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2. A review of the mineral resources and mining potential of the storage areas of the proposed Lower Gordon and King-Franklin hydro-electric power schemes.

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This report is a preliminary review of the mineral resources and mining potential of areas which may be affected by the following power schemes at present under investigation by the Hydro-electric Commission.

1. Lower Franklin diversion and King River scheme.
2. Butler Island-Lower Franklin scheme.
3. Olga scheme.
4. Splits-Denison scheme.

The areas which may be affected by these schemes are illustrated on 1:100 000 scale overlay plans supplied by the Hydro-electric Commission, but only the areas likely to be affected by the Lower Franklin diversion and King River scheme, and the Butler Island-Lower Franklin scheme are reproduced in this report (fig. 5).

A survey has been made of the known mineral resources; and the future mining potential, based on regional geology, has been evaluated for each of the proposed schemes. The regional geology in the vicinity of the proposed power schemes is shown on the Queenstown and Port Davey 1:250 000 geological maps (in press). A study has also been made of aerial magnetometer surveys undertaken by Lyell-E.Z. Explorations in 1957-1958 and by Broken Hill Proprietary Co. Ltd in 1966, covering all of south-western Tasmania. The positions of the magnetic anomalies referred to in this report are shown on Figure 5.

1. LOWER FRANKLIN DIVERSION AND KING RIVER SCHEME

This scheme involves two power stations on the King River supplied with water from a large storage lake east of the West Coast Range, formed by the Huxley and Franklin dams and a smaller lake in the King River valley formed by the Sailor Jack dam (fig. 5).

METALLIC MINERAL RESOURCES

The majority of the known metallic mineral resources in the vicinity of this scheme are in the Jukes-Darwin area of the West Coast Range (fig. 5) and are therefore west of the areas to be flooded by, and in terrain well above the storage level of the lake to be formed by the Huxley and Franklin dams. However the storage waters of the Sailor Jack dam will probably flood Harris' Reward gold mine (see below) and small alluvial gold workings in Newall Creek, upstream from Harris' Reward and in the Garfield River at its confluence with Flannigans Creek (fig. 5).

There are also several prospects and mines on the northern slopes of Mt Jukes, particularly between Proprietry Peak and the King River, but the only prospect which may be of concern involves an adit on the bank of the King River which was described by Hills (1914) to be 6 m above the level of the river and was driven 24 m in a southerly direction disclosing minor veins and blebs of sulphides. Although the exact location of this adit is not known, it is probably situated beyond the eastern limit of the storage waters of the Sailor Jack dam, and downstream from the Huxley dam.

In the vicinity of the low area between Mt Fincham and Mt Maud and extending south-west to the Franklin River (fig. 5), are reported occurrences of rutile in alluvial flats and in creek wash (Whiting, 1970). Later

investigation of these occurrences (Wood, 1971) revealed that the alluvial flats only contain low heavy mineral values and that very limited and localised concentrations of rutile occur in the creek wash. These rutile deposits are therefore of little economic potential.

Harris' Reward Gold Mine

Harris' Reward is situated south of the King River on the eastern side of Newall Creek, 5 km south of Lynchford. The mine is readily accessible by an old pack-track from Lynchford, although the pack bridge over the King River has collapsed.

The first report on the mine (Twelvetrees, 1901) describes two tunnels 24 m and 10 m in length driven on the course of quartz reefs, and two shafts 12 m and 11 m deep. The shafts were later extended and opened out by the Coronation Gold Mining Company which took over the mine in 1902 (*Progr.Miner. Ind.Tasm.*), but operations apparently ceased during 1905. The only evidence of former mining operations in the area, observed during a recent visit, is the surface expression of the two shafts (one filled with rubble and the other filled with water), small dumps of barren quartz, and some rusting machinery. Production from the mine was at least 1.480 kg Au from 109.6 t of lode quartz (table 1).

Table 1. PRODUCTION FROM HARRIS' REWARD GOLD MINE (FROM TWELVETREES, 1901; AND THE QUARTERLY ISSUES OF THE PROGRESS OF THE MINERAL INDUSTRY OF TASMANIA.)

Ore sample and year	Tonnage (tonnes)	Au (total) (kg)	Au (g/t*)	
1. Lode quartz (1900)	8.1	0.466	57.6	
2. Lode quartz (1901)	20.3	0.641	31.6	
3. Lode quartz (1903)	81.3	0.373	4.6	(smelted Au)
4. Lode stone (1904)	-	-	19.1	

* 1 gram/tonne = 0.65 dwt/ton.

The gold occurs in quartz veins which are parallel to the strike and dip of the schistose and porphyritic country rock, and were reported by Twelvetrees (1901) to be 5-12 cm wide. He later records (*Progr.Miner.Ind. Tasm.*) that the gold, which was accompanied by a little galena but no pyrite, occurs in small patches of exceptional richness, but that these shoots of gold proved short and unreliable. Earlier, Twelvetrees (1901) had concluded that even if a solid reef were located it would probably be irregular with depth and inconsistent in width.

MINING POTENTIAL

The areas which may be affected by the storage waters of the Huxley and Franklin dams are underlain by rocks ranging from Devonian to Precambrian in age, although in some areas these rocks are overlain by extensive deposits of Pleistocene glacial sediments and recent alluvial sediments. The stratigraphic units involved include the sedimentary rocks of the Eldon Group (Lower Devonian-Silurian), correlates of the Owen Conglomerate and Gordon Limestone (see below) (Ordovician) and various units of metamorphised Precambrian rocks. Generally, these rocks are not considered as being potential host rocks for mineralisation, although the Gordon Limestone cannot be completely disregarded as a possible host for Mississippi Valley-type Pb-Zn-barite-fluorite deposits similar to the deposit occurring at Bubs Hill near the Lyell Highway.

The areas which may be affected by the storage waters of the Sailor Jack dam are underlain by Eldon Group rocks and Gordon Limestone in the west, and the Mount Read Volcanics (Cambrian) in the east.

The Mount Read Volcanics complex is one of the major host formations for mineralisation in western Tasmania, containing the stratiform(?) massive sulphide deposits at Mt Lyell, Rosebery and Hercules. In the vicinity of the areas affected by the Huxley and Franklin dams these volcanic rocks are exposed to the west of the proposed lake and at elevations above the maximum storage level. However, a narrow, east-west strip across the regional strike of the Mount Read Volcanics, exposed in the King River gorge between the Queen and Toft Rivers, may be flooded by storage waters of the Sailor Jack dam, although this area would probably have been thoroughly prospected on the surface during the 1890s and early 1900s.

Gordon Limestone

The distribution of the Gordon Limestone is indicated in Figure 1; the main exposures are along the Queen and Garfield Rivers, along the eastern flank of the West Coast Range, and along the western flank of the Engineer Range and northward past Mt Madge. A substantial part of each of these major occurrences of limestone may be flooded by this scheme.

The limestone exposed in the Queen River valley was quarried by the Mt Lyell Mining and Railway Company from the Smelters quarry and Halls Creek quarry for its own needs in Queenstown, whilst the North Lyell Company quarried limestone from the Darwin quarry about one kilometre east of Darwin for use at the Crotty smelter until 1911. Analyses of limestone from these quarries (table 2) indicate that the Gordon Limestone at these localities has a calcium carbonate content well over 80% and is relatively low in impurities, particularly magnesia. There are no reliable estimates of the reserves of good quality limestone.

However the potential of the Gordon Limestone in these areas as a possible source of high quality limestone cannot be ignored, particularly since much of the Gordon Limestone is as yet unexplored, especially on the western flank of the Engineer Range and Mt Madge.

Table 2. CHEMICAL ANALYSES OF GORDON LIMESTONE (FROM HUGHES, 1957).

	I %	II %	III %	IV %	V %	VI %	
$CaCO_3$	86.1	88.8	89.3	83.4	95.1	88.9	
MgO	Tr.	Tr.	Tr.	3.0	Tr.	2.2	
SiO_2	2.8	3.8	3.2	10.9	3.3	5.2	(Acid insoluble)
Al_2O_3	1.1	1.1	0.9	2.9	0.9	0.2	
Fe	0.4	0.4	0.4	0.4	0.6	0.4	(Fe_2O_3)
TOTAL	90.4	94.1	93.8	100.6	99.8	97.9	

I-III Limestone from Halls quarry (1952)
IV-V Limestone from the Smelters quarry (1905)
VI Limestone from Darwin (1951)

MAGNETOMETER SURVEY

A study of the aeromagnetic survey records covering south-western Tasmania has revealed three anomalies in areas which may be affected by this scheme (see below). There is also a small anomaly located west of the King River, south of its confluence with Linda Creek, which probably corresponds with the Ordovician Owen Conglomerate on North Owen Peak; and a wide linear anomaly south of the King River and west of the proposed lake which corresponds with the Mount Read Volcanics in the Jukes-Darwin area.

Anomaly A (fig. 5)

Anomaly A, with an order of magnitude of 250 gammas at 210 m above ground level, is located on the Franklin River approximately midway between its junction with the Ness and Maud Creeks; and lies within the boundaries of the Frenchmans Cap National Park (fig. 5). This anomaly is situated over the boundary between metamorphosed Precambrian garnetiferous pelite and quartzite-quartz schist; and although the exact cause of the anomaly is unknown it may be related to magnetic mineral concentrations in an alluvial cover, similar to the rutile and ilmenite concentrations to the west (fig. 5).

Anomalies B and C (fig. 5)

At the confluence of the Andrew and Franklin Rivers is a network of anomalies covering a total area of approximately 100 km^2 (fig. 5). The anomaly which is best defined (at 210 m above ground level) has a magnitude of the order of 250 gammas and occurs on the divide separating the two rivers. To the south-west and south-east of this anomaly are located anomaly B (order of magnitude 180 gammas) and anomaly C (150 gammas) respectively, occurring over areas likely to be affected by storage waters of the Franklin dam. These double peaked anomalies are joined by a ridge of magnetic intensity which crosses the Franklin River midway between the dam site and its confluence with the Andrew River.

The surface geology in the area includes Precambrian metamorphosed pelite, quartzite and quartz schist, and Ordovician Owen Conglomerate and Gordon Limestone. The anomalies appear to be located over the Precambrian rather than the Ordovician rocks and tend to follow the Precambrian garnetiferous pelite.

DARWIN CRATER

Located between the Andrew River and South Darwin Peak is a large circular depression approximately one kilometre in diameter (on the floor) with walls 125 m high, which could be a meteorite crater (fig. 5). The morphology of this depression and its relationship to Darwin glass, which is distributed over an area of some 13 km^2 south and west of the depression and which has been established as an impactite glass, are consistent with its being the site of an impact event occurring approximately 700 000 years ago (Ford, 1972).

The size of this structure, which is possibly one of the largest craters in Australia, and its association with a large amount of impactite glass could well mean the Darwin Crater will be an important geological feature in Tasmania. More detailed research into the origin of the depression and the Darwin glass is continuing under the auspices of R.J. Ford at the University of Tasmania, although at least one diamond drill hole in the centre of the crater would be necessary to further substantiate its impact origin.

2. BUTLER ISLAND-LOWER FRANKLIN SCHEME

This scheme involves the construction of a dam and power station near Butler Island on the Gordon River, flooding parts of the Franklin, Denison, Gordon and Olga River valleys; and a dam and power station on the Franklin River with a holding dam on the King River at its confluence with the Toft River (fig. 5). Only the effects of the Butler Island part of this scheme are discussed in this section as the areas likely to be affected by the Lower Franklin part of the scheme, which duplicates in part the Lower Franklin diversion and King River scheme, have already been discussed in the previous section.

MINERAL RESOURCES AND MINING POTENTIAL

A search of departmental records indicates that no significant metallic mineralisation is known to exist in the areas which may be flooded by the storage waters of the Butler Island dam. The metamorphosed Precambrian rocks, the Ordovician Owen Conglomerate and Gordon Limestone, and the Siluro-Devonian Eldon Group rocks which may be flooded by this scheme are generally not regarded as potential host rocks for mineralisation.

Gordon Limestone

The distribution of the Gordon Limestone in the vicinity of the Butler Island scheme is illustrated in Figure 5, which shows that nearly all the outcropping Gordon Limestone in the areas affected will be flooded by the proposed lake.

The largest area of limestone exposed, occurs as a belt 1-2 km wide and extending for 30 km north of Moores Landing along the Gordon and Franklin Rivers, although the Gordon Limestone probably extends south of Moores Landing as well, beneath the Quaternary sediments in the Olga River valley. A smaller area of Gordon Limestone crops out along the Gordon River near its junction with the Denison River.

The only detailed exploration of the Gordon Limestone in the vicinity of the Gordon River, to establish the grade and size of reserves of limestone, was undertaken by Rowe (1963) along Limekiln Reach which is west of the proposed scheme. No other information is available as to the grade and size of reserves in the two remaining areas of limestone exposed along the Gordon and Franklin Rivers, although these areas could well contain some of Tasmania's largest reserves of high grade limestone.

MAGNETOMETER SURVEY

Apart from the three anomalies situated in the area which may be flooded by the Lower Franklin part of this scheme, there is an additional anomaly, Anomaly D (fig. 5), in the area which would be affected by the Butler Island part of the scheme.

Anomaly D (fig. 5)

This anomaly occurs on the western banks of the Gordon River, near Moores Landing. At 210 m above ground level the anomaly consists of three distinct highs in the total magnetic intensity, with an order of magnitude of 225 gammas for the central peak. When the average height of the recording was reduced to 150 m above ground level the anomaly is delineated into at least four distinct magnetic highs with the main peak increasing in intensity to 280 gammas.

Although the exact cause of this anomaly is not known, the three magnetic highs in Figure 5 are located over the boundary between the Owen Conglomerate (Ordovician) and metamorphosed Precambrian quartzite and quartz schist.

3. OLGA AND SPLITS-DENISON SCHEME

The Olga scheme involves a dam and power station on the Gordon River one kilometre upstream from its confluence with the Olga River, flooding parts of the Denison, Maxwell, Gordon and Orange River valleys. The Splits-Denison scheme is an alternative but smaller scheme with a dam and power station on the Denison River and a holding dam at the Second Split on the Gordon River. Both these schemes are alternatives to the Butler Island scheme.

MINERAL RESOURCES AND MINING POTENTIAL

The areas which may be affected by the Olga scheme proposal are mostly underlain by undifferentiated Precambrian metamorphosed rocks, with Eldon Group sedimentary rocks in the vicinity of the dam site and in the Orange River valley, and Gordon Limestone on the Gordon River at its confluence with the Denison River; whilst the Splits-Denison scheme may flood areas of Precambrian metamorphosed rocks. Also, both the proposed schemes will flood the southern part of the Precambrian dolomite (the Jane Dolomite) exposed in the very inaccessible country around the headwaters of the Maxwell River (fig. 5).

There is no significant mineralisation known within the storage areas of the two schemes, although a small copper prospect occurs on the eastern slopes of Nicholls Range (fig. 5). The Nicholls Range copper prospect consists of chalcopyrite with secondary covellite, malachite and azurite in two parallel mineralised zones, 3.5 m wide and up to 12 m long, occurring 6 m apart in highly contorted quartz schists (Blake, 1938; Wade, 1956). Wade (1956) records that the mineralised zones strike approximately 320°M, dip 65° NE, and that analyses of the east lode averaged 1.15% Cu and the west lode averaged 1.21% Cu. Although the exact location of this prospect is not known, it is probably high up on the slopes of Nicholls Range and therefore well above the maximum storage level of the proposed lakes.

MAGNETOMETER SURVEY

An examination of magnetometer survey records indicates only one small aeromagnetic anomaly (order of magnitude 50 gammas) located over undifferentiated Precambrian rocks in the Maxwell River valley.

4. SUMMARY

This preliminary review of the areas which may be affected by the Hydro-electric Commission's proposed Lower Gordon and King-Franklin power schemes is based partially on broad generalities and should therefore be revised at a later date to reassess any additional information which may be available from the continuing exploration activity in the areas of interest.

The majority of the known metallic mineral resources are to the west of the areas which may be affected by the proposed schemes, or in terrain which is above the storage levels of the proposed lakes. The only area of concern is in the vicinity of the Sailor Jack dam on the King River, where the storage waters of this dam may flood small alluvial gold workings and the long abandoned Harris' Reward gold mine. This mine produced at least 1.48 kg Au occurring in rich patches in narrow quartz veins. However the

irregularity and inconsistency of the quartz veins and the unreliability of the shoots of gold within the veins constitute the main deterrents to mining the deposit.

Also within the area which may be affected by the Lower Franklin part of the proposed schemes is a possible meteorite crater, the Darwin Crater, which is of extreme geological interest, although more conclusive information must be obtained to support the impact origin of the crater.

In the storage areas of the proposed schemes are rocks ranging in age from Devonian to Precambrian. They include the sedimentary rocks of the Eldon Group (Siluro-Devonian), correlates of the Owen Conglomerate and Gordon Limestone (Ordovician), and various units of metamorphosed Precambrian rocks; all of which are generally not regarded as potential host rocks for mineralisation. The economically important Mount Read Volcanics (Cambrian) are exposed west of the proposed storage lakes and at elevations above the maximum storage level, although a narrow section across the regional strike of this formation may be flooded by the storage waters of the Sailor Jack dam.

Distributed throughout the areas which are likely to be flooded by each of the proposed schemes are vast areas of unexplored Gordon Limestone, the largest single exposure of which is in the Gordon and Franklin River valleys from Moores Landing to the Black Forest. In the Queen River and Darwin areas the Gordon Limestone proved to be of a high grade with well over 80% calcium carbonate and to be low in impurities. Apart from the limestone exposed along Limekiln Reach, on the Gordon River, the remaining exposures of Gordon Limestone have not been investigated in detail, so that if similar grades to those in the Queenstown area and Limekiln Reach occur in these areas, then some of Tasmania's largest reserves of high grade limestone may be flooded by the proposed storage lakes. In addition, a small area of the southern part of the Jane Dolomite (Precambrian) may be flooded by the storage waters of either the Olga or Splits-Denison schemes.

The four aeromagnetic anomalies occurring over areas which may be affected by the Lower Franklin and Butler Island proposals are relatively small when compared to other anomalies in south-western Tasmania, and tend to be related to certain rock types (*e.g.* Precambrian garnetiferous pelite). However a more thorough investigation of the geology below these anomalies should be undertaken, depending upon accessibility, although one of the anomalies is situated within the Frenchmans Cap National Park.

5. CONCLUSIONS AND RECOMMENDATIONS

As a broad generalisation, with regard to metallic mineral deposits, the future mining potential of western Tasmania will not be grossly affected by the proposed Lower Gordon and King-Franklin power schemes, although the Gordon Limestone cannot be completely disregarded as a potential host rock for Mississippi Valley-type Pb-Zn-barite-fluorite mineralisation.

Although mineral exploration may benefit from easier road and water access to areas which are now relatively inaccessible, the detailed geological sections exposed in the rivers on which these power developments are based, and in their major tributaries, will however be lost.

As it is possible that large reserves of high grade limestone occur in areas which are likely to be flooded by the proposed schemes, it is recommended that investigations be initiated, including sampling of available diamond drill core, to evaluate the potential of the Gordon Limestone exposed:

(*a*) in the Gordon River at its confluence with the Denison River,
(*b*) in the Gordon and Franklin Rivers from Moores Landing 30 km north to the Black Forest,
(*c*) on the western slopes of the Engineer Range, and
(*d*) on the western slopes of Mt Madge.

At the same time it may be possible to examine the southern part of the Jane Dolomite, exposed in the Maxwell River valley, which may be flooded by the Olga or Splits-Denison schemes.

The significance, geological and otherwise of the Darwin meteorite(?) crater must also be evaluated. To assist in such an evaluation it is recommended that one diamond drill hole be located in the centre of the crater to determine the nature of the rocks below the recent sediments in the floor of the crater.

Since the areas which are likely to be affected by the proposed Lower Gordon and King-Franklin hydro-electric power schemes contain potentially large reserves of high grade limestone, potential reserves of dolomite, and a possible meteorite crater then these factors must be taken into consideration in any future decisions as to the feasibility of the proposed schemes.

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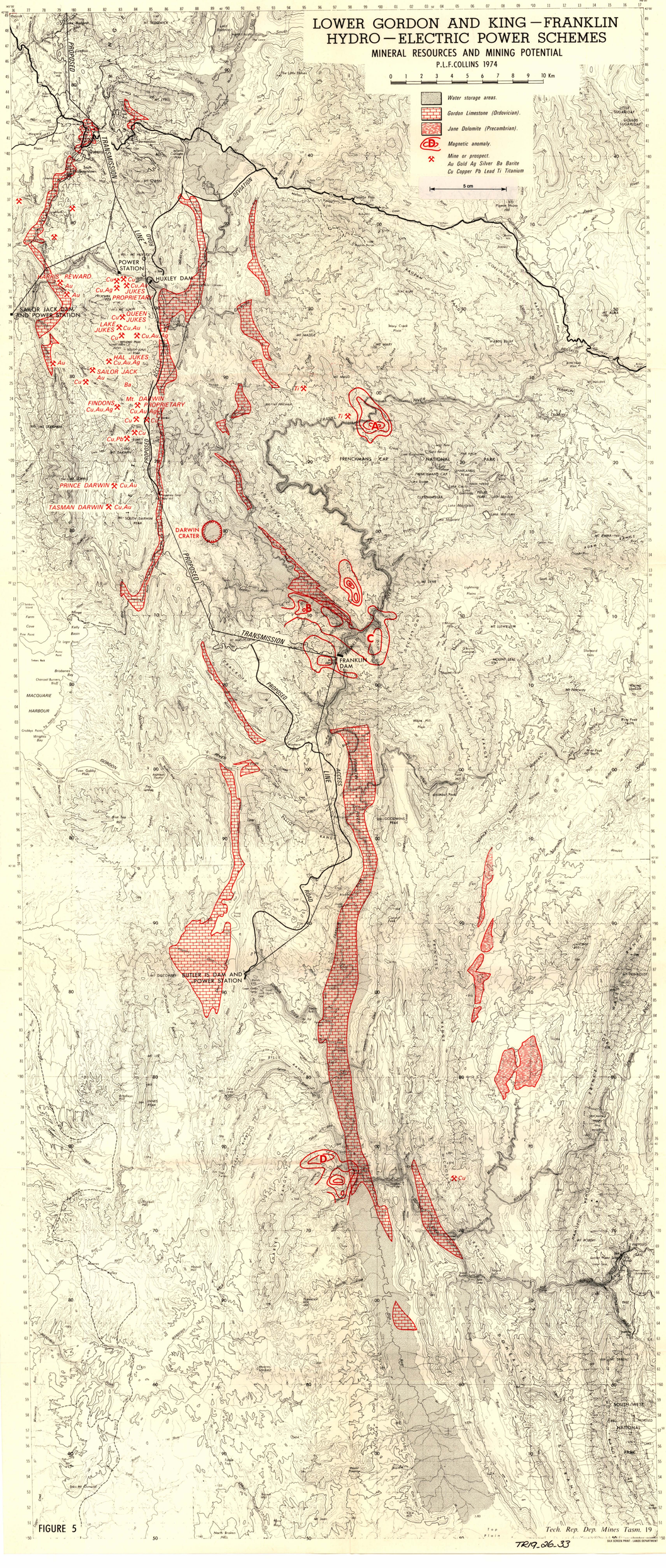

FIGURE 5