite laths are well lineated.

Examined by: R. A. Both

A. W. Whittle,
CHIEF MINERALOGIST AND
PETROLOGIST

21.8.59

APPENDIX B

CARBONATE ANALYSES OF ROCKS FROM

SALT CREEK PUMPED STORAGE PROJECT

Mark	Petrological Report No.	Section	Hundred	Calcium Carbonate ($CaCO_3$)	Magnesium Carbonate ($MgCO_3$)
A294/59	P381/59	59	Yankalilla	7.80%	4.40%
A297/59	P384/59	1490	Yankalilla	4.25	1.28
A299/59	P386/59	1490	Yankalilla	10.7	2.85
A300/59	P387/59	1490	Yankalilla	1.63	1.28
A301/59	388/59	1490	Yankalilla	3.50	1.56
A302/59	P389/59	1491	Yankalilla	3.80	1.19
A303/59	P390/59	1491	Yankalilla	2.40	4.10

Source: W. Johnson, Mines Department.

AR 207/59

A 159/1

Thomas R. Frost
CHIEF ANALYST

27.8.59

APPENDIX C

ANALYSIS OF MATERIAL DEPOSITED FROM "LIME" SEEPS SALT CREEK PUMPED STORAGE PROJECT

Mark	Calcium Carbonate ($CaCO_3$)	Magnesium Carbonate ($MgCO_3$)
A 304/59 (WJ.35)	76.3 %	5.60 %

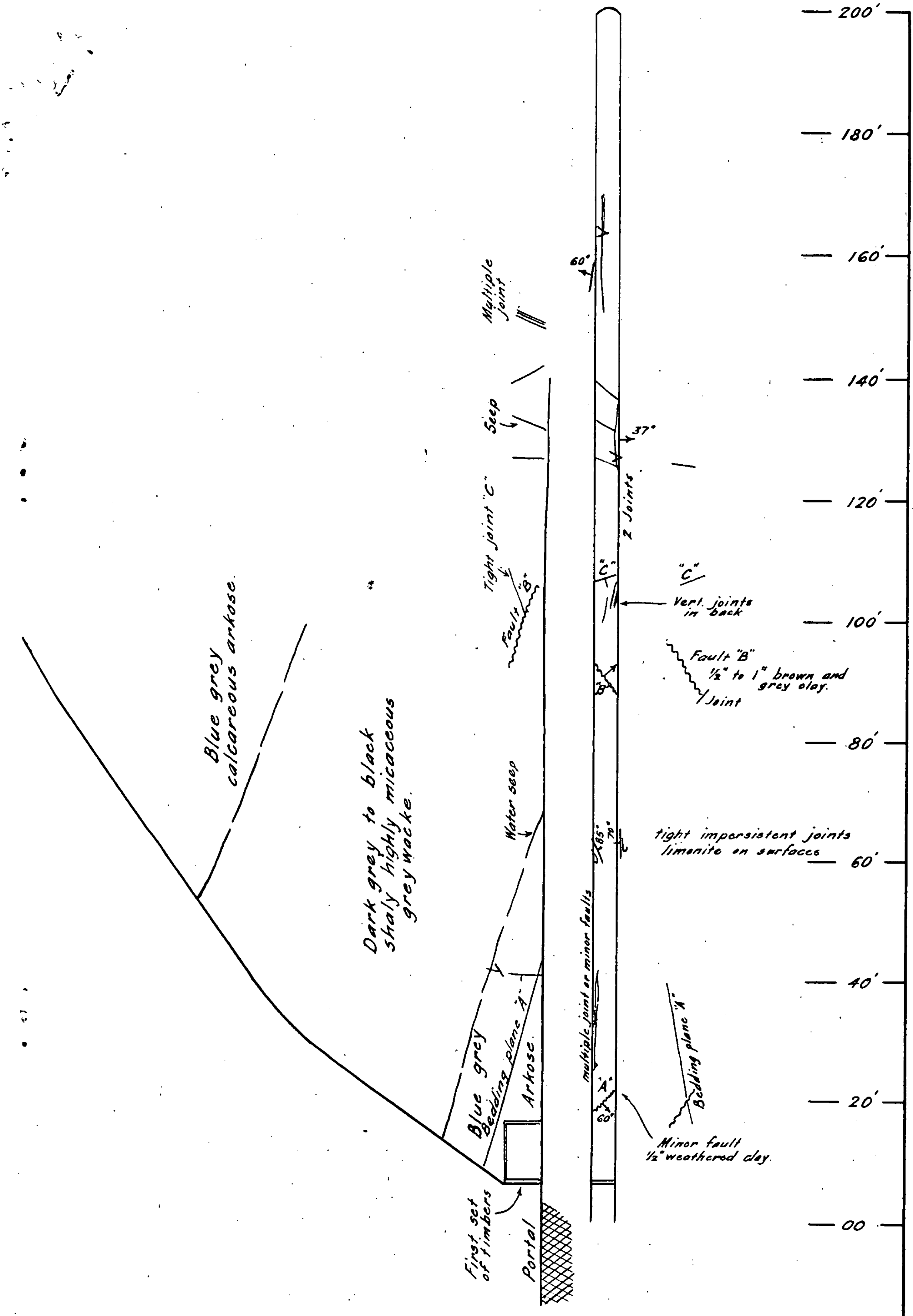
Locality: Section 58, Hundred Yankalilla.

Source: W. Johnson, Mines Department.

AR 237/59
A 159/1

Thomas R. Frost
CHIEF ANALYST

27.8.59



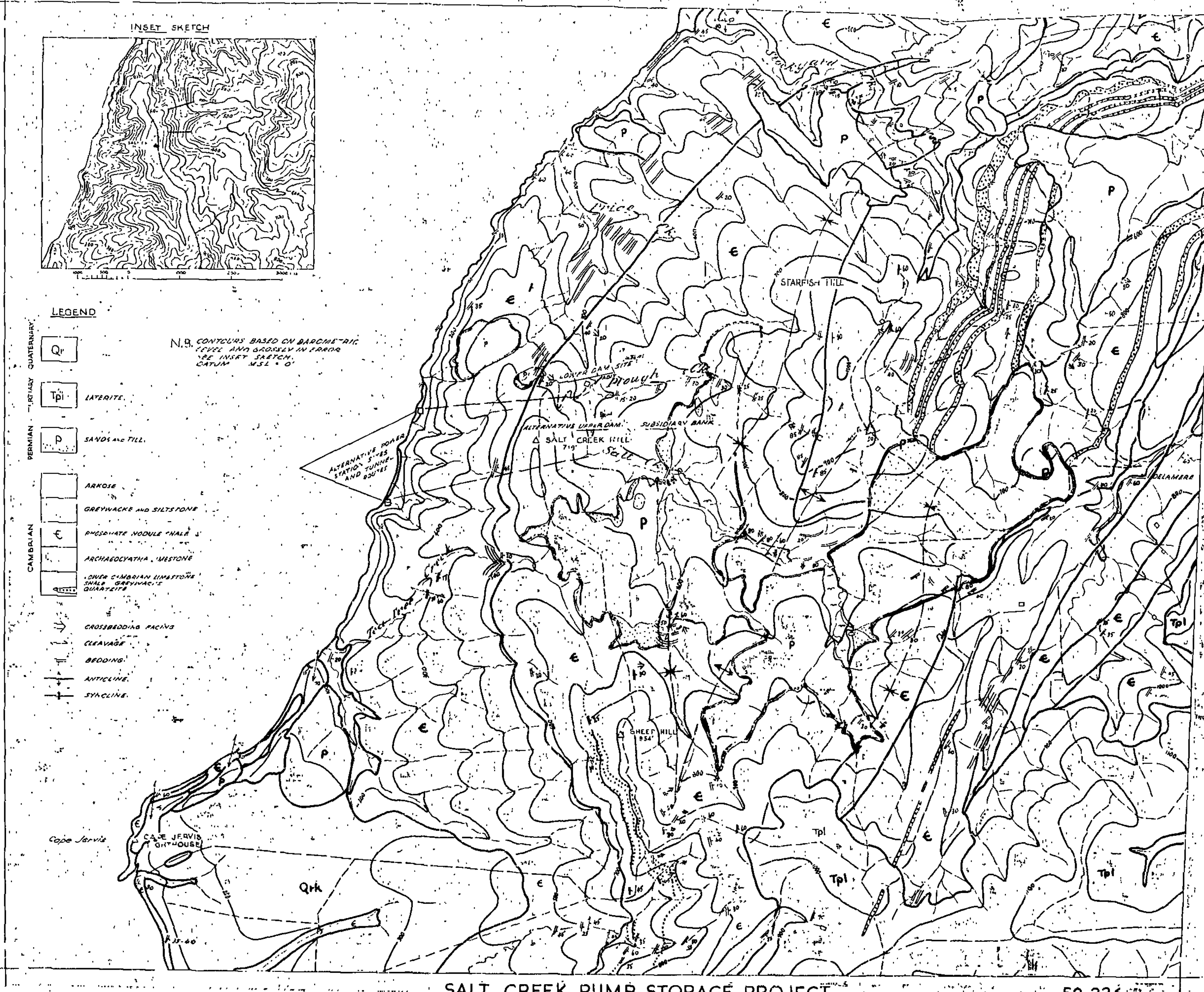
To accompany report by W. Johnson.

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn.	SALT CREEK PUMPED STORAGE PROJECT	D.M.	Scale: Vert. & Horiz. 20 feet to 1 in.
		Tcd.	GEOLOGY OF EXPLORATORY ADIT	Req.	S 2243 Hc7
		Ckd.			
Director		Exd.	LOWER DAM SITE		Date 22·9·59

200—10.58 2018

JERVIS



SALT CREEK PUMP STORAGE PROJECT

GEOLOGICAL SKETCH MAP OF SALT CREEK & ENVIRONS

59·336
Hc7