COMSTAFF PROPRIETARY LIMITED

EXPLORATION LICENCE 5/63

1971/1972 SUMMER FIELD SEASON REPORT

PIEMAN AREA

AUSTRALIAN ANGLO AMERICAN LIMITED

Incorporated in the State of Victoria

PIEMAN AREA

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1. SUMMARY

A programme of geological mapping, heavy concentrate sampling, stream and soil sampling, was carried out in the SE corner of E.L. 5/63. The area is underlain by tuffs, greywackes, shales, siltstones, conglomerates, quartzites and limestones, intruded by ultrabasic and intermediate igneous bodies, and folded into asymmetric synclines and overturned anticlines. Low order sample anomalies may be significant, the samples realising anomalies were spectrographically scanned for all significant cations. Low priority follow-up work is recommended.

2. INTRODUCTION

2.1. Location (see TAS 2-285)

The area of approximately 16 square miles refers to that part of E.L. 5/63 between the area covered by the 1970/71 Huskisson Regional Report and the Pieman river.

2.2. Access

Dry weather access is provided by a dirt road from the Murchison highway, via the Pinnacles, various sections of which have been constructed each summer season. This summer the road was extended from one mile south of the main Huskisson grid to the Huskisson river (see TAS 2-289). A brief helicopter reconnaissance flight over the area facilitated demarkation of the most suitable route for the road. Walking tracks were cut from several points on the road to gain access to the Pieman river and the Huskisson river.

2.3. Previous work

This season's regional work continues on from the work covered by the Huskisson South Preliminary Report (1970-1971 Summer Field Season Report). Otherwise no previous work had been carried out.

2.4. Methods of exploration

1. Geological mapping of major streams, tributaries and access roads following tape and compass surveys.

2. Active stream sediment samples were collected at 500' intervals and at tributary confluences.

3. Roads were soil sampled at 100' intervals.

Sediment and soil samples were dried and sieved at Waratah. The -80 mesh fractions were forwarded to the Australian Mineral Development Laboratories where

2/ they were ....

they were analysed for nickel, copper, zinc, silver, bismuth and mercury by atomic absorption, and for tin and antimony by X-ray fluorescence. All samples realising anomalies from the above processes are scanned for all significant cations.

4. Panned concentrates were collected at 2500' intervals and above tributary confluences. The heavy mineral fractions were examined mineralogically and spectrographically scanned by the Australian Mineral Development Laboratories.

5. Rock specimens were collected for petrographical description by Central Mineralogical Services or for analysis by the Australian Mineral Development Laboratories.

3. GEOLOGY (see TAS 2-286)

3.1. General

The Huskisson south regional area is situated in the northerly trending belt of Palaeozoic eugeosynclinal rocks which extend from Queenstown to Waratah. This belt includes the Mt.Lyell, Rosebery, Renison Bell, Cleveland, Hercules and Mt.Farrell orebodies and consequently is of considerable economic interest.

3.2. Succession

The rock units mapped comprise tuffs, greywackes, tuffaceous sandstones, siltstones and argillites, quartzites, shales, conglomerates and limestones. Intrusive rocks include serpentinised ultrabasics, gabbros and a variety of basic-intermediate dykes. The following succession may be recognised:

Quaternary		Alluvium. Fluvioglacial and moraine deposits.
	unconformity	
	orogeny	Intrusion of intermediate and related rocks. Emplacement of serpentinite and related rocks.
Lower Ordovician		1000' limestones, shales and dolomites. 0-500' conglomerates, shales and quartzites.
	unconformity	
	orogeny	
Cambrian?		Unit 3 more than 3000' rhythmically bedded immature greywackes, siltstones, shales, tuffs and lavas. Unit 2 6000-7000' bedded acid tuffs, shales, tuffaceous sandstones and siltstones, greywackes, basic-intermediate tuffs, tuffaceous siltstones and sandstones.
	faulted contact	
		Unit 1 more than 2000' phyllitic tuffs, boudinaged quartzites, shales and dolomites.

3.2.1. Unit 1

The rocks of unit 1 consist of dynamically metamorphosed pyroclastics represented as quartz-sericite-chlorite schists, green and dark grey phyllites with boudinaged micaceous quartzites, and a single unit of dolomitic conglomerate. The rocks exhibit strong intraformational folding and have been silicified and sericitised along with quartz, carbonate and feldspar veining.

Unit 1 could represent the oldestrocks in the area. It is exposed in the east and south east sections of the Pieman river, east of a major N-S trending fault. These rocks appear to correlate with the oldest rocks exposed in the Machintosh area (1971 Winter Field Season Report - Mackintosh Regional Project).

3.2.2. Unit 2

The rocks of unit 2 crop out to the west of the fault referred to above. The rock units mapped are tuffs, tuffaceous sandstones and siltstones, greywackes, argillites graphitic and carbonaceous shales. The rocks are generally finely bedded in thin bands and are seen to be facies transitional both laterally and vertically. The rocks occur in the slightly overturned western limb of a major anticline (Just-in-Time) and dip steeply with facing directions to the west.

The oldest rocks of the succession consist of well bedded andesitic tuffs, tuffaceous siltstones, fine greywackes and shales.

The tuffs are generally medium grained, highly feldspathic and contain both crystal and lithic fragments. They are generally grey-green in colour but weather to brown ferruginous material with a characteristic flecked appearance.

The greywackes are similar to the tuffs in general appearance and some aspects of composition. The lithic fragments and highly chloritised groundmass of both the tuffs and greywackes indicate a basic to intermediate provenance. Further up the succession the greywackes and tuffs have an acidic composition which reflects either a change of provenance and hence a more acid cycle or volcanicity. In the same position current bedding and grading also become more apparent, the shales and siltstones tend to become carbonaceous further up the sequence and lateral facies changes occur.

Facies changes observed near the top of the sequence are:

Fine to medium graded greywacke and tuffaceous brown siltstone pass laterally southwards into

4/ quartz-feldspathic ....

quartz-feldspathic sandstone, tuffaceous siltstone and carbonaceous sandy argillite. Further south these beds are represented by well bedded dacitic tuffs, grey graphitic shales and carbonaceous pyritic arenaceous argillite. Stringers of carbonaceous matter also occur in the pyroclastic beds.

An ignimbrite with minor sedimentary lithics occurs near the top of the unit on the western limb of the Huskisson synform. The whole sequence reflects shallow marine conditions of sedimentation with proximal volcanic activity.

The unit may be correlated with the upper part of the Renison Bell east succession (1970 Winter Field Season Report) and with Unit 3 of the Huskisson regional area to the north (1970/1971 Summer Field Season Report).

3.2.3. Unit 3

The rocks of unit 3 conformably overlie unit 2 and the base is taken to be the first greywacke conglomerate. They are exposed on the western limb and in the core of the Huskisson syncline. Greywacke conglomerates, coarse lithic greywackes, sandstones, siltstones, shales, pyroclastics and lavas occur in rhythmic greywacke cycles. The conglomerates generally form the lowest part of a cycle. They consist of massively bedded, poorly sorted cobbles of metasedimentary and volcanic rocks. Lithic greywackes, poorly to moderately sorted, overlie the conglomerate. They are arkosic and immature but exhibit overall grading. Thin section examination of the greywackes indicates that moderately rounded lithic fragments make up 50-60% of the grains. Lithic components include carbonaceous shales, sericitic shales, quartzose, siltstone, chert, tuffs and trachytes. Quartz, plagioclase and potash feldspars and minor micas are also present.

The greywackes fine upwards into interbedded siltstones and sandstones, which in turn pass up into carbonaceous silty shales and finally graphite shales. Then there is a sharp break to the greywacke conglomerate of the next cycle. These finer beds are not always represented and may be eroded prior to the deposition of the detritus for the next cycle.

A chloritised and albitised sodic tuff occurs 1000' above the base of the sequence. This distinctive coarse grained rock is a useful marker horizon and may be traced over 1500' along strike. Fine green vitric tuffs with relict shard textures and a rhyolite lava also occur.

I suggest the sequence derives from waxing and waning currents with contemporaneous acid volcanism. The volcanic rocks are similar to those in the Mt.Reid volcanic group (1971 Winter Field Season Report) which lie to the east. The rocks are very similar to those exposed in the Bulgobac/Que area (1970/71 Summer Field Season Report).

5/ 3.2.4. Lower Ordovician

3.2.4. Lower Ordovician

Rocks which may be tentatively equated with the Gordon limestone series overlie the Cambrian? units with a marked unconformity.

The basal rocks consist of 0-500' of coarse pebble conglomerate which passes laterally into quartzite and shales. The conglomerate is very irregular and lensoid in form. Pebbles include limestones, chert, rhyolite, sodic trachyte, greywacke, metaquartzite and sericite schist. The quartzites are well washed, iron stained and occasionally green due to veinlets of hydromuscovite. The shales are grey and often fossiliferous.

Overlying the basal clastic rocks is a sequence of shaly limestone passing up into massive biosparites and dolomites.

3.2.5. Quaternary

Alluvium overlying fluvioglacial deposits occupies flat lowlying areas in the central and southerly parts. Thick moraine deposits are exposed in the Pieman and Huskisson rivers where glacial striae are often developed.

3.3. Structure

3.3.1. Folding

The structural history of the area may be summarised as follows:

1. Deposition of the eugeosynclinal Cambrian(?) rocks.

2. Folding on NNW-SSE axes (F1) into tight anticlines (where fold limbs are dominant over fold hinges) and broad synclines. This period of folding produced the Just-in-Time anticline (described in the 1970/71 Summer Field Season Report op.cit.) with a broad synclinorium to the west.

3. Deposition of the Ordovician conglomerates and limestones and emplacement of the serpentinite.

4. Refolding on the NNW-SSE axes (F2) to produce a sympathetic syncline with the F1 synclinorium, and slightly overturn the western limb of the Just-in-Time anticline. This dominant F2 structure is named the Huskisson syncline on the official map.

5. Further to this, superimposition of a warp phase also affects the plunge and dip of the F1 axes. Minor F1 drag folds tend to plunge both to the north and south. So far there is no evidence of this phase affecting F2 axes.

In the NE of the area and possibly west of the Pieman fault the dominant structure is anticlinal with a shallow north westerly plunge. To the west the

6/ influence of the ....

influence of the superimposed sympathetic F1 and F2 synclines becomes more apparent with the beds on the anticlinal limb slightly overturned. Further west the dominant structure is synclinal, the intraformational F1 folds generally plunge to the SSE while the main F2 Huskisson syncline plunges to the NNW.

3.3.2. Faulting

Two major faults occur in the area. The eastern or Pieman fault N-S trends and in my view downthrows the sediments to the west. A strong schistosity, with minor faults, is well developed on either side of the fault plane.

A keel structure has developed in the Huskisson syncline with a dextral displacement of approximately 6000'. Minor wedge faults and drag folds are in evidence along this fault plane. In addition, this fault represented by a zone of intense shearing could account for the displacement of the ultrabasic body in the Renison Bell east area (1970 Winter Programme op.cit.)

Only one cleavage is developed in the Cambrian(?) argillaceous rocks underlying the unconformity. Micro-faults and complex jointing are developed in the more massive greywackes and tuffs.

3.4. Intrusives

3.4.1. Ultrabasic and related rocks

The Huskisson serpentinite, described in detail elsewhere (1971/1972 Summer Field Season Report - Huskisson Asbestos Project) may be traced to the Renison Bell east serpentinite (1970 Winter Field Season Report op.cit.) as a series of small discordant intrusive bodies. The major rock type is serpentinised peridotite with minor amounts of serpentinised pyroxenite and pods of silicified gabbro. Emplacement of these bodies was accompanied by intense shearing and silicification of the country rock in some parts, whereas elsewhere the country rock has been little altered and the intrusive boundary is marked by the development of nodular magnetite and haematite.

A sheet like body, 1500' wide, is exposed on the western limb of the Huskisson syncline. The main rock type is serpentinised peridotite with serpentinised pyroxenite near the eastern margin. The western part of the sheet consists of a complex of sheared serpentinite, amphibolitised gabbro, pyroxenite and peridotite. The rocks near the eastern and western margins of the sheet have been involved in a series of metasomatic alteration processes, the first being replacement by tremolite or actinolite. The second type of alteration was prehnitisation with the development of grossular garnet, chlorite and leucoxene. Near the eastern contact, the metasomatic alteration has produced a magnesite-quartz-talc rock with relict chromite. This association probably represents an end product of the steatisation alteration processes.

The ultrabasic body described above is very similar to the complex exposed in the Colebrook and Ring rivers to the south (1970 winter report Renison Bell east area, op.cit.). It is quite unlike the Huskisson serpentinite by virtue of the metasomatic alteration, but otherwise the evidence strongly suggests that there is one sheet of serpentinite folded into a syncline by the F2 period of folding.

3.4.2. Intermediate and related rocks

A number of minor basic to intermediate rock bodies crop out within the slightly overturned F1 anticlinal limb. Thin section work indicates the basic end of the series is represented by an andesine dolerite which outcrops near the eastern margin of the Huskisson serpentinite. The rock is both uralitised and saussuritised, but the ophitic texture is well preserved. This rock may be traced for over 10,000' along strike.

Disconnected bodies of diorite up to 300' in width crop out east of the Huskisson serpentinite and on either side of the Pieman fault. The plagioclase is generally sericitised, and the pyroxenes altered to kaolinitic clay,calcite and pyrite before being chloritised. Biotite occurs in most of the diorite bodies. The rock is distinctive by virtue of its coarse ophitic texture, dark grey colour and its hardness.

A medium grained microsyenite in Con creek is composed dominantly of albite laths with interstitial chlorite. A porphyritic brecciated sodic trachyte and a sodic dolerite crop out in the Pieman river west of the Pieman fault.

The acid end of the series is represented by a crushed and altered quartz feldspar porphyry of dacitic composition which crops out 1,500' west of the Pieman fault.

The intrusive rocks are virtually identical to those described from the Huskisson regional area to the north (1970/71 summer report op.cit.).

3.5. Metamorphism

The rocks have been regionally metamorphosed to the chlorite greenschist facies grade. The groundmass of the greywackes and tuffs is altered to a mass of chlorite, sericite, carbonate and opaques. Shales and mudstones have been indurated.

8/ Dynamic metamorphism ......

Dynamic metamorphism of rocks adjacent to fault planes or intruded ultrabasic bodies is common. In the Pieman river, near the Pieman fault, quartz grains in the quartzite exhibit strain extinction while the tuffs are metamorphosed to quartz-sericite schists.

Certain arenaceous argillites adjacent to the Huskisson serpentinite have also been dynamically metamorphosed to quartz-sericite schists.

Some of the intrusive igneous rocks on the other hand have undergone a wide range of metasomatic and metamorphic changes which are described above. One unusual metasomatically altered rock occurs as scree on the west bank of the Pieman near Last Day creek. It comprises coarse grained axinite intergrown with diopside, and is cut by coarse asbestos-quartz veins. It is thought to be a highly altered diorite.

3.6. Mineralisation

No significant mineralisation was found. Finely disseminated pyrite occurs in the black shales and bedded acid tuffs throughout the area.

It is thought to be syngenetic in origin. Framboidal pyrite occurs in the schistose tuffs exposed in the Pieman river east area.

Epigenetic pyrite occurs in the quartzites and is deposited in micro-faults and joints. Chalcopyrite related to potash-feldspar veins occurs through the tuffs and quartzites, adjacent to diorite intrusions.

Accessory sulphide mineralisation is most common in the intermediate and related rock intrusives. Pyrite, chalcopyrite, pyrrhotite and sphalerite have been observed. Most of the mineralisation is directly related to potash feldspar, quartz and carbonate veins.

Magnetite and chromite occur as disseminated grains in the ultrabasics. Chrysotile asbestos occurs in serpentinised pyroxenite as cross-fibre and in peridotite as slip-fibre. The nickel sulphide, heazlewoodite (Ni_3S_2), has been identified from a thin section of the metasomatic quartz-talc-magnesite rock. Pyrite occurs throughout the metasomatically altered ultrabasics and also in the adjacent silicified country rock.

4. GEOCHEMISTRY (see TAS 2-288 and 2-289)

4.1. General

No really significant anomalies have been found. Spurious anomalous values for Bi, Zn and Ag occur along the south Pieman suspected to be due to contamination from the Rosebery Pb/Zn mine and along the Emu Bay railway line by contamination from passing ore trains.

9/ The poorly drained ....

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The poorly drained Quaternary alluvial flats cannot be considered to have been adequately sampled. Sporadic anomalies for tin occur in these flats reflecting the immobile alluvial nature of cassiterite. There is close association between tin and antimony values from sediments collected in these poorly drained areas.

Low order anomalies for Cu, Zn, Pb, and Ag may be related to the Pieman fault zone on the eastern margin of the area. On the other hand the region is underlain by mineralised intermediate intrusives within pyritic tuffs and quartzites. Ferruginous seepages along the Pieman river give rise to the anomalous soil results on the Pieman grid lines and it should be noted that the only Hg values (.5 ppm) were obtained from a creek in this area.

4.2. Results

Histograms of population against ppm have been drawn up for the various elements. The results are tabulated below. Possible anomalous values are taken to be those values above the preferred threshold, read off the histogram.

Stream sediments

Element	Range	Mean (Pop. peaks)	Histogram threshold	No. of possible anomalous values
Cu	<5-3200	5	75	7
Zn	<5-6%	15	270	16
Ni	<5-2750	<5	250	11
Ag	<1-65	<1	N/A	5
Bi	<10-35	<10	20	3
Sn	<10-100	<10	30	9
Sb	<10-40	<10	20	14
Hg	<1-1	<1	N/A	3
As	<2-1600	2	40	3

Soil samples

Element	Range	Mean (Pop. peaks)	Histogram threshold	No. of possible anomalous values
Cu	<5-150	5,25	85	8
Zn	<5-430	25	180	10
Ni	<5-2500	<5	200	15
Ag		all samples <1		no anomalies
Bi	<10-10	<10	N/A	no anomalies
Sb	<10-20	<10	15	2
Hg		all samples < 1		no anomalies
Pb	<5-630	<5	150	3

4.2.1. Copper

Low order anomalous copper values occur in the headwaters of Cairo creek and in the soil lines west of the Pieman river in the same region. These values may be due to the mineralisation seen in the pyroclastics and intrusives of this area.

10/ The tuff-greywacke- ....

The tuff-greywacke-shale sequence (unit 2) is seen to have a higher background than that for the greywacke sequence (unit 3) or the ultrabasics.

4.2.2. Zinc

Low order anomalous zinc values occur in streams draining the ultrabasic and related rocks. Anomalous values are also obtained from small springs or ferruginous seepages draining into the east Pieman.

4.2.3. Nickel

The possible anomalous values of 250 ppm and 200 ppm for stream sediments and soils respectively were not plotted as they coincide with high zinc values and clearly indicate the ultrabasic rocks. Values of more than 2,000 ppm were considered to be anomalous for soils or sediments on ultrabasics. Only two sporadic low order stream sediment anomalies were found and one soil anomaly.

4.2.4. Silver

Two low order anomalous values of 3 ppm are associated with the anomalous zinc values in the small springs draining into the east Pieman.. Elsewhere, except for obvious contamination, the values were less than 1 ppm.

4.2.5. Bismuth

The bismuth anomalies are entirely due to contamination from the Rosebery tailings.

4.2.6. Tin

Low order anomalous tin values were obtained in creeks draining the south eastern Quaternary flats. Heavy concentrate samples taken in similar environments throughout the area contain significant values in tin. The anomalous tin values are probably associated with minor concentrations of alluvial cassiterite.

4.2.7. Antimony

Low order anomalous antimony values occur in close proximity to tin anomalous values stated above.

4.2.8. Mercury

The only mercury value recorded (.5 to 1 ppm) came from sediments collected from a creek flowing into the east Pieman. This anomaly is associated with anomalous zinc and silver values.

4.2.9. Arsenic

Stream sediment samples in the southern part of

11/ the area were ....

the area were analysed for arsenic because this element seems to be related to tin mineralisation in the Renison Bell east area to the south. The anomalous values recorded are due to contamination in the Pieman.

4.2.10. Lead

Soil samples collected along the east Pieman were analysed for lead. Three low order anomalous values were recorded.

5. HEAVY CONCENTRATES

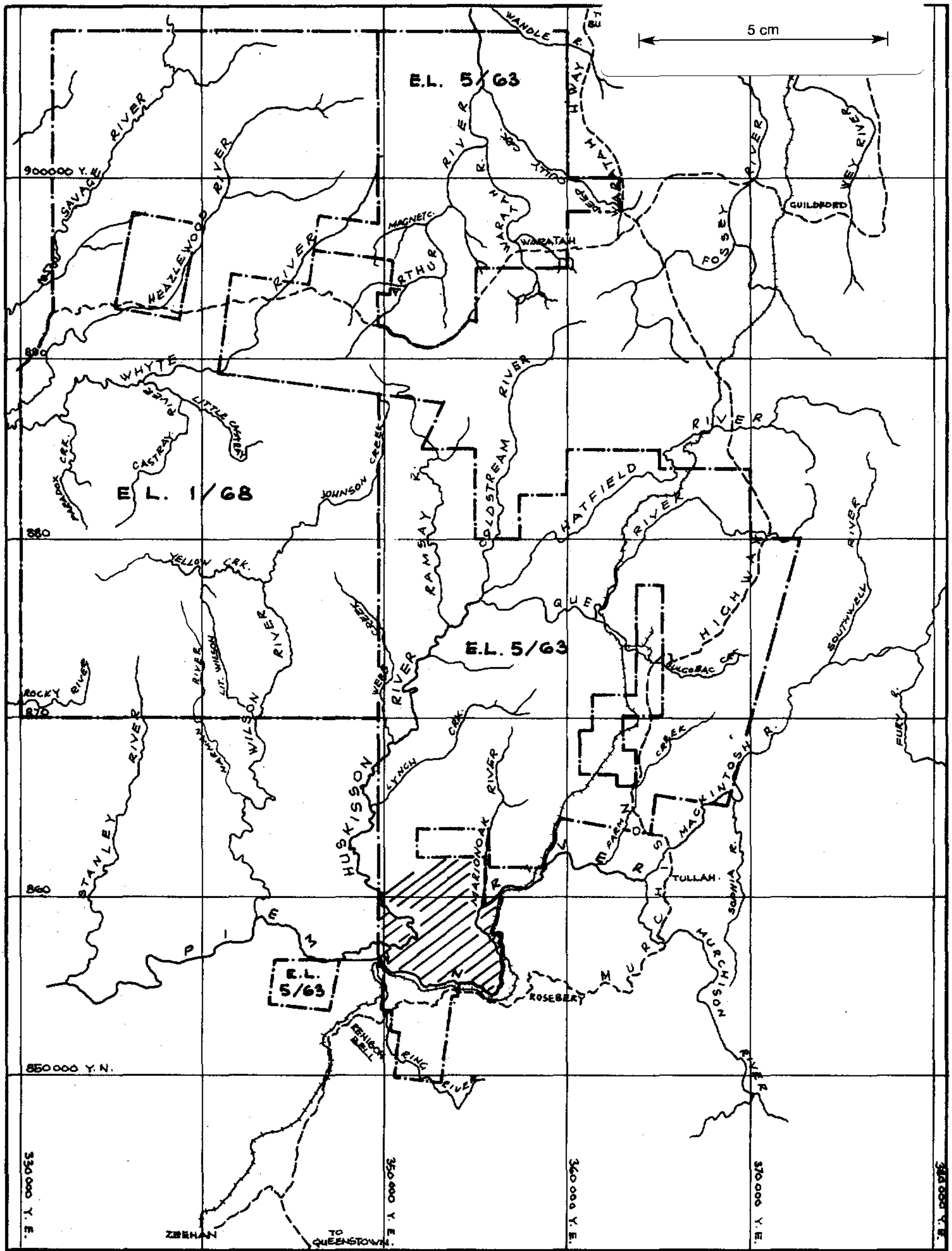
The heavy mineral fraction of the panned concentrates were mineragraphically examined and semi-quantitatively scanned by the Australian Mineral Development Laboratories for most of the economically significant cations. Samples from creeks draining the ultrabasics were found to contain high amounts of magnetite and chromite. These samples analysed 1000-3000 ppm Co, 100-1500 ppm Ni, 1000-2000 ppm V, and more than 1% Cr. The samples collected from Quaternary flats contained 300 to 1000 ppm Sn but cassiterite was not recorded.

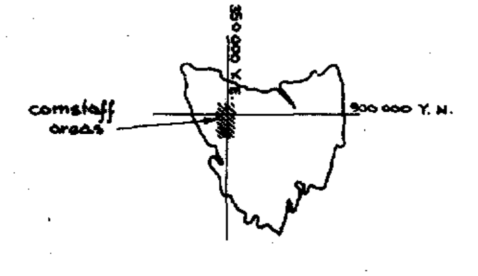
6. PLANS

TAS 2-285	Pieman Area Location Plan
2-286	" " Geology
2-287	" " Idealised Section
2-288	Pieman/Huskisson Geochemical Cover
2-289	Pieman Area Geochemical Anomalies.

G.PIGOTT

March 1972



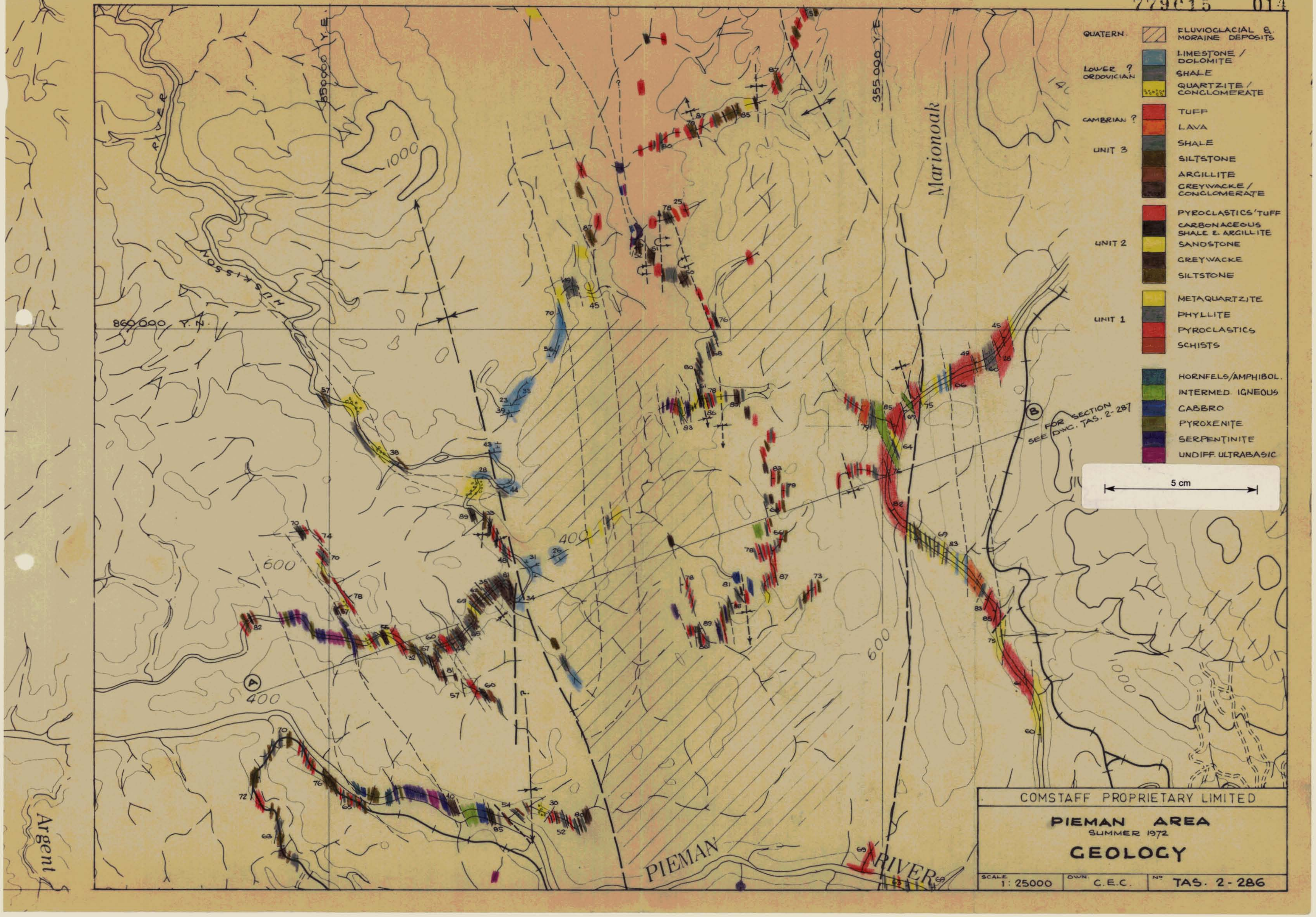


COMSTAFF PROPRIETARY LIMITED

PIEMAN AREA

LOCATION PLAN-SUMMER 1972

DRAWN	COMPILED	SCALE	
G.C.		1:250,000.	TAS-2-285


QUATERN.
FLUVIOGLACIAL & MORAINE DEPOSITS
LOWER ? ORDOVICIAN
LIMESTONE / DOLOMITE
SHALE
QUARTZITE / CONGLOMERATE
CAMBRIAN ?
UNIT 3
TUFF
LAVA
SHALE
SILTSTONE
ARGILLITE
GREYWACKE / CONGLOMERATE
UNIT 2
PYROCLASTICS 'TUFF
CARBONACEOUS SHALE & ARGILLITE
SANDSTONE
GREYWACKE
SILTSTONE
UNIT 1
METAQUARTZITE
PHYLLITE
PYROCLASTICS
SCHISTS
HORNFELS/AMPHIBOL.
INTERMED. IGNEOUS
GABBRO
PYROXENITE
SERPENTINITE
UNDIFF. ULTRABASIC
5 cm
FOR SECTION SEE DWG. TAS. 2-287
350000 Y.E.
355000 Y.E.
860000 Y.N.
HUSKISSON RIVER
Marionoak
PIEMAN RIVER
Argent
COMSTAFF PROPRIETARY LIMITED
PIEMAN AREA
SUMMER 1972
GEOLOGY
SCALE 1:25000
DWN. C.E.C.
No TAS. 2-286

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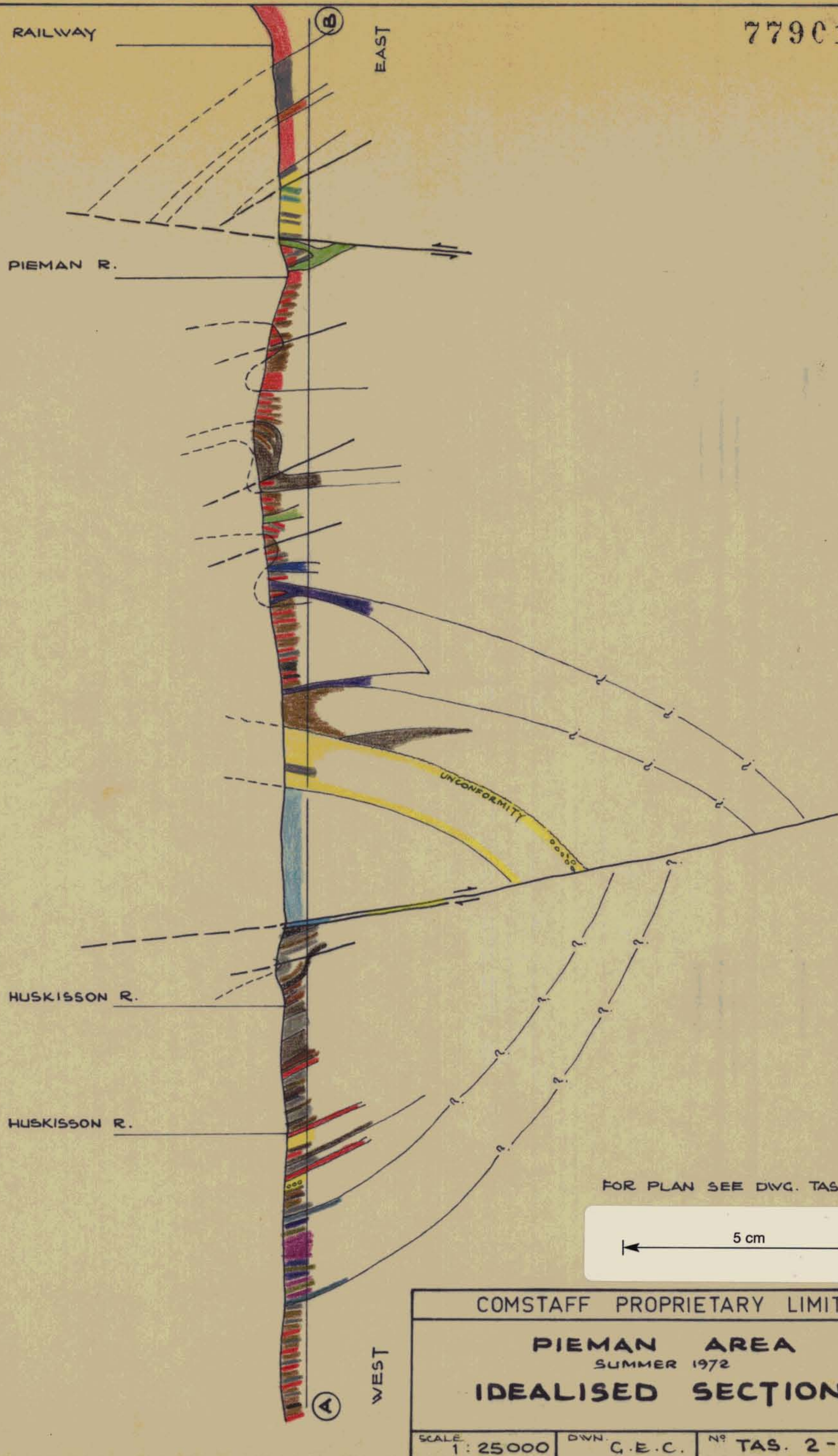

FOR PLAN SEE DWG. TAS. 2-286

5 cm

COMSTAFF PROPRIETARY LIMITED

PIEMAN AREA

SUMMER 1972

IDEALISED SECTION

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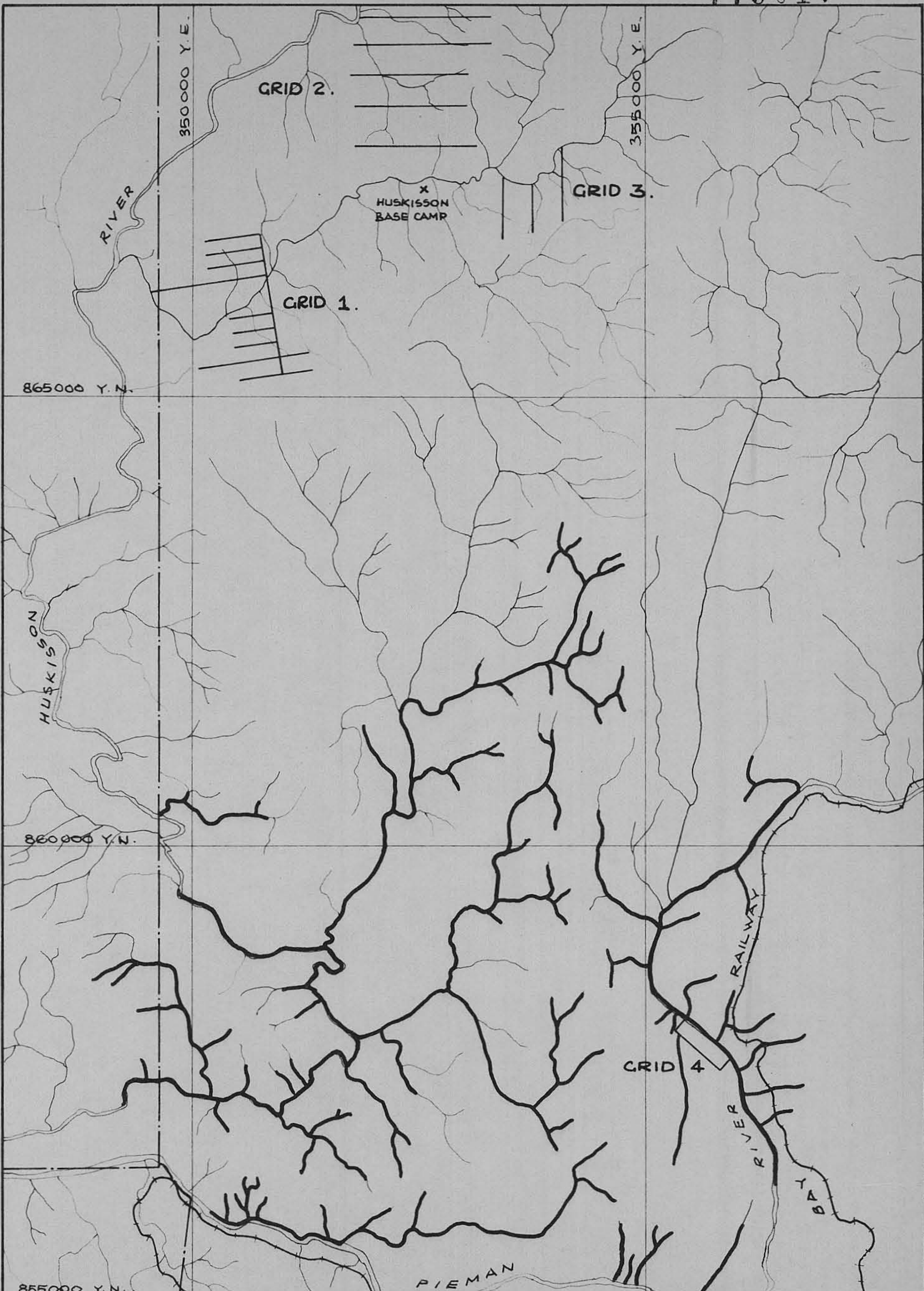
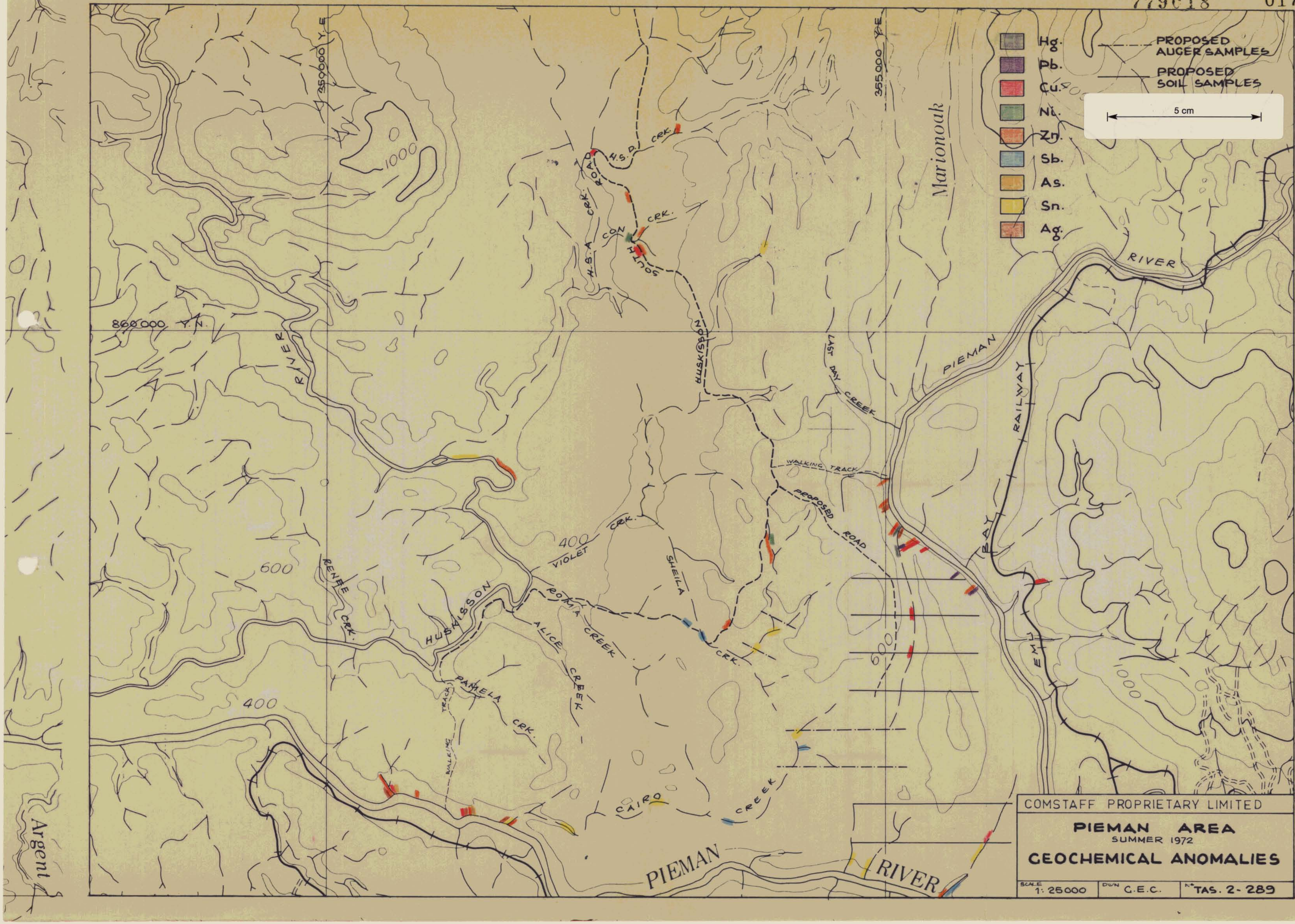


COMSTAFF PROPRIETARY LIMITED		
PIEMAN HUSKISSON GEOCHEMICAL COVER		
SCALE 1:50000	DWN C.E.C.	No TAS. 2·288


Hg.
Pb.
Cu.
Ni.
Zn.
Sb.
As.
Sn.
Ag.
PROPOSED AUGER SAMPLES
PROPOSED SOIL SAMPLES
5 cm
350000 Y.E.
355000 Y.E.
860000 Y.N.
1000
600
400
Marionoak
RIVER
PIEMAN
RAILWAY
EMU BAY
H.S.D. CRK.
ROAD
H.S.A. CRK.
CON CRK.
SOUTH
HUSKISSON
LAST DAY CREEK
WALKING TRACK
PROPOSED ROAD
VIOLET CRK.
SHEILA CRK.
ROMA CREEK
ALICE CREEK
RENEE CRK.
HUSKISSON
PAMELA CRK.
WALKING TRACK
CAIRO CREEK
PIEMAN RIVER
Argent
COMSTAFF PROPRIETARY LIMITED
PIEMAN AREA
SUMMER 1972
GEOCHEMICAL ANOMALIES
SCALE 1: 25000
DWN C.E.C.
No TAS. 2-289