QUINTETTE - GENERAL
PR-QUINTETTE 22(1)B.

CONFIDENTIAL

QUINTETTE PROJECT

INTERIM REGIONAL REPORT

Edited March 15, 1972

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QUINTETTE PROJECT

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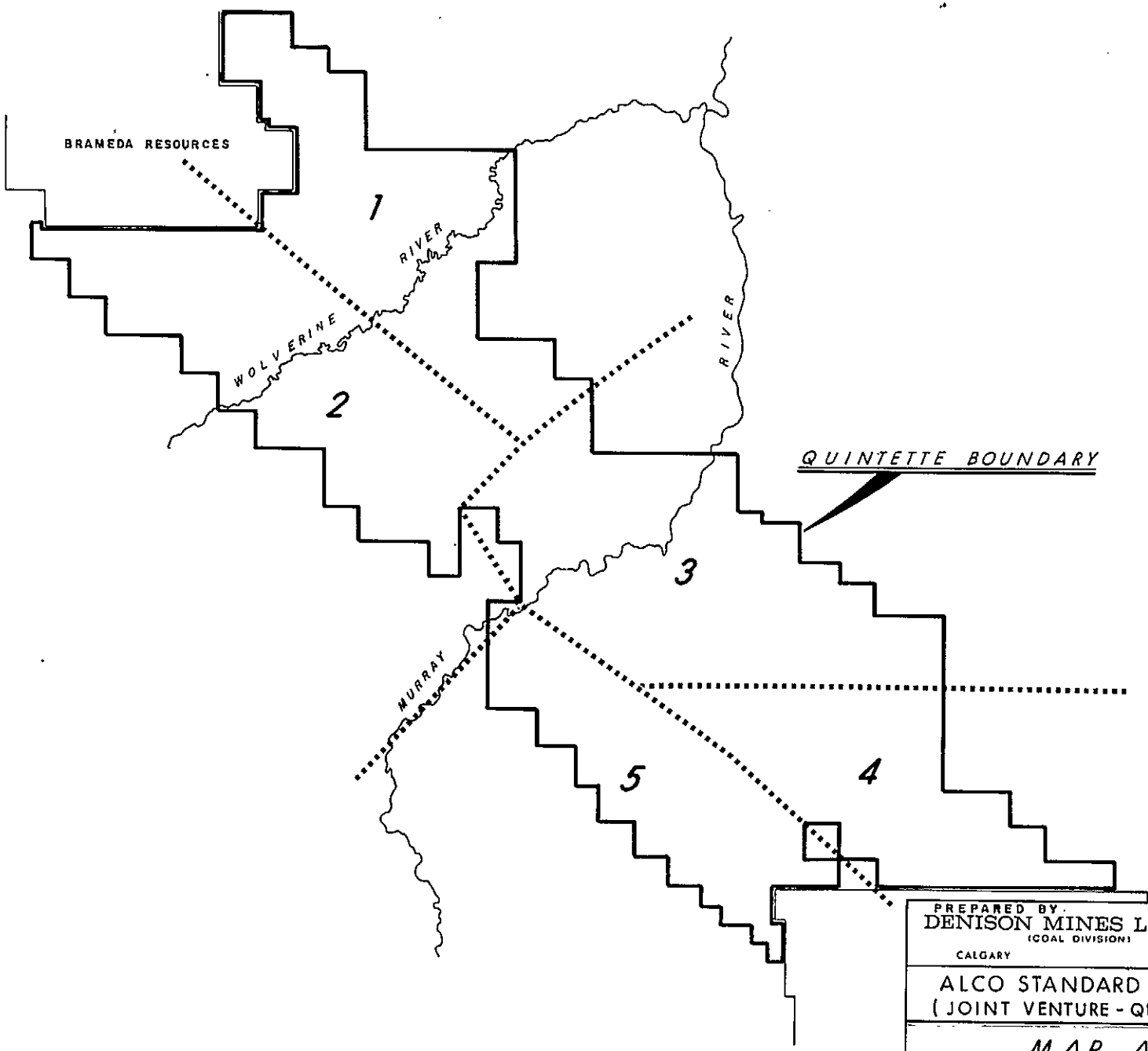
APPENDIX I

INTRODUCTION

The Quintette Project encompasses some 226 square miles of land underlain, in part, by coal bearing Cretaceous sedimentary strata. The original property was acquired in stages by Denison Mines Limited in 1970 and 1971 and was later added to as a result of the geological mapping with which this report is concerned. (See map QNTT 72-0272-R01, back pocket, and map LAND 71-0202-R01, before Page 4). Details of the coal licences are given in Appendix I.

In February, 1971, the original coal lands were the subject of a reconnaissance drilling program undertaken by World Resources Company and Denison Mines Limited to test the regional potential of the local coal measures. The success of this work lead to the signing of an agreement in March, 1971 for a major exploration program on the property and the adjoining areas.

As this exploration program required a sound base of geological data before specific drilling patterns could be laid out, it was decided that the entire property should be mapped to outline the areas where coal measures could be expected and, within these areas, the most structurally sound sections which would be amenable to various mining methods. This mapping was accomplished by six teams consisting of a Geologist and an assistant who were deployed daily from the base camp by helicopter. The mapping was done on 1/4 mile mylar enlargements of the standard 1:50,000 topographic map series. These map sheets were used in conjunction with the B.C. Government 1/4 mile air photos. Traverses were placed at approximately 1 mile intervals and the final maps were photo-reduced to the 1:50,000 scale. The geological map so prepared (QNTT R-71-0100-R05) forms the basis of this report.



72(2)B

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

MAP AREAS

Drawn by : E. Toth	Date : OCT. '71	Scale : 1" = 4 mi
App. by : R.S. Lee	Drawing No: QNTT 71-0207-R01	

PLATE 1

SUMMARY & CONCLUSIONS

The present geological mapping, and the results of the earlier drilling program clearly indicate that a very large possible reserve of coal exists on the Quintette property. This possible reserve has been estimated at 2.9 billion tons in place (Table C), of which some 500 million tons may be available as potential net clean coal providing that suitable mining methods can be developed. These possible reserves are located in a variety of structures which range from the broad, flat monocline at Babcock Mountain to the steep, regularly dipping beds on the flank of Quintette Mountain. There is every indication that small open pit areas may also be available to supplement the potential underground production. Preliminary analysis of the coal in the initial program and the present drilling at Babcock, indicates that it is a medium volatile coal (volatiles 20% to 25%) with excellent coking and cleaning characteristics.

Five target areas have been outlined (Plate II in Appendix I). These regions may be listed in order of increasing structural complexity as follows: (NOT NOS. AS SHOWN ON PREV. MAP)

1. Babcock Mountain

   This is the prime target for a deep mine and includes approximately five square miles of relatively flat strata. The beds pitching at 5^{0} to 15^{0} continue beyond the initial area but may be buried too deeply. (At this writing, drilling is confirming the potential of the Babcock area.)

2. Wolverine North

   A potential underground area with dips varying between 10^{0} and 20^{0} on the southern exposures. More complicated structures along Perry Creek result in beds as steep as 40^{0}. The dip-sloping

Gates strata may contain low ratio strip coal.

3. Five Cabin Syncline

This area of dominantly underground potential may provide small surface mining possibilities as well. Bedding dips are steep, varying between 15^{o} and 70^{o}.

4. Wolverine South

The greatest reserve in this region would require underground mining although surface mining potential exists on the eastern side. Strata dip steeply along the limbs of folds, flattening over small areas at the crest of folds.

5. Quintette

This area of steep dips (50^{o} to 85^{o}) may provide an initial contour type open pit operation. Later, with developing underground techniques such as hydraulic mining, deep mining reserves might be developed.

72(2)B

DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

GENERAL LOCATION MAP

ROADS

RAIL ROADS

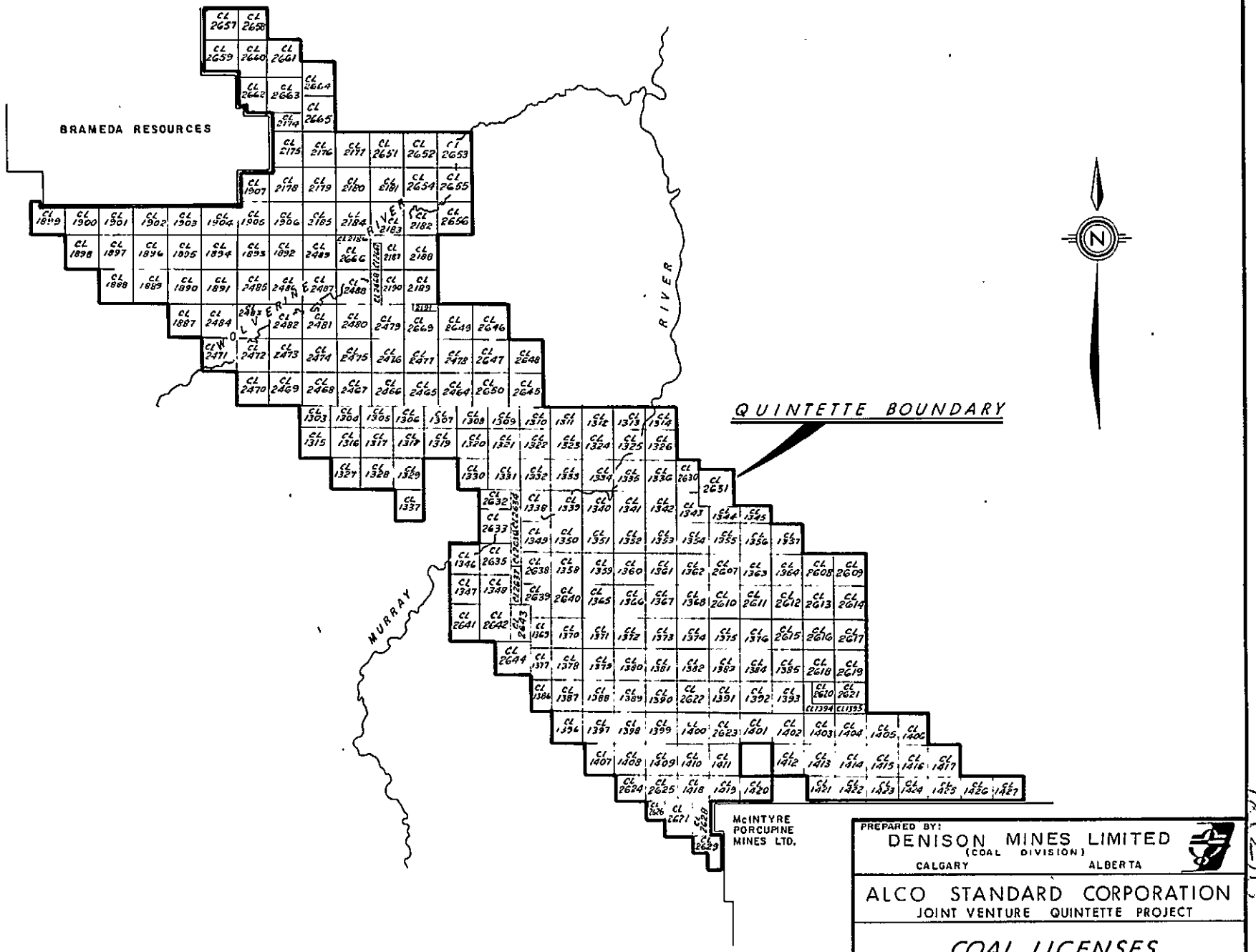
QUINTETTE AREA

FIG. 1

BRITISH COLUMBIA

Scale
40 30 20 10 0 40 80 120 160 MILES

138° 136° 134° 132° 130° 128° 126° 124° 122° 120° 118° 116° 114° 112° 110°
60° 58° 56° 54° 52° 50° 48°



PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
JOINT VENTURE QUINTETTE PROJECT

COAL LICENSES

Drawn by : E. Toth	Date : OCT '71	Scale : 1" = 4 mi
App. by :	Drawing No : QNTT 71 - 0202 - R02	

72(2)R

LOCATION & ACCESS

The centre of the coal licence area lies 70 miles by air southwest of Dawson Creek in British Columbia. The licences form a belt extending from Kinuseo Creek in the south to Perry Creek in the north, a distance of approximately 30 miles.

The southern access route, starting at Beaverlodge, Alberta runs 83 miles west to Five Cabin Creek, the site of the base camp. The northern route starts at Chetwynd, British Columbia and leads south then east 75 miles to the Wolverine Valley. Both roads provide fair weather access, deteriorating rapidly under wet conditions. (Ref. Figure 1 and Figure 2).

Two short airstrips are located within the property boundary. The first, on the north side of the Wolverine River, is an all season dirt strip suitable for light aircraft of the Cessna 180 variety, and is accessible by road constructed by Denison Mines for the joint venture Quintette Project of February, 1971. The second airstrip is located south of the Murray River and is useable only in winter by aircraft as large as a DC-3. However, no access route to the strip is available for land vehicles.

RELIEF & ELEVATION

Quintette Mountain (6,404') forms a prominant peak usefully employed as a station site for survey control in the south central region of the property. Topography to the west of the peak exhibits less relief, but does reach an elevation of 6,651 feet. To the north, Mt. Ressor (6,702') forms a distinctive land mark near the western border. Table A below shows the relief between the 3 main drainage basins and the surrounding ridges.

TABLE A

	Avg. Elev.	Avg. Ridge Elev.	Relief
Kinuseo Creek	3000'	5500'	2500'
Murray River	2500'	5500'	3000'
Wolverine River	2700'	5200'	2500'

TOPOGRAPHY

The topography above the treeline in the southern section of the property forms gently rolling ridges which conform to the N.W.-S.E. trending structural controls. To the north these ridges are more rugged and extend N.E. due to drainage truncation and increased structural complexity. Slopes below the treeline are generally steep (30^{o}-40^{o}) and are characterized by sparse glacial cover and steeply banked creeks. Due to the non-resistant nature and lack of pronounced structure in the Shaftesbury Formation along the eastern property border, very low relief and gently rolling topography are diagnostic.

DRAINAGE

The two primary drainage systems of the Murray River and the Wolverine River cut the structural trend at approximate right angles and exhibit remanent ox-bow lakes, wide flood plains and gentle gradients.

This indicates a mature primary drainage in terms of the erosion cycle and it was probably oriented in its present direction by plunges in the fold system. The secondary drainage pattern is structurally controlled following fold axes and to a lesser extent fault traces. Feeder creeks draining fold limbs generally enter the main creeks at right angles. Snow run-off is usually complete by mid-June but rain storms throughout the year can rapidly raise water levels to peak volumes. The Murray River is navigable by low draft boats during the summer months but low water and ice would make winter passage treacherous if not impossible.

VEGETATION

The tree line is encountered between 5,000 and 5,500 feet throughout the property. Above these elevations, alpine vegetation in the form of juniper, dwarf pine, moss and sporadic grassy meadows present no obstacles to foot traverses. Below the 5,000 to 5,500 datum, a continuous cover of spruce, pine and occasional cottonwood may be found. Generally the trees at the higher elevations are small and tightly packed, whereas, at lower elevations an increase in size and decrease in density is noted, although areas of windfall and heavy underbrush in the form of alder and devil's club are located in damp regions. The timber on the property is mainly of no economic interest except in a vicinity north of the Wolverine River where the timber is under licence to Canfor Ltd. of Chetwynd, B. C.

OUTCROPS

Alpine areas generally have the best exposure and usually the identification of rock formations and structures are made in these regions.

Below tree line, only creek beds present exposed outcrop. In the valley bottoms, very little exposure is encountered due to the thick alluvial fill of the mature drainage systems.

CLIMATE

Operations are possible year-round in the Quintette area. Generally, the weather conditions are no more severe than those at Edmonton, Alberta, Dawson Creek, B.C., or Grande Prairie, Alberta, although more precipitation can be expected. In the summer of 1971 when this work was done, rains were unusually severe and subsequently road building operations were severely hampered. This did not prevent the project from attaining its major objectives and there is little chance that such conditions would interfere with a major mining operation once good gravel roads had been built. On the average, a few inches of precipitation can be expected in any given month in this area.

TABLE B

	Jan.	Feb.	Mar.	Apr.	May	June
1971 Ppt.	2.43	.22	.59	.69	.12	6.68
(Inches of Snow)	(2.81)	(3.4)	(7.4)	(.44)	-	-
1970 Ppt.	.54	.43	1.07	.42	.82	1.15
(Inches of Snow)	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
30 Yr. Aug. Temp.	1.0^{o}	6.7^{o}	18.6^{o}	36.3^{o}	50.0^{o}	56.7^{o}

	July	Aug.	Sept.	Oct.	Nov.	Dec.
1971 Ppt.	N.A.	2.52	N.A.	-	-	-
(Inches of Snow)	-	-	-	-	-	-
1970 Ppt.	1.46	.5	.84	.33	1.59	.88
(Inches of Snow)	-	-	(1.0)	(1.5)	(19.1)	(9.9)
30 Yr. Aug. Temp.	60.8^{o}	58.6^{o}	50.3^{o}	39.4^{o}	20.6^{o}	8.2^{o}

*N.A. = Not Available

FORM 71-0097-R01

DENISON MINES LIMITED

FOOTHILLS DATA SHEET

UTM _____ STATION _____ UNIT _____

A BASIC PLOTTING DATA

DIP _____ DIP DIR _____

WAY UP: NRML OVRD IDRM

UNIT THICKNESS _____

FMTN: KNk KCd KGt KMb KCm(g) KCm(h) KCm(b) KSL

TYPE OF OUTCROP

O/C SUB O/C TRENCH

B MAJOR LITHOLOGY

% OF UNIT _____

TYPE	MDFR	SIZE	SORT	CLUR
		VF		WTHR
SHLE	SHLY	F		
SLST	SLTY	M		
SDST	SNDY	CRS		
CNGL	PBBL	VCR		FRSH
CARB	CALC	PBBL	POOR	
COAL	COAL	CBBL	MODR	
		BLDR	WELL	

COMPONENTS - BREAKDOWN BY PERCENT

	PERCENT CLASTS	PERCENT MATRIX (CLAY SAND SILT)	PERCENT CEMENT	TOTAL % 100
QTZ				
CO_3				
CHRT				
FLDP				
RKFM				
FRRG				
OTHR				
SAMPLE				

C MINOR LITHOLOGY

LTLG	%	DISTRIBUTION Top Bottom Middle Disper.	GRAIN SIZE				COLOUR Fresh Weathered
SILTY SHALE SANDY			VF	F	M	CR	
SLST			VF	F	M	CR	
SDST			VF	F	M	CR	
CNGL			VF	F	M	CR	
COAL			VF	F	M	CR	
CARB			VF	F	M	CR	

D SEDIMENTARY FEATURES

1. NATURE OF CONTACT:
   GRADATIONAL SHARP
   CONFORM. UNCONFORM.

2. BEDS: IN INCHES
   THLM (<.1) LAMN (.1-.4) VTBD (.4-1) THBD (1-4) MDBD (4-12) TKBD (12-36) VTKB (>36)
   WTHR: RECESSIVE MODERATE RESIST.
   WYUP: NRML OVRD IDRM

3. STRUCTURES
   BEDS: X GRDD CNTD
   CAST:
   RPMK:
   OTHR:

4. POROSITY - PERCENT
   <3 3-10 10-20 >20

5. FOSSILS: YES NO
   TYPE:
   SMPL:

E STRUCTURES

1. JOINTS:

CLASS	OPEN	CLSD	VEINED
No. SETS			
SPACING			

2. CLEAVAGE: DIP
   DDRC

3. FOLDS SYMMETRY SMCL
   AMCL S Z (VIEW NW)
   VERGENCE
   INTENSITY LOW MDRT SVR

4. FAULTS

	NORM.	RVRS	LTRL	
DIP				
DDRC				
SDRC				
PLNG				
AZMI				
SNS			R	L

5. PHOTO No. FCDR COMMENT

DIAGRAMS & REMARKS

(LABEL ALL DIAGRAMS)

DATE: _____

GEOLOGIST: _____

AIR PHOTO No: _____

N.T.S.: _____

REGIONAL MAPPING

The mapping program commenced on May 15, 1971, employing thirteen (13) geologists, assistants and supervisors. All field traverses were helicopter assisted and were completed by two-man parties. Mapping teams travelled to the traverse location each day and returned each night.

Geologists recorded field notes on a sheet prepared by Denison Mines in conjunction with Drs. G. Williams and M. Stauffer. The Foothills Data Sheet, Figure 3 provided a check list of required data and a short method for recording this data. Information, traverse locations and geological contacts were also plotted on aerial photographs at a scale of 1" = 1320 feet. These details appear in final drafted form on Plate IV at a reduced scale of 1:50,000. (Map QNTT 71-0100-R05).

STRUCTURAL GEOLOGY

INTRODUCTION

The property boundary encloses an area of coal bearing Cretaceous rocks which exhibit coherent northwest - southeast trending structures. The structures are comprised of anticlines and synclines with associated local faulting.

TECTONIC STYLE

The tectonic style of the region of which Quintette is a part is somewhat transitional between the Southern Foothills listric thrust belts and the Northern Foothills concentric fold and low angle thrust belts. Though regional thrusting occurs in the Quintette portion of the foothills, the general style is one such that rock units as a whole remain coherent, and any faults that do occur are of very minimal stratigraphic displacement. Therefore, adverse deformation in this region is mainly folding of quite variable intensity.

FOLDS

The western portion of the area (west of the reference line in the Cross Section Plate III) consists of companion synclines and anticlines, the axial traces of which are generally straight in a northwest - southeast direction extending approximately 10 to 15 miles. The traces plunge quite rapidly from culminations (represented by topographic highs) to depressions (normally associated with river valleys). North of the Murray River the folds exhibit a wave length of up to two miles. The western limbs of these folds have tightly folded intra-formational folds, likely due to a flexural slip phenomenon in the broad large structure, of

which these folds are part. Often measurements here are not truly representative of the structure as a whole and usually only detailed mapping can reveal the intraformational complexities. The syn and anticlinoriums here have limb intensities of 20 to 30 degrees, increasing towards the axes. (Cross Sections AA' - HH'.)

In the south eastern portion of the property, south of the Murray River, folding is very intense, but rock coherence apparently remains. Again complimentary anticlines and synclines have similar straight northwest-south eastward trending axial traces which plunge and culminate systematically to form en echelon types of folds. Dips are consistently high, in the 65 to 75 degree range. (Cross Section LL' - RR'.)

The eastern portion of the property is structurally complex between the Murray and Wolverine Rivers. In this area, folds and faults have been extremely difficult to trace with any degree of certainty. The geological picture seems to be one of extremely intense folding, recumbent folding and associated thrusting. (Section FF' - II'). Obvious examples of overturned folds reveal axial planes inclined eastward, a situation not common in the foothills regional structural pattern. In the same western portion, north of the Wolverine River and south of the Murray River, the structural complexity decreases markedly. (Sections AA' - EE' and LL' - NN'). These two areas are respectively a synclinal depression and a syn-anticline culmination, free of any major complexities. South of the Murray River and north of Babcock Creek, the deformation is so slight that only the necessity of maintaining reasonable stratigraphic thicknesses in cross section warrants a synclinal structure, and even so the bedding attitudes are in the five to ten degree range. North of the Wolverine River the synclinal structure is more prevalent, but the dips decrease consistently eastward for two miles from 18 degrees through level beds to 19 degrees

of opposing direction. Immediately east of these two regions, deformation again becomes complex, then rapidly the formation dip beneath the plains and the decrease in topography and increase in overburden prevent further study.

FAULTS

Only one regional thrust fault disturbs the stratigraphic succession in the property area. The fault trace approximately divides the property in half and trends northwest-southeast from beyond the property boundary, and terminates approximately three miles southeast of the Murray River. The thrust begins as a back limb thrust and progresses across the structure on an anticlinal system until the displacement and fault stresses are absorbed in a forelimb thrust which terminates in a syncline (Cross Sections BB' - KK', Plate III). In part, the thrust is complimented by several listric thrusts of minimal displacement (Cross Sections FF', GG', HH'). Displacement on the thrust is in the order of 200 to 350 feet, determined by relative formational contacts. Stratigraphically this displacement means the juxtaposition of rock units which are from formations that are one or two sequences apart.

Other thrust faults (Cross Sections FF', GG', II') are of a-real magnitude and these occur, in general, with tight isoclinal folding. Such faults can be considered, in part, as a mechanism for stress release and space compensation in tight geometric folds, although in some areas these faults are also initiated by a change in thickness and competency of a particular rock unit - particularly the occurrence of channel fills in river gravels and other continental deposits in the Gates Member of the Commotion Formation and in the Gething Formation. Similarly, in areas where such faults could possibly occur, the marine Moosebar and Hulcross

members should be highly deformed, being the most likely units to fail first. Stratigraphic throw on these thrusts is limited to several tens of feet, and thus the thrusts are normally related and remain within the formation in which they began.

The regional thrust respects the normal Foothills tectonic pattern, having a steeply dipping westward plunging fault plane showing a listric shape in cross section, and having associated faults likely joining the main thrust at depth. The areal thrusts are highly variable in dip direction, some eastward dipping, and therefore careful study of these structures is necessary to reveal whether they are folded regional thrusts or whether they are thrusts associated with the tight folding.

INTRODUCTION TO STRATIGRAPHIC REPORT

This interim stratigraphic report encompasses the Quintette Mountain, Wolverine River, and adjacent areas. It is based primarily on the study of isolated outcrops coupled with information from a few boreholes.

Main emphasis has been placed on lateral and temporal relationships of lithofacies and their thickness variations. Sedimentary and organic structures, and other petrologic attributes, were carefully analysed and used to synthesize various genetically related lithofacies with built-in implications of their depositional environments. It is thus possible, in a general way, to interpret paleogeography and tectonic elements influencing the site of deposition during Lower Cretaceous times.

No attempt has been made to elucidate mutual age relationships of different rock types based on faunal and floral assemblages. Rather these elements have been utilized (wherever available) as intrinsic sedimentary particles of a particular suite of rock. Much more information is required to reconstruct the precise paleogeographic picture over the entire area.

SUGGESTIONS FOR FURTHER STUDY

More precise and extensive data are prerequisite to the construction of a cross-sectional model elucidating the distribution of sandstone bodies, carbonaceous facies, and their component microfacies in a paralic environment. To achieve this the following procedure is recommended:

1. Outcrops should be examined extensively and stratigraphic columns erected. After correlating various units, certain bedding surfaces should be selected and traced laterally thus mapping various

facies changes between these surfaces. The correlations and lithofacies patterns could then be drawn on various data by restoring the landward surfaces of facies (such as offshore bars) as horizontal data.

2. Detailed measurements, classification and analysis of paleocurrents and other directional structures should be made.

3. Petrographic sections should be studied to establish provenance of various suites of minerals and the relationship between sand mineralogy and transport of sand.

Thus it will be possible to reconstruct a fairly reliable stratigraphic framework embracing facies relationships and geometry of various paleogeomorphic units. It is hoped that such a study will appreciably guide our exploration effort in indicating more favourable areas for coal. Paleogeomorphic synthesis will point out possible 'wash-out' areas.

NIKANASSIN FORMATION

These are the oldest Cretaceous rocks exposed within the limits of this area. The formation generally forms topographic lows and is invariably tightly folded - a useful feature for its identification in the field. Nikanassin Strata are incompletely exposed, the lower boundary being almost everywhere concealed. However, from the knowledge of successions of adjoining areas, it can be safely assumed that the lower contact of the formation with the underlying Fernie Shales is gradual.

The upper contact of the Nikanassin Formation with the Cadomin Conglomerate is abrupt but not erosional. Some tiny undulations of the contact are noted but these may be due to original surface of accumulation rather than scouring or erosional episodes. Locally, therefore, the contact is disconformable, but regionally, it is known

to involve angular discordance.

Lithologically, the formation can broadly be subdivided into two parts:

1. Brown weathering, argillaceous sandstones constituting the lower part;
2. Dominantly silty/shaly sequence comprising the upper part.

The lower part of the Nikanassin is composed of fine to medium-grained sandstone, ubiquitously argillaceous with subordinate intervals of siltstone and shale. The sandstones are brownish weathering,massive, and they exhibit large-scale cross-stratified units averaging 2 to 3 feet in thickness and several meters long. The angle of cross-lamination is moderate, commonly ranging from 12 to 15 degrees. The upper contacts of the cross-bedded units are generally planar and occasionally slightly erosional, small-scale cross-laminated units (0.5 to 0.8 feet thick) are sometimes encountered but these are seldom found in the coeval sandstones embodying large cross-stratified units. Large channel structures, cross-cutting the older sedimentary bedding are a common feature though these may not be readily obvious to a casual observer.

Twiggy material, fossilized leaves and rootlets at certain horizons are found. Abundant finely macerated plant matter is seen intimately mixed with the sandstone matrix. At two levels (approximately in the middle) marine pelecypods have been noted.

The upper part of the formation exhibits a more variable sequence though dominantly silty-shaly in nature. A typical sequence may begin with fine to medium-grained sandstone, passing upward into siltstones/shales (by far the thickest unit in a cyclothem) and then coal seams. The shales are commonly dark grey to black, carbonaceous and with abundant plant matter. The sandy sequences have a very character-

istic look. These are brownish grey, richly argillaceous and display small-scale ripple-drift type of cross-lamination. A few large burrows occur, mainly in the shale portions. Very noticeable is the occurrence of fine-grained, medium grey sandstones, extremely well indurated with abundant carbonized plant fragments. These sandstones are almost as hard as quartzite and have not been noted anywhere in the lower part of the formation. The reasons for such an extraordinary hardening of these sandstones (among otherwise moderately indurated sediments) are not known. One of the many factors contributing to such a property may well be the partially siliceous nature of its cement.

Within the uppermost 200 feet of the Nikanassin Formation, numerous rust-coloured argillaceous micrites occur-barren of any megafossils. These bands (6 inches to 1 - 5 feet thick), if carefully followed laterally, could be used as marker horizons. Thin-sectioning of these limy bands might reveal marine/brackish water ostracods or foraminifera.

Coal occurs at many horizons in the Nikanassin. It is often 6 inches to 1 foot thick and commonly shaly. The thickest coal seam, 2.5 feet thick, was seen in the neighbourhood of Quintette Mountain.

On the whole, there are no coarse sandy or gritty successions in the formation a feature very useful in distinguishing sandstone and shaly sequences (in isolated exposures) from the Gething sequences which usually have coarser suites of rocks.

Precise measurements of thickness are difficult to make because of intense folding, coupled with faulting. However, it is estimated to be over 1500 feet thick.

Nikanassin Formation is equated laterally in the south with Kootenay shales and in the northwest with Minnes Group - a preponderantly marine suite of rocks. The lower sandstones of this region appear to be homotaxially equivalent to Monteith sandstones of the Peace River

region.

The lower, dominantly arenaceous sequence of the Nikanassin Formation, appears to represent a fluvial regimen of sedimentation. The area witnessed occasional, marine incursions as is borne out by aberrant fossils. The micritic bands were also probably laid down under marine conditions. The fact that there are no coarse terrigeneous clasts (gritstones and conglomerates - normal concomitants of high energy environments) suggests the hinterland was of low to moderate relief. During the later phases of deposition of Nikanassin, conditions were unsettled precluding the deposition of any significant amount of coal.

CADOMIN FORMATION

The formation often exhibits positive relief - usually as prominent ledges or circular hills. This topographic expression is invaluable in figuring out the general layout and tectonic disposition of these associated rocks.

The conglomerate is composed of cobbles, pebbles and boulders (listed in order abundance) of quartzite, quartzitic sandstone, cherts of green, grey, black and white colours, phyllites, argillites, banded cherts and carbonate rocks. The latter component is scarce and is generally confined to the finer pebble fraction. Only one boulder (about 6 inches across) of grey biomicrite (or biolithite/boundstone) with colonial corals was found in a section above Quintette Drill Hole #1. The pebbles are embedded in a fine to medium-grained sandy matrix. Very occasionally, packing of the pebbles is profuse and their mutual boundaries interlocked. Little or no matrix is present in such instances.

In any given horizon, sorting appears to be fair. No systematic tendency was noted toward gradation of pebbles from coarse at base to fine towards top, although, locally there was a rude charac-

terization toward this feature.

The conglomerates usually show large-scale cross-stratification. The angle of cross-lamination is invariably high - usually in 25 to 30 degrees range. Bedding characteristics in the conglomerate are not always manifest - being only decipherable in zones attended by changes in grain size and/or when an intercalation of shale/sandstone is found.

Entombed within the conglomerates are numerous medium to coarse-grained sandstones, exhibiting strong cross-bedding. Most sandstones are essentially lenticular in nature and can usually be seen petering out laterally within the confines of a single exposure. Large amounts of coal fragments and macerated plant debris are commonly associated with these. Sometimes thin coal seams, in conjunction with finer lithologies are encountered. These sandstones probably represent large scale channel-fills within the conglomerate regimen.

The conglomerate maintains a constant thickness within this area, although a slight thinning in the section in the neighbourhood of the Wolverine River has been noted. In most of the sections around the Quintette Mountain region, the thickness is about 180 to 200 feet, and around Wolverine River, it is about 150 feet or less. This slight thinning in that direction is also accompanied by a sensible decrease in pebble size.

The pebbles and cobbles, as noted earlier, show remarkable sphericity and roundness. This feature is important in unravelling the depositional history of the pebbles. The chert pebbles are extremely hard and must have been in transportation/circulation for a considerable length of time to achieve such a physical state. Considering the possible derivative (source) areas, it seems unlikely that such a degree of rounding could be achieved. It therefore appears that some of the pebbles may have undergone

more than one cycle of erosion. Such an idea is further supported by some of the constituent pebbles of the conglomerate that are relatively more decayed and exhibit numerous patinae.

Most of the pebbles must have been derived from the older Paleozoics and the chert pebbles from carbonate sequences of the same age. Though the chert pebbles have not been examined petrographically, the majority of them, when examined with a hand lens, reveal intricate relics of carbonate fabrics and phantom outlines of sparry masses (now completely silicified). Much of the carbonate detritus may have come from the Silurian/Devonian rocks as evidenced by readily recognizable Amphiporan and Halysites colonies.

It appears necessary to invoke a considerable relief of the older mountainous regions during the formation of the conglomerates to account for abundant coarse detrital material. No systematic study of directional structures was made. However, a cursory glance at the major cross-stratified units reveals that these units advanced from a general direction of northwest to southeast - thus pointing to a dominantly westerly source.

The environment of deposition appears to be a piedmont alluvial plain with numerous laterally coalescing alluvial fans. This plain might have been occasionally activated by torrential flood streams. Systematic mapping of various microfacies within the conglomerates would reveal the nature, dimensions and mutual relationships of such alluvial fans.

The upper contact of the Cadomin with the Gething Formation is drawn arbitrarily. In most sections the conglomerate passes upward into sandstone and carbonaceous shale and back into conglomerate. Occasionally there may be two or three sets of conglomerate intervening higher in the succession. Since mapping in the field is done on lithologic basis (hence maps depicting facies boundaries), it is considered

valid to place the boundary between the Cadomin and Gething where any significant amount of conglomerate ceases to occur. Such a demarcation will be fully consistent with the genetic implications of facies associations. By following such a procedure, it is easier to keep track of facies changes on a regional scale and hence the awareness of any ascending or descending formational boundary lines.

GETHING FORMATION

This formation exhibits moderate relief but because of its occurence between massive Cadomin conglomerates and very recessive Moosebar Formation, its boundaries can often be delineated with considerable facility.

The lower contact of the formation does not form any persistent stratigraphical horizon, but lies on various conglomerate beds in different areas - hence the junction is essentially diachronous.

The Gething constitutes interbedded mudstones, shales, siltstones and sandstones. Conglomerate beds occur sporadically. Coal is present within these units but is more erratic than the rest of the cyclic lithologies. Repetition of numerous units is quite a common feature of the Gething assemblage.

Thickness of the formation remains more or less uniform although there is a slight thickening towards northwest, i.e. in the environs of Wolverine River. In Quintette region the thickness is around 450 feet and around Wolverine River it is approximately 500 or slightly more. It is known that there is a regional thickening of the Gething in a northwest direction and in the Peace River region it attains a maximum thickness of over 1500 feet. This increase in sediment is also accompanied by an increase in coal thickness and frequency of coal seams.

The upper boundary of the Gething is everywhere characterized

by the occurrence of a conglomerate band, commonly one to three feet in thickness. No large-scale scouring or channeling below the conglomerate beds was noticed. Only locally there are some bumpy and irregular contacts. It is remarkable to note that matrix sediments of the conglomerate (in most cases) closely resemble the lithology immediately underlain by them. This fact strongly suggests that there must have been some mild episodes of erosion before the onset of Fort St. John Sea. Thus the upper contact of the Gething within this region is probably disconformable.

The Gething Formation constitutes three distinct lithofacies:

1. Conglomerates and associated gritty sandstones;
2. Fine to medium-grained sandstones;
3. Siltstones/mudstones with coal.

The conglomerates and gritty sandstones resemble in all important attributes, those of the Cadomin conglomerates. However, the size of the clasts is sensibly smaller and the thickness of conglomeratic units seldom exceeds 30 feet. Lower contacts of the conglomeratic units with sandstones and mudstones are highly indented and often the underlying lithology (in the form of flat-pebble conglomerates) is seen in juxtaposition with chert pebbles. This fact suggests rapid hardening and induration of sand/muddy lithologies. General patterns of gritty and conglomeratic zones have not been outlined in the field. Their lithological associations and mutual contacts with finer lithologies suggest encroachment of alluvial plains by major tributaries.

Fine to medium-grained sandstones are the commonest type encountered in the Gething and may constitute 20 to 30 percent of total rock types in a given succession. The sandstones are rusty weathering, evenly-bedded, often laminated, and occur in units that range from a few feet to several tens of feet. Occasionally, coarse-grained sandstones may be encountered but they are not a common feature.

Fine to medium-grained sandstones are much more abundant in the Quintette region than in the Wolverine River area. It is not clear whether this facies change reflects a regional picture or a local deviation from depositional pattern.

Cross bedding in medium-grained sandstone is dominantly of large festoon type but its dimensions vary considerably. Fine-grained sandstones are usually ripple-marked and laminated. Planar or tabular type of cross-stratification is not common in the sandstones. Parallel lamination is usually associated with well sorted, clean sandstones.

Organic structures are not very common. Rootlets have been noted in some sections. These are generally found in silty and shaly beds immediately underlain by coal seams. Some rootlets are found as carbonized vertical structures (perpendicular to bedding) exhibiting branching at the lower ends. Other rootlets are found as thin tubes (slightly calcareous). On breaking, these tubes show rusty weathering powder within them. The beds entombing these structures probably represent paleosoils.

Burrowing structures have occasionally been seen in mudstone/shale sequences overlying some of the coal seams. No appreciable alteration of original fabrics was evident.

Siltstone/mudstone facies is most abundant in the Gething. It consists of a vaguely cyclic sequence of argillaceous siltstones, silty mudstones, carbonaceous shales and coal seams. The siltstones are medium-grey, uniformly laminated, flaggy and thin bedded. These grade upward into silty mudstones, dark brown in colour, and are essentially structureless. Rootlets and plant fragments are often found. This sequence may imperceptibly grade into coaly shales or a clean coal seam. It has commonly been noted that coal seams are often overlain by thin-bedded argillaceous siltstones that display yellow to orange weathering.

Sometimes thin rusty concretions have been seen. These beds probably represent periods during which subaerial weathering took place.

A few marine fossils, e.g. Pectin and Artica, have been seen in beds overlying rusty concretionary siltstones. These are often fragmented, suggesting that they have been subjected to current activity. Since they are embedded in a muddy lithology that shows no signs of rigorous current activity, it seems probable that their ecological niche lay in contiguous beds where they were broken up and subsequently transported to a quieter milieu. The occurrence of these fossils indicates brief periods of marine innundations.

MOOSEBAR FORMATION

The shales of the Moosebar Formation occur as a recessive interval between the more prominent ridges of the Gething and Commotion Formations. The lower contact of the formation is disconformable and may represent a brief hiatus.

The upper boundary of the Moosebar with the Gates is very transitional and is placed at the first significant sandstone bed.

The bulk of the formation is composed of medium-grey blocky shales that are apparently structureless. Siltstones and sometimes fine sandstones are inter-bedded with the shales. The contacts of siltstones and shales are more often than not erosional. Erosional contacts may be characterized by minutely indented outlines or may be distinctly channeled. Shaly intraclasts, often pointed, are associated with the channeled contacts.

In any given section, it appears that the upper half of the formation exhibits more variable lithology than the lower half, where it is dominantly shaly.

In the region of Wolverine River, short intervals of coarse-grained sandstones with fine pebbly zones were found. This feature in the Moosebar has not been noted elsewhere and might represent local shallowing of the sea or nearness to shore-line.

Very characteristic is the occurrence of sideritic concretions that weather rusty brown and are often strewn over the bedding surfaces. Sometimes thin dolomitic nodules are also found. These are confined mainly to the lower half of the formation.

Bentonite layers, only a few inches thick, occur in the lowermost 50 feet. It is not uncommon to find bentonitic layers in contact with the basal conglomerate (on top of the Gething). Glauconite occurs sporadically and is usually associated with sandstone layers. Carbonaceous fragments and plant material are rare and their absence is a fairly reliable guide to the identification of Moosebar.

Organic structures are abundant in the formation. These are in the form of burrows that are of two types.

1. Megaburrows that may be from a few millimetres to a few inches across and are often perpendicular to bedding. The fabric within the burrowed zone is disordered and is sensibly coarser than the juxtaposed lithology. These might be resting burrows made by various pelecypods.
2. Microburrowing is widespread throughout the Moosebar. These usually appear as dark 'pin-heads' in the shaly lithology. These are so intensive in some of the intervals that primary lamination is complete obliterated (only obvious in cored samples).

Often these burrows are impregnated with particulate pyrite. These burrows provided preferential avenues for sulphide solutions. Faecal pellets, though rare, have been found at some horizons.

The Moosebar Sea, in this region, appears to have been quite shallow. The sea floor was subjected to constant wave action, resulting in the ripping up of semi-consolidated muddy sediments (now seen in the form of intraclasts). The abundance of burrows suggests frequent fluctuation of marine conditions

forcing organisms to stick to the sediments to achieve stable living conditions. The paucity of preserved bodied fossils is suggestive of an environment where mud-grabbing soft-bodied animals (probably worms) prevailed. This would in turn suggest rather abnormal marine conditions. The milieu may have been slightly reducing as suggested by abundance of pyrite.

A foramniferal assemblage has been reported (Williams, 1971) from the Moosebar. These are both calcareous and agglutinated types. The former is thought to represent normal marine conditions whereas the latter as near-shore to brackish environment. The presence of an arenaceous assemblage suggests a water depth not exceeding 200 feet.

The thickness of the Moosebar Formation in this region varies from 150 to 250 feet.

COMMOTION FORMATION

This is a succession of sandstones, siltstones, mudstones/shales and conglomerates. It is subdivided into three members. The lower part is Gates, middle designated as Hulcross and the upper as the Boulder Creek. Because of its heterogeniety, the Commotion forms distinct ridges and depressions. Conglomeratic zones are especially noticeable in some of the sections.

The lower contact with the Moosebar Formation is invariably transitional and is placed at the base of sandstones that ascend in stratigraphical level from the Quintette area in southeast to the Wolverine River area in the northwest.

The upper contact of the Commotion Formation constitutes a persistent horizon and appears to encompass the same stratigraphic interval in the entire area. There is a marked regional thickening of the Commotion from the southeast to the northwest.

GATES MEMBER

This member succeeds the Moosebar Formation and has a very transitional lower boundary and sometimes may constitute beds much as 50 feet in thickness. The boundary is placed at the base of first thick fine-grained sandstones. This boundary rises stratigraphically from south-east to northwest. In the absence of a well-defined and continuous sandstone band, the placement of the boundary is highly arbitrary and the interbedded sequence of sandstones, mudstones and shales has been incorporated in the Moosebar shales. The upper boundary of the Gates appears to lie at a persistent stratigraphic level throughout the area.

The lowermost 150 - 200 feet of the Gates Member are ubiquitously fine-to medium-grained, clean and well-sorted sandstones. These are characterized by fine parallel laminations. The units may vary from 2 feet to more than 10 feet thick and weather light brown grey to dark grey. There are two zones in the sandstones that are riddled with tubes of organic origin. Several types of structures are recognized. Burrows are apparently unbranched, silt-filled tunnels, generally about 5 millimeters in diameter and arranged almost parallel to bedding. The tunnels are widely spaced. Branching type of burrows are also seen and at certain intervals they impart a mottled appearance to the rock. There are some sinuous irregularly branching tubes from 5 to 15 millimeters in diameter, without any preferred orientation in relation to bedding plane. The component material is generally finer (of silt grade) and some ovoidal pellets can sometimes be discerned in it.

In the lower levels of these well-sorted sandstones, silty/shaly intraclasts are numerous. These are often associated with a slight coarsening of sand grains and the suite is relatively ill-sorted.

Few Ammonites were collected from basal Gates. There is a pea-shaped structure often associated with the sandstones. The precise nature of this is not known - it may well be a large burrow made by an organism comparable in size to an Ammonite.

The middle part of the Gates consists of conglomerates, medium- to coarse-sandstones and mudstones. These lithologic units may exhibit a rhythmic succession with sub-facies grading into one another, or more commonly certain units may be missing giving rise to repetitions of two of three units.

The conglomerates in the Gates are medium type with associated coarse-grained sandstones. Components of the conglomerates include pebbles/boulders of chert, quartzitic sandstone and quartzites of black, white and green hues. The conglomerate resembles very closely the Cadomin conglomerate in composition but the entombed pebbles are smaller and appear to incorporate greater proportions of matrix.

Sometimes the conglomerates constitute the roof of a coal seam, and may laterally grade into a sandstone. Such lateral facies changes have been found to affect the thickness of coal seams.

Shales and mudstones constitute a large bulk of the Gates. The mudstones are commonly arenaceous and devoid of any sedimentary structures. The mudstones may grade upwards into coal. Thin-bedded, rusty weathering siltstones that often overlie the coal seams, are an infallible guide in locating the coal seams on talus covered slopes. Sedimentary structures are more common in sandstones facies than in the fine-grained carbonaceous facies. The former is characterized by large-scale (excluding basal sandstone), thick bedded units that beautifully weather in stacks of plates, while the latter facies is generally thin-bedded and has small scale cross-laminations and microchannels. Slump structures were commonly noted in

muddy facies.

The thickness of the Gates within the region varies from 740 to 1000 feet. This thinning is noticeable around Wolverine area.

The abundance of burrows, and few Ammonites in the basal Gates suggests marine condition. The paleogeomorphic regimen may have been intertidal and/or offshore. Uniform lithologies and their well-sorted nature attest to periodic wafting by waves and current action.

The middle and upper sequence of the sandstone/mudstones and coal represent fluvial and back swamp conditions. Peat (now represented by coal) could result only from the accumulation of vegetable matter in the absence of major terrigeneous detritus. Shales and silty shales are thought to represent open water backswamp area, receiving only silts and clays from adjoining channels. The conglomerates essentially represent flood channels.

HULCROSS MEMBER

This member is generally recessive and the outcrop surface is generally strewn with blocky rubble. The lower contact of the Hulcross with the Gates is marked everywhere by a thin conglomerate band - usually from few inches to several inches thick. The pebbles are less than ¼ inch in diameter, poorly sorted and set in a distinctly bluish-grey muddy matrix. The upper boundary of the member with the Boulder Creek is gradational. In a typical contact zone, siltstones and interbedded shales of the Hulcross may become sandier toward the top and gradually pass into fine to medium-grained, thick bedded sandstones of the Boulder Creek. The contact is not persistent but becomes gradually lower in stratigraphic level in the southeast.

The Hulcross Member is dominantly composed of silty shale. The

shales are dark grey to black, commonly encrusted with limonite. Very characteristic is the reddish tinge of the matrix that appears to be primary in origin. Toward the top of the member, bedding is demonstrably poor, and an increase of argillaceous siltstones takes place.

Ironstone concretions are ubiquitous in the Hulcross Member and weather bluish grey to reddish brown. The size of the concretions commonly ranges from ½ inch to several inches across.

Small-scale cross-lamination is very characteristic of the Hulcross. The cross-sets often have minutely-eroded contacts. Alternations of dark and light laminae impart a banded appearance to the rock. This feature has not been noted in shales of other horizons and hence it is very useful in differentiating various shaly lithologies.

The shales are riddled with large and small burrows. The burrows (now in the form of tubes) have no clean and smooth outer surfaces and appear to have been modified during deposition. It appears that most of the burrows were slightly affected by current activity and hence they are of irregular shape. Certain closely appressed burrows give an indication of the amount of compaction suffered by the shales. No body fossils were found, but the shales are known to contain some invertebrate marine fauna.

The Hulcross shales were deposited in a marine environment. Ubiquitous cross-lamination suggests mild current activity. The reddish colouration of the matrix suggests that the detritus was derived from areas undergoing near-lateritic weathering. This would imply considerable change in climatic conditions after the depositon of the Gates sediments. This idea is also-supported by the appearance of a distinct floral assemblage during the Boulder Creek sedimentation.

The thickness of the Hulcross member appears to vary between 300 and 350 feet.

Boulder Creek Member: This is the highest member of the Commotion Formation and forms conspicuous ridges that constitute mappable horizons. The lower contact is transitional with the Hulcross Member. The lower part of the member is composed of massive, fine-grained, well sorted sandstones. These are overlain by 40' - 50' of massive conglomerates that are essentially lenticular in nature. The conglomerates have well sorted pebbles (dominantly of green chert) usually under ¼" in diameter with little or no matrix. Carbonaceous shales with thin coal lenses also occur in the member. The upper part of the Boulder Creek is composed of siltstones, mudstone and carbonaceous sandstones. They are usually ill-sorted and have a greyish brown look. Carbonaceous fragments are common in some horizons of the sandstones. The total thickness of the member is probably between 440' - 450'.

SHAFTESBURY FORMATION

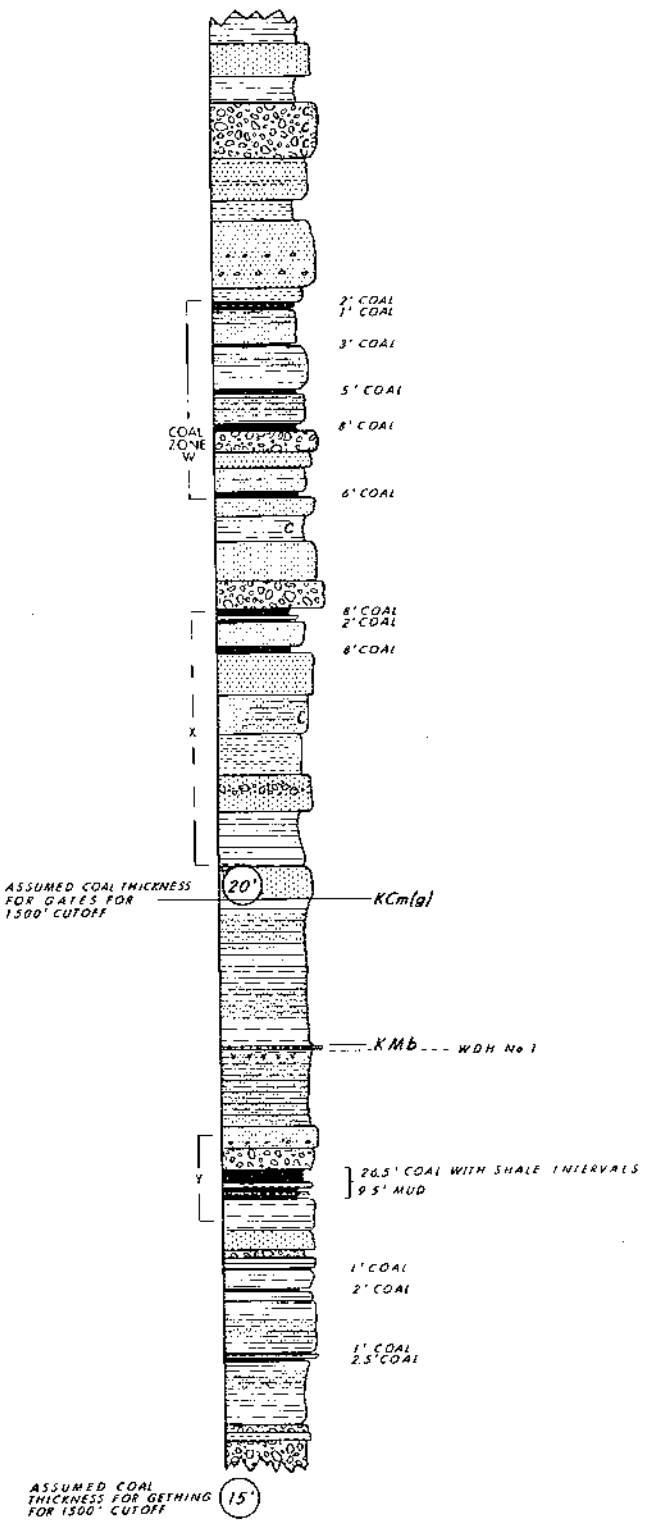
The formation is entirely marine and is grey to dark grey in colour. Silts are uniformly disseminated in a shaly matrix and hence there is an absence of well-defined lamination. Fish scales are encountered 200' - 300' from the base of the formation. North of the Murray River, the formation is divisible into three lithologies - Hasler at the base, Goodrich in middle (sandstones) and Cruiser at the top. The Hasler and Cruiser are very similar lithologically but can be isolated only because of the intervening Goodrich sandstones. Goodrich sandstones are fine-grained and cross-bedded with subordinate amounts of mudstones and shales. The Cruiser and Hasler Members have sideritic concretions. Minor conglomerates may sometimes be seen in the lower part of Hasler. The combined thickness of the three members may exceed 2000'.

DUNVEGAN FORMATION

This formation consits of marine and non-marine sandstone/shale sequences with minor amounts of coal. No exposures of this formation have been observed within the confines of the region under investigation.

AREA 1

WOLVERINE NORTH,
SECTION ALONG PERRY
CREEK PLUS WDH No 1



LEGEND

	SANDSTONE	CRETACEOUS	
	SILTSTONE	KCm(h)	Commotion Formation (Hollcross member)
	SHALE	KCm(g)	Commotion Formation (Gates member)
	SILTY, SANDY SHALE	KMb	Moosebar Formation
	CONGLOMERATE	KGt	Gething Formation
	COAL	KCd	Cadomin Formation
	CARBONIFEROUS SHALE	KNk	Nikanassin Formation
	MUDSTONE		

72-203

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

AREA 1
STRATIGRAPHIC SECTION

DRAWN BY: E. Toth	DATE: Feb '72	SCALE: 1" = 200'
APPROVED BY	DRAWING NO QNTT 72-0276-R01	

REGIONAL STRATIGRAPHY

For the convenience of mapping, the entire area was subdivided into five regions (see map QNTT 71-0207-R01, Page 1a, for delineation of boundaries of the individual areas). The preceding account depicts major lithological variations, gross physical features and thickness changes within the entire area. The following account attempts to describe local variations within the stratigraphic succession.

Area 1 (Section QNTT 72-0276-R01) (in part Wolverine North)

Area I is located at the north end of the Quintette property, northeast of the main fault. The Nikanassin and Cadomin Formations do not outcrop within the boundaries of the area. The Gething Formation, though not exposed, was penetrated by drill hole WDH #1. The Gething is 410 feet thick and is dominantly composed of mudstones/shales with subordinate amounts of sandstones. One 20 foot thick conglomerate unit was encountered, about 100 feet from the top of the Gething. This conglomerate constitutes the roof of the thickest coal zone in the formation.

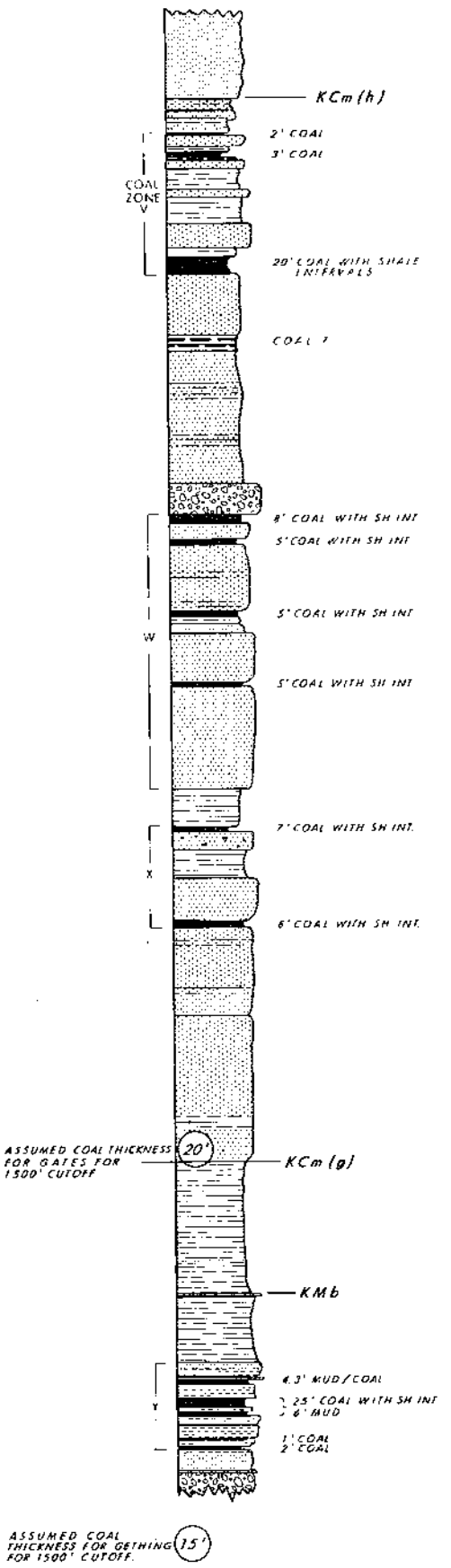
The Moosebar Formation is about 155 feet thick and has appreciable sandy/silty intervals.

The Gates Member has similar lithology as noted previously except that two thick conglomerates were found on ridges south of the Wolverine. These units resemble the Boulder Creek conglomerates in that they consisted of well sorted chert fragments in a siliceous matrix.

Hulcross Member: Approximately 350 feet of this section was measured north of the Wolverine River but no complete sections were found to the south. The upper and lower contacts were located in an exposure near Mount Spieker. The latter contact was found to be slightly erosional, marked by a poorly sorted conglomerate.

AREA 2

WOLVERINE NORTH &
SOUTH WESTERN HALF
NORTH OF WOLVERINE RIVER
4 MILES S.E. OF MT REASOR



LEGEND

		CRETACEOUS	
	SANDSTONE	KCm(h)	Commotion Formation (Hallcross member)
	SILTSTONE	KCm(g)	Commotion Formation (Gates member)
	SHALE	KMb	Moosebar Formation
	SILTY, SANDY SHALE	KGt	Gething Formation
	CONGLOMERATE	KCd	Cadomin Formation
	COAL	KNk	Nikanassin Formation
C C	CARBONIFEROUS SHALE		
	MUDSTONE		

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ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

AREA 2
STRATIGRAPHIC SECTION

DRAWN BY: E. Toth	DATE: Feb '72	SCALE: 1" = 200'
APPROVED BY:	DRAWING NO: QNTT 72 - 277 - R01	

Boulder Creek Member: The conglomerates and carbonaceous sandstones of this member resemble similar lithology in the Gates. It is approximately 400 feet in thickness and forms resistant cliffs and dip slopes. No significant coal occurrences were found. Some ferruginous sandstones were noted.

Shaftesbury Formation: Fish scales and some problematic objects (resembling teeth) were found in black shales on tributaries of Mast Creek in the northeast corner of the area. Fish scales constitute correlatable marker bed in the Hasler Formation; approximately 100 feet from the Lower Commotion contact.

Hasler in this region is distinctly homogenous and has staining of iron oxide. Good rich sandstones, about 500 feet thick, occur in the area but were not examined in detail.

Area 2 (Section QNTT 72-0277 R01) (in part Wolverine South)

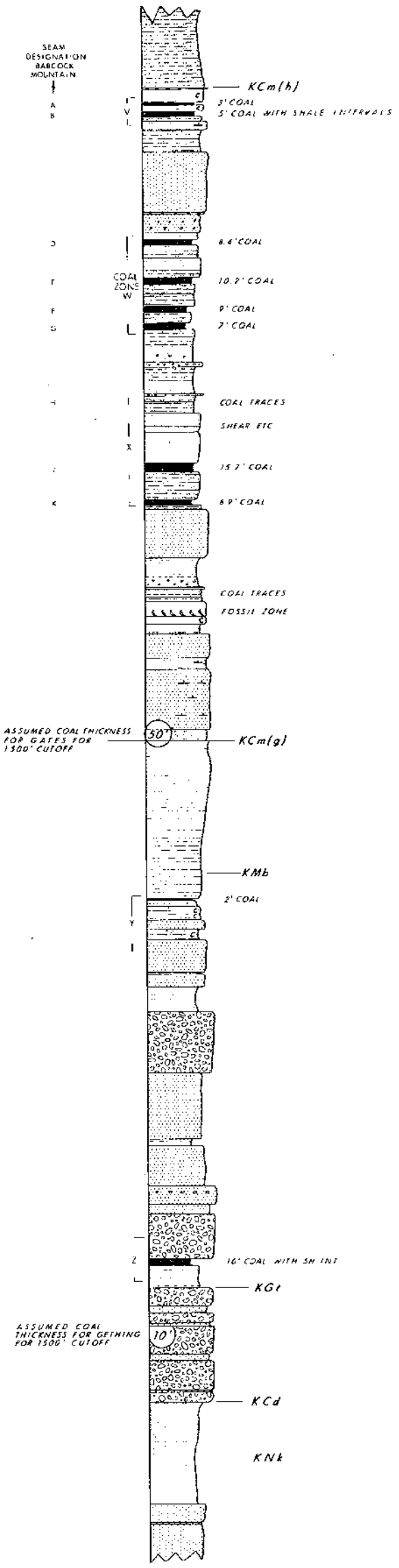
In this area, which lies southwest of Area 1, the Nikanassin Formation is poorly exposed, the only exposures being along several creeks near the southwest of the area. The exposures show interbedded siltstones, shales, sandstones and coal shales. The upper contact of the formation with Cadomin is locally channelled.

The Cadomin Formation varies from 100 to 160 feet in thickness. Average clast size is smaller than that observed in the south of the area.

The Gething Formation is similar to that described for the region in general. It is about 500 feet thick. The Moosebar is lithologically similar to the other areas. It was found to be 150 feet thick on a limb of a tight anticline. The contact between the Moosebar and Gates is marked by carbonaceous shales.

AREA 3

BABCOCK.
SECTION WESTERN SPUR OF
BABCOCK MOUNTAIN, SOUTH
OF MURRAY RIVER



LEGEND

	SANDSTONE		CRETACEOUS
	SILTSTONE	KCm(h)	Commotion Formation (Hultcross member)
	SHALE	KCm(g)	Commotion Formation (Gates member)
	SILTY, SANDY SHALE	KMb	Moosebar Formation
	CONGLOMERATE	KGr	Gething Formation
	COAL	KCd	Cadomin Formation
C C	CARBONIFEROUS SHALE	KNk	Nikanassin Formation
	MUDSTONE		

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

AREA 3
STRATIGRAPHIC SECTION

DRAWN BY: E Toth	DATE: FEB '72	SCALE: 1"=200'
APPROVED BY	DRAWING NO: QNTT 72-0278-R01	

72/12/R

The Gates is well exposed in sections just above drill hole WDH #2. It is about 800 feet thick and encompasses three widely spaced conglomerates. A ferrunginous band, about 25 feet thick, was noted to extend throughout the lower part of the Gates. Three coal seams seem to occur persistently, aggregating 30 feet in thickness.

The Boulder Creek Member is not preserved south of the Murray, but is well preserved to the north. There is a massive conglomerate unit, about 40 feet thick and is associated with medium-grained sandstones. Total thickness of the unit is about 490 feet.

Area 3 (Section QNTT 72-0278-R01) (Babcock)

The central portion of the property is represented by this Area. It contains the Babcock Mountain area which encloses one of the most promising structures.

Nikanassin Formation: North of the Murray River, the Nikanassin consists of cyclothemic interbedded argillaceous siltstones, mudstone, shale and coal. The siltstones exhibit a characteristically distinct brown, orange brown to black weathering habit, along with festoon cross-bedding. In the upper 400 feet, the siltstones have slump structures indicative of a highly disturbed shallow water environment. The siltstones are interbedded, but still retain similar lithologic and structural characters, and thickness as the other siltstone units above or below it within the formation. Uniform thickness, and distinct and straight boundaries with the complimentary lithological units adjacent to the siltstones are very characteristic.

The mudstones and shales are brown to grey and become fossiliferous and grade laterally to coal. The coal is very limited in extent and despite the uniform lithology enclosing the coal, it is highly sheared.

South of the Murray River, fine to coarse sands appear near the top of the formation. In the north, the formation is disconformable over the overlying Cadomin, but in the south, the increase in coarse clastics prevents an easy separation of the Cadomin and the Nikanassin. Thickness is estimated in excess of 1000 feet.

Cadomin Formation: The Cadomin varies between 170 to 200 feet in thickness, and respects the regional lithological description previously mentioned. However, there is an apparent decrease in clast size and increase in coarse sand matrix north of the Murray River compared to south of the Murray River.

Gething Formation: The Gething is on the order of 600 feet in thickness, the increase over the regional thickness possibly being a function of internal deformation. The Gething exhibits sedimentary structures and lithology that match those of the region, with the lower (100 feet) Gething having zones of sandstone and shales (but lacking coal) with similar sedimentary structures and characteristics as the Nikanassin. Immediately south of the Murray River, in the upper 100 feet of the formation, distinctive, very thin, carbonaceous (coal) beds occur in association with worm burrows with Meniscus structures. The formation as a whole represents a lacustrine, or deltaic environment as only a very small interval (20 - 30 feet) in the lower part of the formation has marine characteristics. The marine characteristics were defined predominantly on the basis of a highly inconsistent pelecypod-bearing sandstone.

Moosebar Formation: There is only one exposure of Moosebar within the area, and this exposure is immediately adjacent to the geological area to the south where a 300 foot section was measured. Otherwise, estimations of thicknesses of the Moosebar (200 - 300 feet), have been deduced by the relative thicknesses of recessive zones between mappable

units of the Gething and Commotion Formations. This lack of information is the result of the vegetation cover.

The existing exposure consists of dark grey black to brown black shales, with several continuous bands of orange brown concretions. The concretions vary from ½ to 1½ inches in diameter, being somewhat elliptical in profile. Bioturbation and worm burrows are prevalent.

Commotion Formation

Gates Member: The Gates Member conforms to the regional lithological description. Typical structures, i.e. planar cross-beds exist periodically throughout the 800 to 900 foot thickness of the member. The lower sandstone units are fine to medium-grained and are exceptionally clean and well sorted. North of the Murray, the lower sequence has a ferruginous sandstone bed about 40 feet in thickness, which does not appear south of the Murray River. The lower sandstones also have pelecypod fragments denoting a marine environment. The upper sandstone units are distinctly calcereous, highly fossiliferous (flora) and characteristically flaggy with a brown to orange weathering habit. The upper sandstone units also are characterized by underlying carbonaceous shales and extensive coal seams.

A zone of structural complexity south of the Murray River and west of Babcock Mountain, exposes a thick shale unit which lithologically is the Hulcross Member of the Commotion, however, if the structure is not as complicated as first thought, then the shale unit may be a Hulcross equivalent in the Gates.

Hulcross Member: The Hulcross varies from 200 to 300 feet in thickness within the area. The marine shale lithology is generally concurrent with the regional description. There is sharp increase in the member thickness from the region north of the Murray River, south to

Babcock Mountain.

In the lower part of the section, notably in the first 100 feet, there is a sideritic conglomerate unit of 6 to 8 inches of thickness. The matrix consists of a blue grey shale and coarse chert sand. The clasts are composed of rounded chert in the order of ½ inches in diameter. The distinctive yellow weathering of the Hulcross Member is quite prevalent in this layer. North of the Murray River, the conglomerate unit comprises the Gates Hulcross contact while south of the Murray River in the Babcock Mountain region, the conglomerate unit is found up in the Hulcross shales.

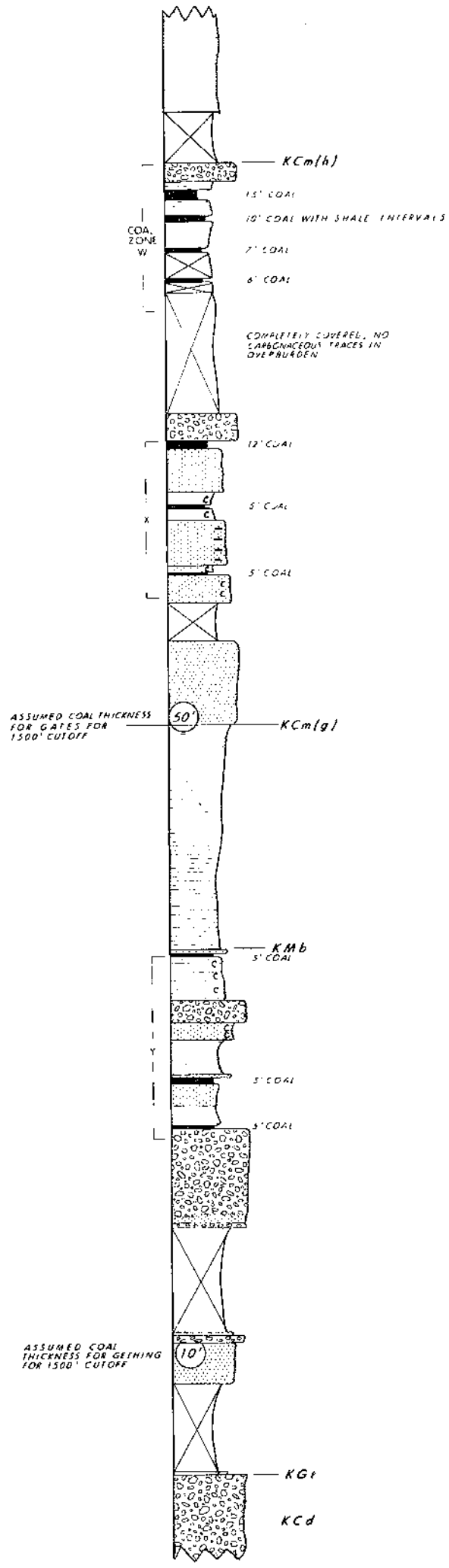
To the southwest of Babcock Mountain, the Hulcross has a flaggy character, as well as weathering red. This change in character is likely the result of an increase in silt percentage. Cast structures, similar to worm burrows, are also prevalent here.

Boulder Creek: The massive fine-grained sandstones, previously described are consistent throughout the area, as they are regionally. The lower units are characteristically clean and well sorted massive sandstones and chert conglomerates, 20 to 30 feet thick above which are found interdispersed units of siltstone, mudstone, sandstone, shale and coal. At Babcock Mountain, the basal beds are overlain by dark grey to black shales, carbonaceous towards the top, topped by a 4 foot coal seam upon which a normal sequence of mudstones, siltstones and sandstones occur. Concretionary mudstone and sandstone are common, as well as flaggy crossbedded sandstone. Ripple marks are extremely well developed and preserved in the Member. The Member thickness is in the order of 500 feet.

Shaftesbury Formation: It can be divided into three distinct members in the area. North of the Murray River, the members were not distinguished because the Shaftesbury was not mapped there. However, south

AREA 4

QUINTETTE,
FIRST RIDGE SOUTH AND WEST
OF BABCOCK CREEK.



LEGEND

		CRETACEOUS	
	SANDSTONE	KCm(h)	Commotion Formation (Hullcross member)
	SILTSTONE	KCm(g)	Commotion Formation (Gates member)
	SHALE	KMb	Moosebar Formation
	SILTY, SANDY SHALE	KGt	Gething Formation
	CONGLOMERATE	KCd	Cadomin Formation
	COAL	KNk	Nikanassin Formation
	CARBONIFEROUS SHALE		
	MUDSTONE		

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

AREA 4
STRATIGRAPHIC SECTION

DRAWN BY: E. Toth	DATE: FEB. '72	SCALE: 1" = 200'
APPROVED BY:	DRAWING NO: QNTT 72-0279-R01	

of the Murray River the distinction between Hasler shales, Goodrich sandstones and Cruiser shales could be made. No individual thicknesses were measured but the following could be used as an estimate.

Hasler Member	600 - 800 feet
Goodrich Member	200 feet
Cruiser Member	1000 - 1200 feet

The Hasler is very similar to the Hulcross Member of the Commotion Formation, though the former has a pronounced red weathering habit. The lower contact of the Hasler with the Boulder Creek is an abrupt clean sandstone unit (Boulder Creek) overlain by argillaceous light blue grey shales. The lower Hasler shales are massive, but up section develop from a blocky weathering character to a fissile shale character.

The Goodrich was given a cursory examination, and noted only as a sandstone. Shales overlying the Goodrich Member, were assumed to be the Cruiser Member.

Area 4 (Section QNTT 72-0279-R01) (Quintette)

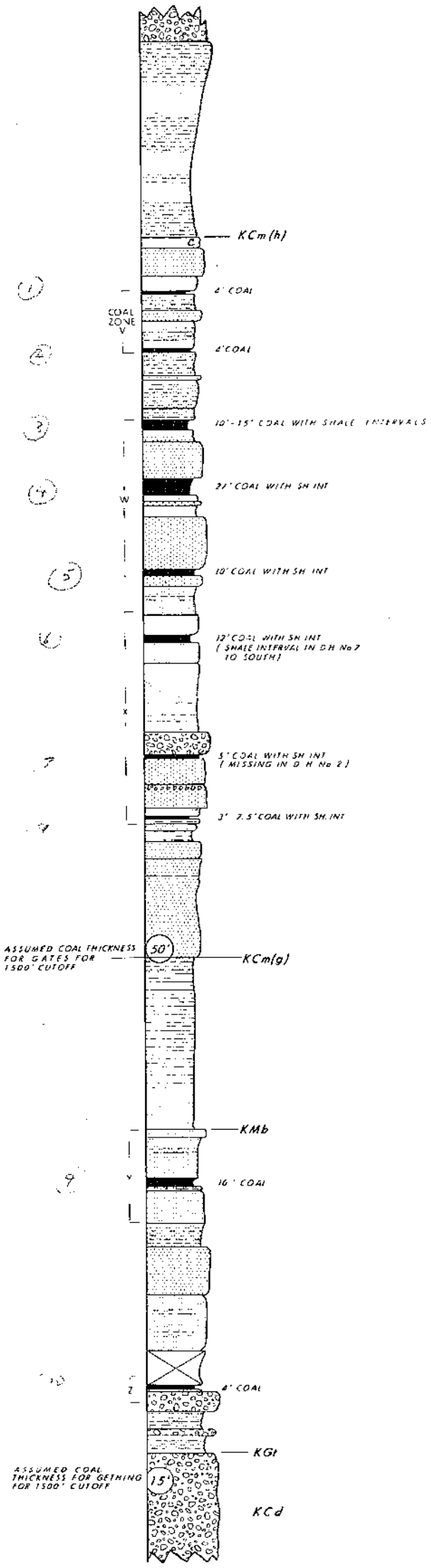
Quintette Mountain is located in Area 4 at the southeast end of the property. In Area 4, the Nikanassin Formation is highly folded and appears to represent the lithological sequences noted elsewhere. It is estimated to be well over 1000 feet thick.

The Cadomin Formation makes an excellent marker horizon throughout. Three thick sandstone bodies, lenticular in nature were noted. Percentage of matrix and clast size seem to increase to the southeast. The formation ranges from 60 to 100 feet in thickness.

The Gething was seen to incorporate large amount of sandstone, exhibiting festoon crossbedding. Abundant plant fossils are associated with a 20 foot pelecypod zone found in one section within 150 feet of the

AREA 5

FIVE CABIN SYNCLINE,
FIRST RIDGE NORTH OF FIVE
CABIN CK, ON EASTERN
LIMB OF SYNCLINE



LEGEND

		CRETACEOUS	
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	SHALE	KMb	Moosebar Formation
	SILTY, SANDY SHALE	KGt	Gething Formation
	CONGLOMERATE	KCd	Cadomin Formation
	COAL	KNk	Nikanassin Formation
C C	CARBONIFEROUS SHALE		
	MUDSTONE		

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AREA 5
STRATIGRAPHIC SECTION

DRAWN BY: E Toth	DATE: Feb '72	SCALE: 1"= 200'
APPROVED BY:	DRAWING NO: QNTT 72 - 0280 - R01	

top of Gething. Abundant burrows were noted toward the upper beds of the Gething.

The Moosebar exhibits typical lithologies and is measured from 240 to 260 feet thick.

The Gates was found to represent major lithofacies encountered elsewhere. Three conglomerate bands are found; these, when traced laterally, pinched and swelled considerably. The Hulcross Member showed a distinct limestone band within 50 feet of its contact with the Gates.

Boulder Creek Member entombs a 50-foot thick conglomerate with phenoclasts of less than one inch in diameter. This is overlain by an alternating sequence of sandstones, siltstones and mudstones. One coal seam about 3 feet thick was found. Boulder Creek is 450 feet thick.

Area 5 (Section QNTT 72-0280-R01) (Five Cabin Syncline)

The Five Cabin Syncline in the southwest part of the property is the major structural element in Area 5.

The Nikanassin Formation is partially exposed in the core of an anticline and distinctly silty and sandy (fine-grained) beds, with numerous coaly intercalations can be examined.

Cadomin Formation varies from 150 to 190 feet in thickness. One large boulder of limestone with colonial corals was found in association with other components. Large chunks of coal are a common feature. These were probably derived from a nearby coal seam.

Gething is about 400 feet thick and sandstones comprise about one-third of the sequence. A distinct pebbly zone occurs in the middle of the sequence. Three coal zones occur, but only the uppermost, about 8 to 10 feet thick, is thought to be of economic significance.

A good section in the Moosebar is amenable for study. A three foot thick conglomerate is found at the base of Moosebar. Some bentonitic layers as high as 70 feet from the base of Moosebar were noted. It is about 235 feet thick.

The Gates is about 850 to 900 feet thick and has at least five significant coal seams. A large portion of the member is made up of sandstones that have, in addition to discreet conglomerate beds, several pebbly zones. The uppermost 150 to 200 feet represent silty/shaly lithologies with emaciated coal seams.

The Hulcross Member is well exposed and a gradational sequence into the overlying Boulder Creek is found.

Shaftesbury shales are found in the core of a syncline. The remanent beds are homogeneous, dark grey shales with thin silty bands. Only 300 feet of the strata is preserved.

DISTRIBUTION AND THICKNESS OF COAL

The geological mapping on the Quintette property has outlined significant coal bearing zones within both the Gething Formation and the Gates Member of the Commotion Formation. These zones are summarized on drawing QNTT 72-267-R01 which is found in the back pocket accompanying this report.

MOOSEBAR - GETHING ZONE

Coal occurs within a few feet of the conglomerate defining the top of the Gething. Coal is almost exclusively restricted to steeply inclined strata exposed south of Babcock Mountain. The coal bearing stratum is about 30 feet thick and constitutes an inter-layered sequence of carbonaceous shale and some silt and coal, the latter being highly sheared. There is in total about 5 to 6 feet of coal in the unit. It is capped by 5 feet of sandstones and, at the base, after a transitional 10 feet siltstone/shale interval, there are 15 feet of well developed conglomerates. Immediately toward the northeast and southwest of this locality (where 5 to 6 feet of coal is localized), the succession is tightly folded. No noticeable coal horizon has been seen at the comparable level in these tight structures (although the possibility of complete squeezing of the coal due to structural intensity cannot be eliminated completely) albeit there is a semblance of coaly stringers within the carbonaceous shales. A cursory examination of the stratigraphic columns across the Murray River and in the environs of Wolverine River reveals that a dominantly sandy facies, and occasionally some shales, intervene at this coal level. This occurrence of shale is invariably associated with thin dirty coal intercalations. This fact appears to suggest a marked facies change at this level from southeast to northwest. The incipient coal horizons within this generally sandy suite indicate ephemeral conditions - the swamps (or peat bogs) were continually being

encased by shifting sand bodies. Exposures southeast of the well developed section have not been examined (this being mainly dictated by the paucity of exposures), and it is quite possible that this zone in this direction gradually developes into a sizeable coal horizon with an increasing amount of clean coal. Further work is needed to elucidate this hypotheses.

An alternative explanation can be tendered for the erratic behaviour of this coaly, shaly interval. Since the coaly unit almost straddles the Gething/Moosebar boundary, it may well be that differential erosion has washed away the coal horizon. Because of its sporadic nature, this interval has not been designated a zonal status, but its occurrence has a regional geologic significance.

GETHING ZONE Y

Generally speaking, Zone Y occurs within 100 feet of the Gething/Moosebar boundary. Coal may be dispersed within 50 feet of a unit of shale/siltstone and coalified shales and aggregates from 15 to 20 feet in the extreme northwest of the area (i.e. Wolverine South). It encompasses appreciable amounts of sands and is roofed locally by conglomerates and gritstones which are as much as 20 feet in thickness. By and large, the individual seams within the zone show great compositional variations, both lateral and vertical. North of the Murray, the Gething is highly folded and exposures are extremely poor. Therefore, no strict stratigraphical correspondence of this zone in the region is known. South of the Murray, the horizon has been recognized in a number of sections and is generally seen to occur slightly higher stratigraphically (i.e. within 80 to 100 feet from the base of Moosebar). The zone appears to have one good clean seam averaging 7 to 8 feet in thickness and is interlayered with numberous smaller seams (1.5 feet or less). Beyond the site of drill hole QDH #1, the exposures are patchy and the zone could not be traced with confidence. However, a

number of conglomerate beds appear, and as they are traced in more southerly sections, they swell considerably. Thin coal showings occur in the fine sediments interlayered with the conglomerates. Also, considerable thickness variations of the Gething Formation appear to be indicated in the southernmost Quintette region. This characterization, therefore, tends to negate the substantial accumulation of coal in this region. The Cadomin conglomerate, in itself, shows pinching and swelling with a profound corresponding effect on the Gething sedimentation, including the likely coal-bearing zones.

GETHING ZONE Z

This zone occurs 150 feet stratigraphically below the Zone Y. It is very variable - essentially composed of one seam that varies from 4.5 to 7 feet but apparently maintains uniform stratigraphical level. In the easternmost sections of the Quintette region, it is considerably thinner and perhaps has no economic significance, and is usually floored by thick conglomerate beds. Around the Wolverine, it is enveloped by shaly lithology. On the whole, this zone is poorly exposed throughout the region. It is remarkable to note, however, that in drill holes WDH #1 and QDH #1, in spite of the considerable distance involved (over 30 miles horizontally), the zone in both holes occurs at about the equivalent level. It is difficult to ascertain its regional variations, but it appears to be thickening toward the extreme northwest. Such an increase in coal thickness would be consistent with the general thickening of the Gething Formation in that direction.

Between the above two well defined zones, there are numberous thin coal seams that seldom exceed three feet. These have short lateral continuity and have not been correlated nor are they designated to a specific coal zone.

GATES ZONE V

This zone is composed of a maximum of four seams that are separated by a variable thickness of sediments that are essentially shales and carbonaceous shales. The individual seam thickness seldom exceeds four feet. This zone is generally found to begin within 50 feet of the top of the Gates and may encompass over 100 feet of strata.

The coal within the zone is shaly and erratic. The zone has been traced consistently in regions south of the Murray and around Quintette Mountain region. Across the Murray and further northwest, the zone is extremely intermittent and may be represented only by a solitary seam. The horizon as a whole has no economic significance.

GATES ZONE W

This is the most consistent and regionally extensive coal zone in the area south of Murray River and in the Quintette region. It begins approximately 250 feet below the top of the Gates and incorporates 3 to 5 coal seams with an average thickness of 30 feet, spread over 120 feet of the interval. The zone is capped by 150 feet or more of fine to medium-grained sandstones that at the base are locally replaced by conglomerate beds up to 10 feet in thickness. The above-mentioned sandstone unit gradually thickens toward the northwest and across the Murray River. In the vicinity of Wolverine, it exceeds 250 feet in thickness. This thickening of dominantly arenaceous facies in this direction appears to be genetically related to the accumulation of coal in the general southeastern regions. The sandstones must have started accumulating initially in and around the Wolverine region and progressively fanned out southeast of this point, thus precluding the development of coal seams. But away from its depo-centre (i.e. thinner end southeastwards), it must have had a contem-

poraneous tranquil environment where the conditions were conducive for the formation of coal. Therefore, this coal zone perhaps has no lateral equivalent across the Wolverine River. Individual coal seam thicknesses range from 5 to 15 feet, the seams generally have fairly clean coal. The topmost seam of the zone is roofed by sandy'conglomeratic lithology while the rest are characterized by transitional roofs of silts and silty shales. This zone as a whole promises good mining potential.

North and south of the Wolverine region, although the coal occurs as three well defined zones, it appears to occupy a much lower stratigraphic position, and appears to be confined to the lower 450 to 500 feet of the succession. The Gates is thinner by 150 to 200 feet in this region because of depositional convergence. The seams are widely spaced within the coal sequence. The thickest seam in the zone occurs in the middle with the thickness ranging between 12 and 18 feet. The topmost seams appear to maintain a fairly uniform thickness of 9 to 10 feet. The bottommost seam in the zone is variable and ranges from 4½ to 6 feet but often has appreciable quantities of shale and, therefore, is not favourable for mining. The average thickness of coal in the Gates of the Wolverine region is thought to be not less than 20 feet.

GATES ZONE X

This zone occurs at about 150 feet stratigraphically below Zone W and it is a composite of several seams, but out of these, two seams have regional continuity, south of the Murray River, with an average aggregate thickness of not less than 20 feet. All the seams in the zone are rather closely spaced, separated at the most by 30 to 35 feet of strata in the western regions. In environs of Quintette and Babcock Mountains, the seams appear to be much more closely spaced (at times only punctuated by

5 feet of strata) than they are to the northwest.

(Further information regarding the Gates and Gething coal formations could be made by referring to the "Quintette Project, Babcock Area, Interim Report" which is presently in preparation and will deal with the results of drilling in the Babcock area.)

ECONOMIC GEOLOGY

Coal seams in the Lower Cretaceous sediments underlying the Quintette-Wolverine property are located in two stratigraphic units. The Gething Formation and the Gates Member of the overlying Commotion Formation both contain seams of mineable thicknesses greater than five feet.

As has been pointed out in the stratigraphic section dealing with the distribution of coal, individual seams were difficult to identify and even more difficult to accurately measure due to the reliance on natural and existing exposures. Existing exposure measurements were augmented with drill results obtained in February, 1971. This information permitted the designation of "Coal Zones". A zone is defined as a coal bearing horizon correlatable over the entire property. The number and thickness of seams in a zone varies from place to place due to the nature of the paleoenvironment but the zones appear to be continuous. The rationale used in assigning aggregate coal thicknesses to each coal bearing member in each area for the calculation of possible reserves is explained in the following sections.

DESIGNATION OF COAL ZONES (Columnar Sections, QNTT 72-267-R01, back pocket)

COMMOTION FORMATION (GATES MEMBER)

Three zones containing variable thicknesses of coal have been lettered from the top of the Gates Member of the Commotion Formation; V, W and X respectively down section. In zone V, no mineable thickness of coal occurs although in Wolverine North (western portion) a 20 to 25 foot shale coal interval has been observed, it is felt that this occurrence is localized.

GETHING FORMATION

Two coal zones are present in the Gething Formation. These zones lettered, from the top of the Gething, Y and Z respectively, are developed throughout the property except in the Babcock and Quintette areas. In these two areas, only one coal zone is present in the Gething.

WOLVERINE NORTH (Part Area 1, part Area 2)

GATES MEMBER

Two sections measured in this area indicate the occurrence of both the W and X coal zones. The Perry Creek section has an average of 18 feet of coal, found in three seams of the W coal zone. The X coal zone is present in this section only as coal traces, with no mineable thicknesses of coal present. In the section south of Mt. Reesor - which is typical of the western half of the Wolverine South area - both the W and X coal zones are developed with mineable thicknesses of coal. The W coal zone has 4 seams with an accumulated thickness of 28 feet. The X zone has two poorly developed seams with a total combined thickness of 15 feet.

A conservative estimation of total coal thickness for the Gates Member would be the 20 feet of coal from the W coal zone. The X coal zone is omitted on the basis of its poor development in the area.

GETHING FORMATION

The Y coal zone is present in both the section south of Mr. Reesor and WDH #1. The zone consists of several coal layers with much shale and only 10 feet of coal is likely mineable in the zone. The Z zone is present in WDH #2 in the form of a 7 foot seam. WDH #1 did not intercept this zone nor are there adequate exposures of Gething north of the Murray River to test the occurrence of this coal zone. However, the Z zone is absent only in the Quintette area in the extreme southeast of the property. Therefore, a total coal thickness for the Gething, including the Y and Z coal zones, has been estimated at 15 feet.

WOLVERINE SOUTH (Part Area 1, part Area 2)

No sections were measured in this area due to the lack of sufficient exposures and due to structural complexities. However, from field examination, the coal horizons are similar to those of the Wolverine North area. Therefore, coal thicknesses in the coal formations have been assumed as 20 and 15 feet for the Gates Member and Gething Formation respectively.

FIVE CABIN SYNCLINE (Area 5)

GATES MEMBER

In the Five Cabin Syncline region, both the W and X coal zones occur with an accumulated thickness of approximately 50 feet. The W zone consists of three seams,one27 feet and two 10 foot seams. This aggregate total of 47 feet has been reduced to approximately 33 feet because of the extremely shaley nature of the 27 foot seam. The X coal zone has three seams with a total thickness of 20 feet, however, only two seams are mineable - a 12 foot and a 5 foot seam. The composite thickness of coal is on the order of 50 feet for the member in this region.

GETHING FORMATION (Area 3)

The Y and Z zones are developed in this area, in the form of two seams of 10 and 5 feet respectively, for a total of 15 feet of coal.

BABCOCK

GATES MEMBER

Coal zone W contains four seams with a composite thickness on the order of 35 feet. Accurate measurements in this area have been facilitated by trenching and further development work (see "Quintette

Project, Babcock Area, Interim Report").

Coal zone X is well represented by 24 feet of coal in the section with consistent occurrences of at least two coal seams. Allowing for lateral variation in seam thickness, it is felt that an aggregate coal thickness of 50 feet would be justly conservative for coal in the Gates Member of this area.

GETHING FORMATION

Only coal zone Z with one seam of a thickness of 10 feet was observed in the Babcock area, whereas, coal zone Y was arbitrarily assigned to a carbonaceous interval higher in the section.

QUINTETTE (Area 4)

GATES MEMBER

Coal zone W occupies a similar stratigraphic position in the Quintette area as it does in the Babcock area. Four seams with a combined thickness on the order of 38 feet are present. Coal zone X is comprised of three widely separated seams with a combined thickness of 22 feet. An aggregate thickness of 50 feet serves as a conservative estimate of the total thickness of coal in the Gates of this area.

GETHING FORMATION

A three seam Y coal zone, with two seams of 5 feet each for a total of 10 feet of coal, is the only mineable Gething coal zone found in the Quintette block. (Area 4)

The coal zone thicknesses are conservative estimates of the possible reserves in place derived from stratigraphic considerations and minimized to account for topographical attentuation of the coal bearing units, lateral lithological variation and measurement error.

Tables C and D detail the potential coal in place for areas outlined on Plates V and VI. Plate V and Plate VI show areas with less than 1500 feet of cover for the Gates Member and the Gething Formation respectively. The areas on both Plates have been subdivided for calculation purposes and coal tonnages have been calculated and tabulated for each cross-section. Calculations for tonnages were completed in the following manner:

1. Geological Plates V and VI outline areas where depth of cover to the coal bearing formations do not exceed 1500 feet.

2. Cross sections were made of the property, placed at 10,000 foot (1.9 miles) intervals, across strike, so that in calculating reserve area along strike, the maximum distance of interpolation would not exceed 5000 feet (.95 miles). (Sections AA' - QQ' inclusive).

3. The area of influence used for the tonnage calculation was determined from the product of a measurement across strike and along strike. These measurements were determined from the cross section and geological map to a point where one of the following occurred:

a) the coal bearing formation ended;

b) the amount of cover exceeded 1500 feet;

c) the geologic structure changed.

4. Each area of influence was designated by an arbitrary number placed inside a circle on the relevent cross section line. (Plates V and VI).

5. An aggregate thickness of coal was assumed for each area of calculation, as outlined from stratigraphic work and consideration of the type sections. The seam thicknesses are as follows:

Area	Aggregate Coal Thickness GATES	Aggregate Coal GETHING
1	20	15
2	20	15
3	50	10
4	50	10
5	50	15

6. To determine tonnage of coal in place, an exploration figure of 1 million long tons per vertical square mile foot of coal was assumed. Toobtain the tonnage value, the following equation was used:

(Seam Length in Miles to 1500 feet of cover)
X (Length of Calculation Influence in Miles)
X (Aggregate Coal Thickness in Feet)
= (Millions of Tons of Coal)

TABLE C

GATES MEMBER

WOLVERINE NORTH (Part Area 1, part Area 2)

CROSS SECTION & CALCULATION NUMBER	SEAM LENGTH TO 1500' OF COVER		LENGTH OF CALCULATION INFLUENCE MILES	TOTAL COAL THICKNESS	COAL TONNAGE IN PLACE	
	FEET	MILES				
B1	3,600	.68	.8	20	10.80	
C1	1,200	.23	1.9	20	8.80	
C2	1,800	.34	1.8	20	12.20	
C3	5,000	.95	.9	20	17.20	
C4	17,300	3.28	1.5	20	98.40	
D1	2,200	.42	1.9	20	16.00	
D2	14,300	2.71	1.9	20	103.00	
					266.40	298.37

WOLVERINE SOUTH (Part Area 1, part Area 2)

F1	2,400	.45	.8	20	7.20	
G1	6,700	1.27	1.7	20	43.20	
G2	1,700	.32	1.6	20	10.20	
H1	4,400	.83	1.0	20	16.60	
					77.20	86.46

FIVE CABIN SYNCLINE (Area 5)

J1	3,400	.64	1.2	50	38.40	
L1	800	.15	1.0	50	7.50	
M1	7,500	1.42	1.9	50	134.90	
N1	4,000	.76	1.9	50	72.20	
N2	3,400	.64	1.9	50	60.80	
O1	6,800	1.29	1.9	50	122.55	
P1	1,500	.28	.9	50	12.60	
					448.95	502.82

BABCOCK (Area 3)

CROSS SECTION & CALCULATION NUMBER	SEAM LENGTH TO 1500' OF COVER		LENGTH OF CALCULATION INFLUENCE MILES	TOTAL COAL THICKNESS	COAL TONNAGE IN PLACE
	FEET	MILES			
I1	5,400	1.02	1.5	50	76.50
J3	13,000	2.46	1.9	50	233.70
K2	4,200	.80	1.3	50	52.00
L3	8,000	1.52	1.9	50	144.40
M3	8,000	1.52	1.9	50	144.40
					651.00

GATES MEMBER

QUINTETTE (Area 4)

J2	5,500	1.04	.9	50	46.80
K1	11,200	2.12	1.9	50	201.40
L2	4,000	.76	1.9	50	72.20
M2	2,100	.40	1.9	50	38.00
N3	3,900	.74	1.9	50	70.30
N4	1,800	.34	1.9	50	32.30
O2	1,500	.28	1.9	50	26.60
P2	1,600	.30	1.9	50	28.50
Q1	2.400	.45	1.8	50	40.50
					556.60

TOTAL 2000.15

TABLE D

CALCULATION OF POSSIBLE RESERVES

GETHING FORMATION

WOLVERINE NORTH (Part Area 1, Part Area 2)

CROSS SECTION & CALCULATION NUMBER	SEAM LENGTH TO 1500' OF COVER FEET	SEAM LENGTH TO 1500' OF COVER MILES	LENGTH OF CALCULATION INFLUENCE MILES	TOTAL COAL THICKNESS	COAL TONNAGE IN PLACE
B1	16,000	3.03	1.6	15	72.75
C1	3,000	.57	1.9	15	16.20
C2	5,000	.95	1.3	15	18.60
C3	3,500	.66	1.1	15	10.95
C4	9,500	1.80	1.3	15	35.10
D1	6,800	1.29	1.7	15	32.85
D2	3,700	.70	1.7	15	17.85
D3	6,800	1.29	1.5	15	29.10
					233.40

WOLVERINE SOUTH (Part Area 1, Part Area 2)

E1	4,000	.76	1.9	15	21.60
F1	6,000	1.14	1.9	15	32.55
F2	16,000	3.03	1.9	15	86.40
G1	4,200	.80	1.9	15	22.80
G2	2,900	.55	1.9	15	15.75
G3	7,500	1.42	1.9	15	40.50
H1	1,300	.25	.9	15	3.45
H2	10,000	2.06	1.9	15	58.65
I1	12,000	2.27	1.9	15	64.65
					346.35

GETHING

FIVE CABIN SYNCLINE (Area 5)

CROSS SECTION & CALCULATION NUMBER	SEAM LENGTH TO 1500' OF COVER		LENGTH OF CALCULATION INFLUENCE	TOTAL COAL THICKNESS	COAL TONNAGE IN PLACE	
	FEET	MILES	MILES			
J1	6,000	1.14	1.9	15	32.55	
K1	3,400	.64	1.9	15	18.30	
L1	8,200	1.55	1.9	15	44.25	
M1	2,600	.49	1.9	15	13.95	
M2	2,300	.44	1.9	15	12.60	
N1	2,200	.42	1.9	15	12.00	
N2	2,700	.51	1.9	15	14.55	
O1	4,600	.87	.9	15	11.70	
					159.90	179.09
			BABCOCK (Area 3)			
K3	9,500	1.80	1.6	10	43.20	48.38
			QUINTETTE (Area 4)			
J2	10,000	1.89	1.7	10	48.15	
K2	2,600	.49	1.9	10	13.95	
L2	1,500	.28	1.9	10	5.30	
M3	7,300	1.38	1.9	10	26.20	
N3	2,200	.42	1.9	10	7.98	
N4	2,500	.47	1.9	10	8.93	
O2	3,000	.57	1.9	10	10.83	
O3	1,000	.19	1.9	10	3.61	
P1	2,200	.42	1.5	10	6.30	
P2	1,600	.30	1.9	10	5.70	
Q1	2,000	.37	1.9	10	7.22	
					144.17	161.47
	927.02			TOTAL	927.02	1,038.26
	2000.15					
TOTAL	2927.17	or 2.9 Billions				

For each area of influence this has been done and the tonnage has been tabulated in tables C and D. These tonnages have also been placed within the respective circles on Plates V and VI.

The total possible reserve of coal in place has been estimated at 2.9 billion tons which is an approximation of coal in situ with no allowances made for mineability.

MINEABILITY OF POSSIBLE RESERVES

Due to the wide variation in the structural environment of the possible reserve of coal on the Quintette property, a system of tabulation has been devised which divides the reserves into classes depending on the average dip of the strata and the degree of deformation in the structures. Of necessity, this system of classification must be somewhat subjective, however, it does provide a broad basis for estimating the mining recovery from each block (Table E). Naturally, considerable caution must be used in referring to these figures as the economics of recovery are only considered by inference. That is, actual recovery from steeply dipping, disturbed strata may not be economically feasible at present and may depend on such developing techniques as hydraulic mining or raise boring for their ultimate realization. On the other hand, it will be noted that in the Babcock area, the recoverable reserves are estimated at 70 million tons in a Class IA setting (gently dipping, undisturbed). Present work certainly appears to be at least confirming this figure. The factors used in calculating possible recoverability are set out in Table E. The final tabulation of these results is given in Table F. All calculations assume underground mining methods. Local improvements are, therefore,

TABLE E

POSSIBLE RESERVES AND
ESTIMATES FOR MINEABILITY

Use 40%?

CLASS	DIPS	STRUCTURE	SEAM THICKNESS	ESTIMATED GEOLOGICAL LOSS FACTOR	ESTIMATED MINING RECOVERY	ESTIMATED WASH PLANT RECOVERY	POTENTIAL NET CLEAN TONS FACTOR
IA	0-15°	Undisturbed	> 5'	25%	50%	65%	24.37%
IB	0-15°	Disturbed	> 5'	40%	40%	65%	15.6%
IIA	15-30°	Undisturbed	> 5'	30% *	50% *	65%	22.75%
IIB	15-30°	Disturbed	> 5'	50% *	30% *	65%	9.75%
IIIA	30-90°	Undisturbed	> 5'	40% *	50% *	65%	19.50%
IIIB	30-90°	Disturbed	> 5'	50% *	30% *	65%	9.75%
IVA **	0-90°	Undisturbed	< 5'				
IVB **	0-90°	Disturbed	< 5'				

* Class II & III: Must use novel techniques such as hydraulic mining or raise boring which are being developed.

** Class IV: Was not used since seam thicknesses used in initial potential coal in place calculations were aggregate mineable thicknesses of seams over 5'.

Definition of Terms

Undisturbed: relatively uniform dips and few obvious minor structural complications.

Disturbed: undulating bedding exhibiting dragfolds, flexure slips and minor faults.

TABLE F

SUMMARY OF POSSIBLE TONNAGE IN PLACE
WITH ESTIMATED MINEABILITY FACTORS APPLIED

FIVE CABIN SYNCLINE

	GATES MEMBER						GETHING FORMATION					
Coal Class	IA	IB	IIA	IIB	IIIA	IIIB	IA	IB	IIA	IIB	IIIA	IIIB
Potential Coal In Place					390.50	7.50			32.60	56.00	71.10	
Mineability Factor (%)					19.50	9.75			22.75	9.75	19.50	
Potential Clean Coal					76.15	.73			7.42	5.46	13.88	
						76.88					26.76	M.T.
									103.64			

QUINTETTE

	GATES MEMBER						GETHING FORMATION					
Coal Class	IA	IB	IIA	IIB	IIIA	IIIB	IA	IB	IIA	IIB	IIIA	IIIB
Potential Coal In Place					414.10	142.50			62.20		58.00	26.20
Mineability Factor (%)					19.50	9.75			22.75		19.50	9.75
Potential Clean Coal					80.75	13.89			14.15		11.31	2.55
						94.64					28.01	M.T.
									122.65			

BABCOCK

	GATES MEMBER						GETHING FORMATION					
Coal Class	IA	IB	IIA	IIB	IIIA	IIIB	IA	IB	IIA	IIB	IIIA	IIIB
Potential Coal In Place	288.80				30.60	285.70				43.20		
Mineability Factor (%)	24.37				19.50	9.75				9.75		
Potential Clean Coal	70.38				5.97	27.86				4.21		
						104.21					4.21	M.T.
									108.42			

WOLVERINE SOUTH

	GATES MEMBER						GETHING FORMATION					
Coal Class	IA	IB	IIA	IIB	IIIA	IIIB	IA	IB	IIA	IIB	IIIA	IIIB
Potential Coal In Place			53.40			23.80			183.20		58.7	109.20
Mineability Factor (%)			22.75			9.75			22.75		19.5	9.75
Potential Clean Coal			12.15			2.32			41.68		11.45	10.65
						14.47					63.78	M.T.
									78.25			

WOLVERINE NORTH

	GATES MEMBER						GETHING FORMATION					
Coal Class	IA	IB	IIA	IIB	IIIA	IIIB	IA	IB	IIA	IIB	IIIA	IIIB
Potential Coal In Place			201.40		31.80	33.20			58.70	35.10	66.90	72.80
Mineability Factor (%)			22.75		19.50	9.75			22.75	9.75	19.50	9.75
Potential Clean Coal			45.81		6.20	3.24			13.35	3.42	13.05	7.10
						55.25					36.92	M.T.
									92.17			

TOTAL GETHING 159.68
TOTAL GATES 345.45

TOTAL - ALL CLASSES 505.13 M.T.

505.13

possible where open pit reserves may be outlined.

QUALITY OF RESERVES

No lengthy description of coal quality can be made on the basis of the geological data comprising this report. A large body of information is presently being assembled from the drilling results of work being done at Wolverine North, Babcock and Five Cabin Creek. Present indications are that a medium volatile coking coal with excellent swelling characteristics (F.S.I. 7 - 8) can be obtained from this property. The coal also cleans very well and the volatiles range from about 20% to 25% (on a 7% ash, 5% moisture basis) depending on the seam.

CONCLUSIONS

The Quintette property contains a very large possible reserve of medium volatile coking coal. The present mapping has outlined a possible reserve of 2.9 billion tons of coal, of which some 500 million tons may ultimately be recoverable.

(a) The Babcock area (Area 4) is by far the most promising. It contains four or more good seams which are enclosed in a broad, gently dipping monocline (dips 5 to 10 degrees). Detailed drilling of this deposit is currently proceeding.

(b) The Wolverine North area contains the broad limb of an anticline which dips about 15 degrees to the northeast. This structure also contains both the Gates Member and the Gething Formation. This structure represents an excellent potential addition to the underground reserves on the Quintette property. (Recent drilling has confirmed the presence of this reserve).

(c) The Five Cabin Creek Syncline may provide areas for potential stripping operations at its northwest end. The underground potential at Five Cabin would be limited to that along the axis of the Syncline.

(d) All of the remaining areas of the Quintette property require systematic, detailed mapping and exploration to determine, firstly, their potential for small strip operation and, later, their potential for underground mining.

Respectfully submitted,

DENISON MINES LIMITED

Alan A. Johnson
Chief Geologist (Coal)

QUINTETTE COAL LEASE INFORMATION

Date Acquired	Lease Numbers	Amount of Leases	Expiry Date	Total Acres
October 16/70	1303 - 1427 inc.	125	October 15	72,769
February 2/71	1887 - 1907 inc.	21	February 1	12,135
April 29/71	2174 - 2191 inc.	18	April 28	9,870
May 27/71	2464 - 2489 inc.	26	May 26	16,640
November 25/71	2607 - 2669 inc.	63	November 24	33,080
	TOTAL	253	TOTAL	144,494

PERSONNEL

A. A. Johnson	Chief Geologist
D. M. Parkes	Chief Engineer
J. A. Irvine	Project Geologist
Dr. M. A. Chowdry	Stratigrapher
G. P. Gormley	Geologist
R. S. Gee	Geologist
W. K. Smith	Geologist
R. G. Nellis	Geologist
R. D. Sevold	Assistant Geologist
N. R. Oborne	Assistant Geologist
D. L. Barlow	Assistant Geologist
J. G. Pearson	Assistant Geologist
H. L. Swennumson	Assistant Geologist
G. D. Turcott	Assistant Geologist
R. C. Meyers	Assistant Geologist

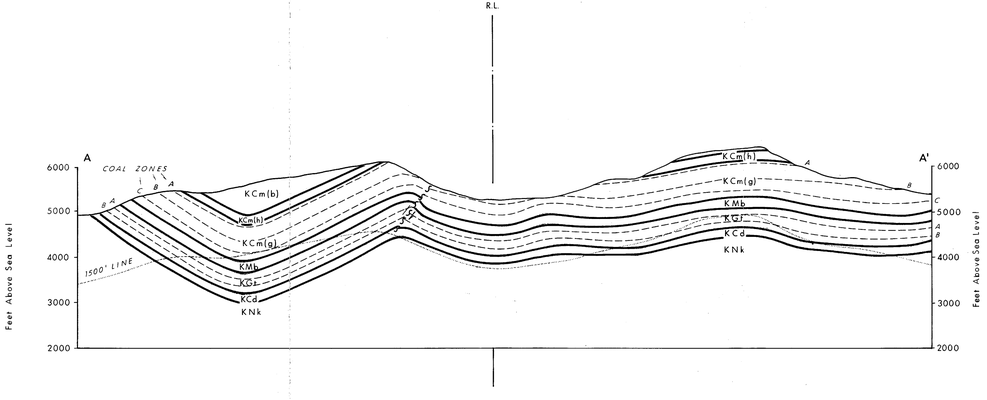
PR-QUINTETTE 72(2)#3.

QUINTETTE PROJECT

INTERIM REGIONAL REPORT

APPENDIX I

Edited March 15, 1972



CRETACEOUS

KSh	SHAFTESBURY FORMATION
KCm(b)	COMMOTION FORMATION (Boulder Creek Member)
KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

PREPARED BY:
DENISON MINES LIMITED (COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: A - A'

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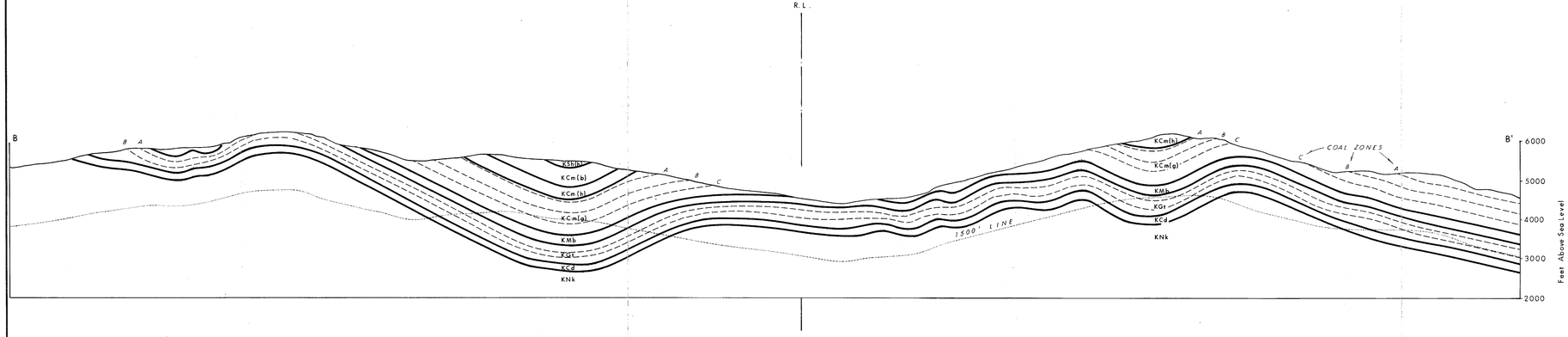

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

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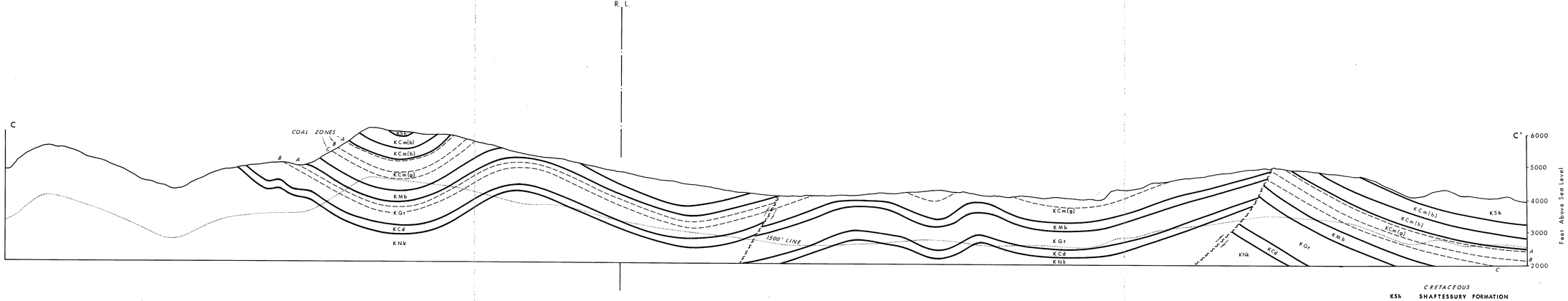

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
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KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

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Cross Section : C - C'

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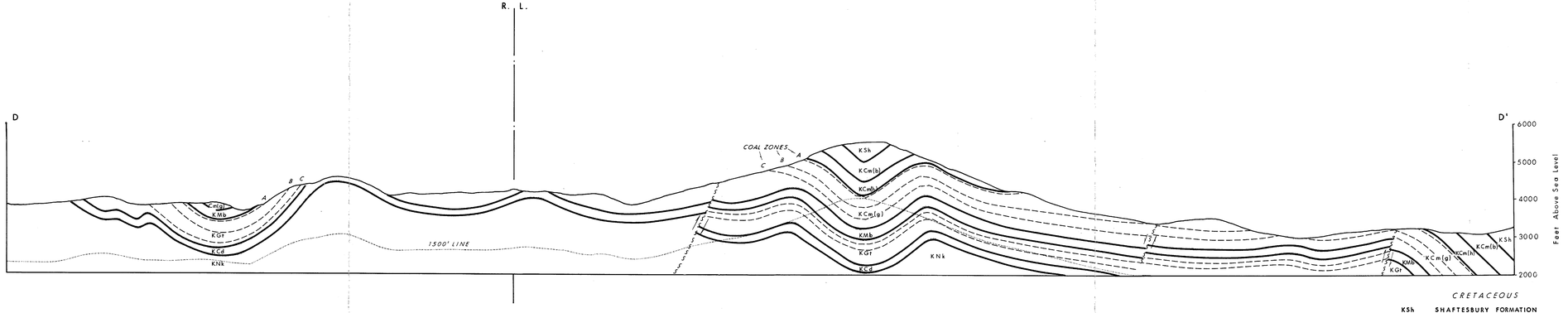

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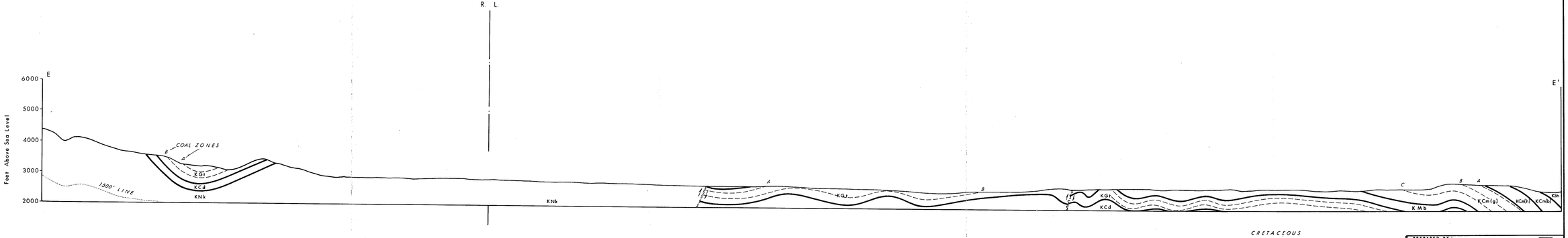

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KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

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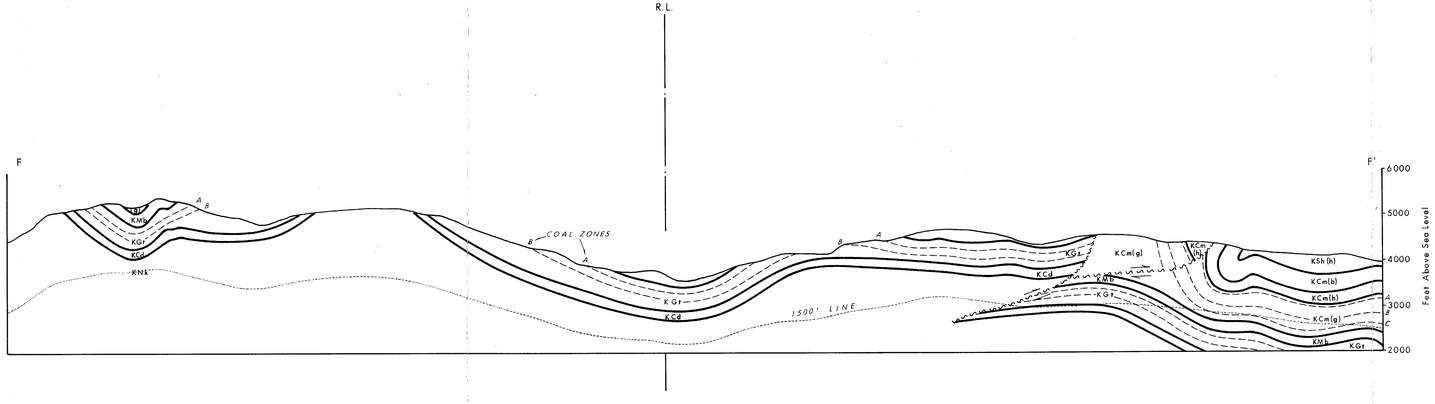

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KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

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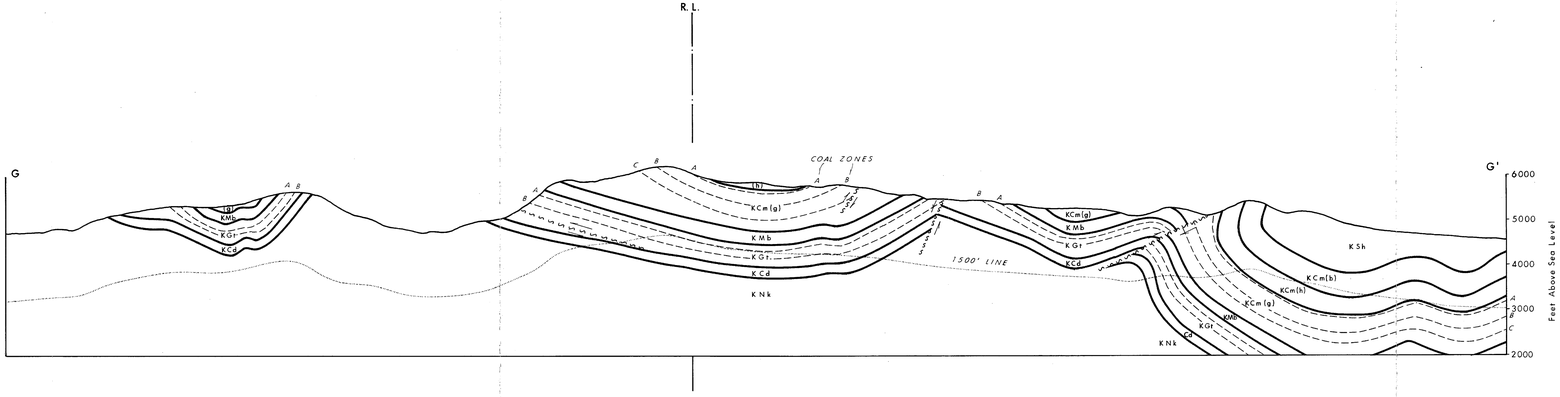

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

PREPARED BY:
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(COAL DIVISION)
CALGARY ALBERTA

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(JOINT VENTURE - QUINTETTE PROJECT)

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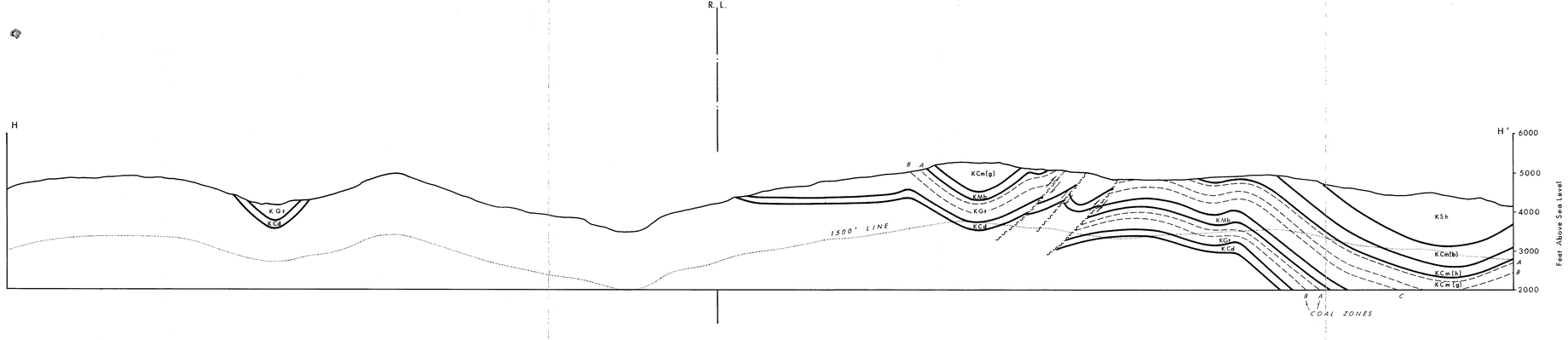

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KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

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DENISON MINES LIMITED (COAL DIVISION)
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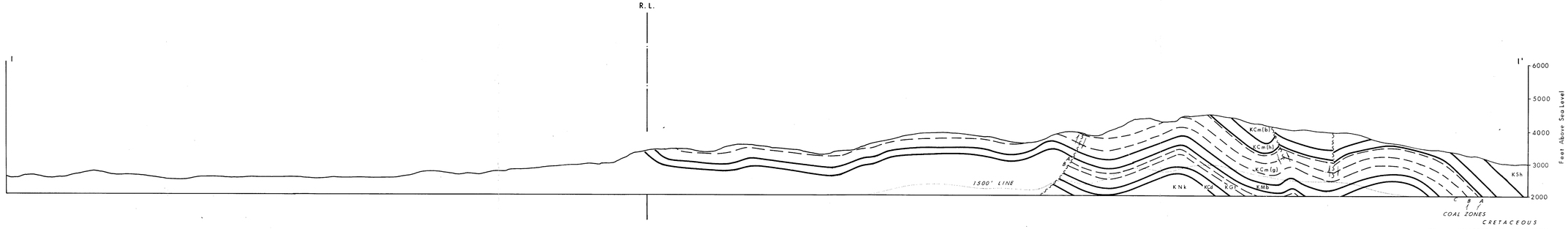

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KCm(h)	COMMOTION FORMATION (Hultcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

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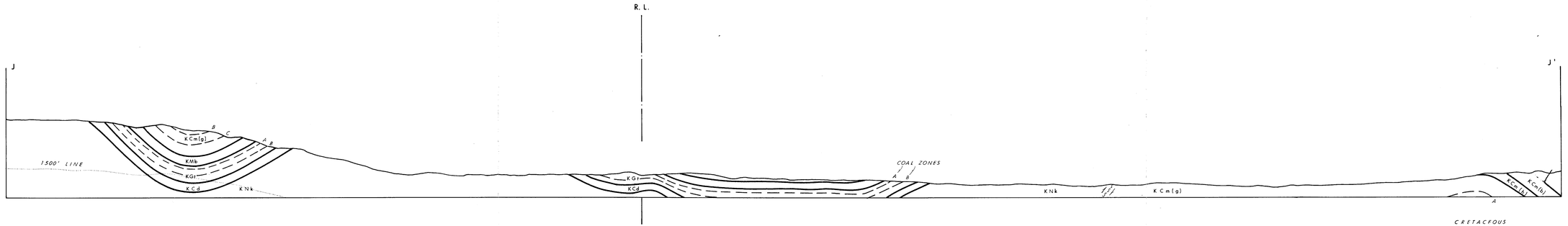

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KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

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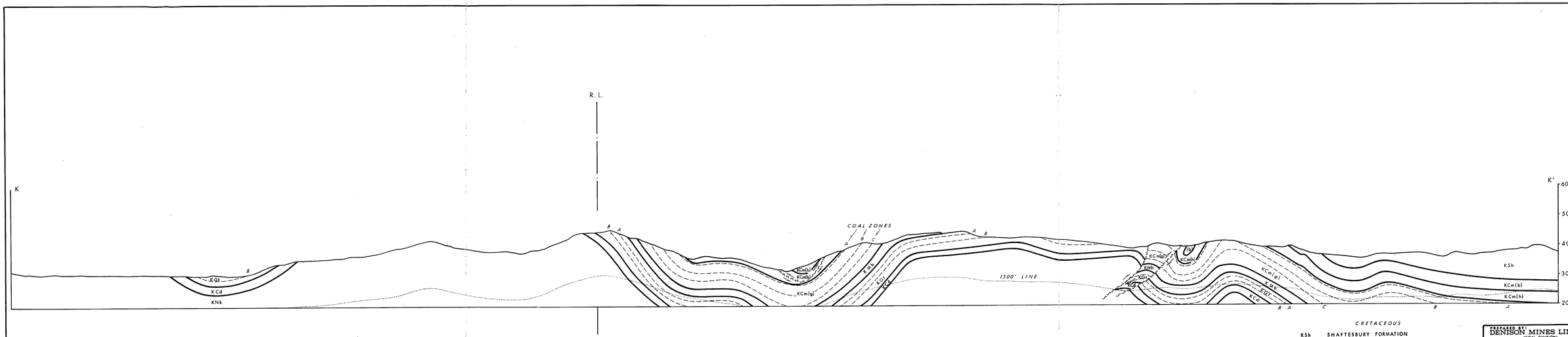

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KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

PREPARED BY:
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COAL DIVISION
CALGARY ALBERTA

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(JOINT VENTURE - QUINTETTE PROJECT)

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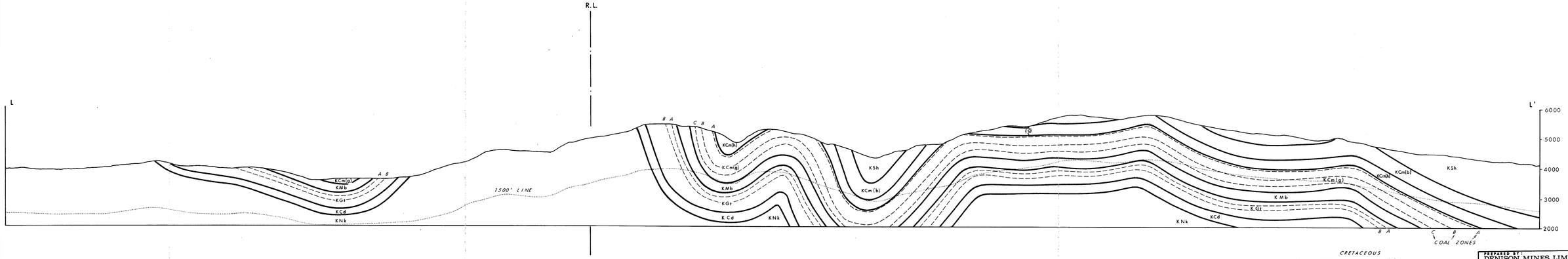

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KCm(g)	COMMOTION FORMATION (Gates Member)
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KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

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(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: L - L'

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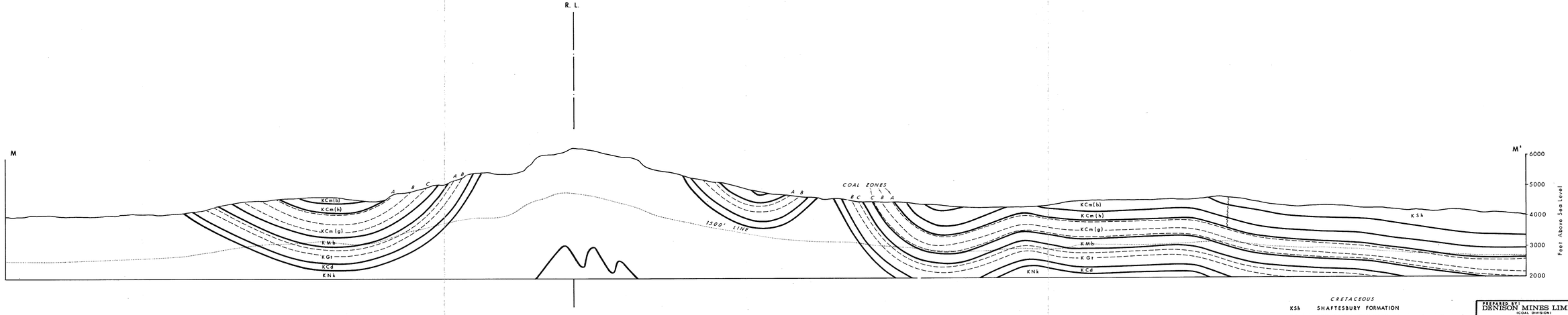

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CRETACEOUS

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

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CALGARY ALBERTA

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(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section : M - M'

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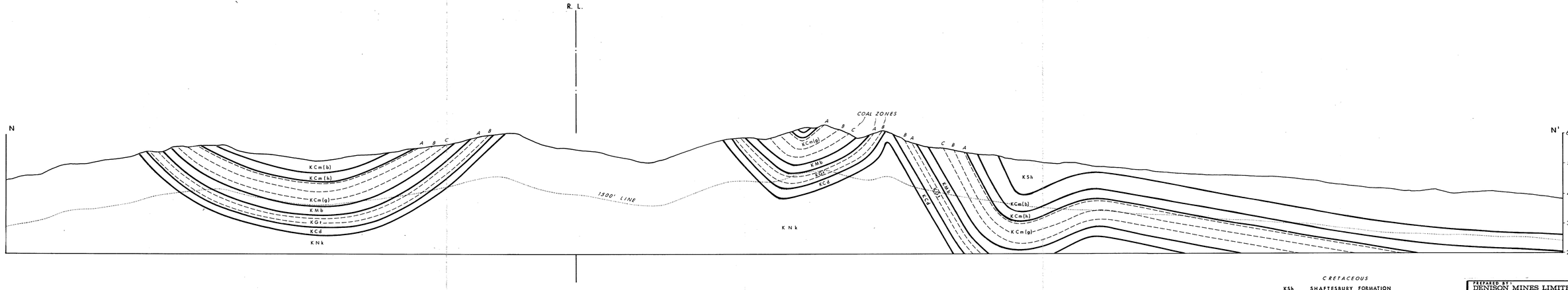

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CRETACEOUS

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

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(COAL DIVISION)
CALGARY ALBERTA

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(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: N-N'

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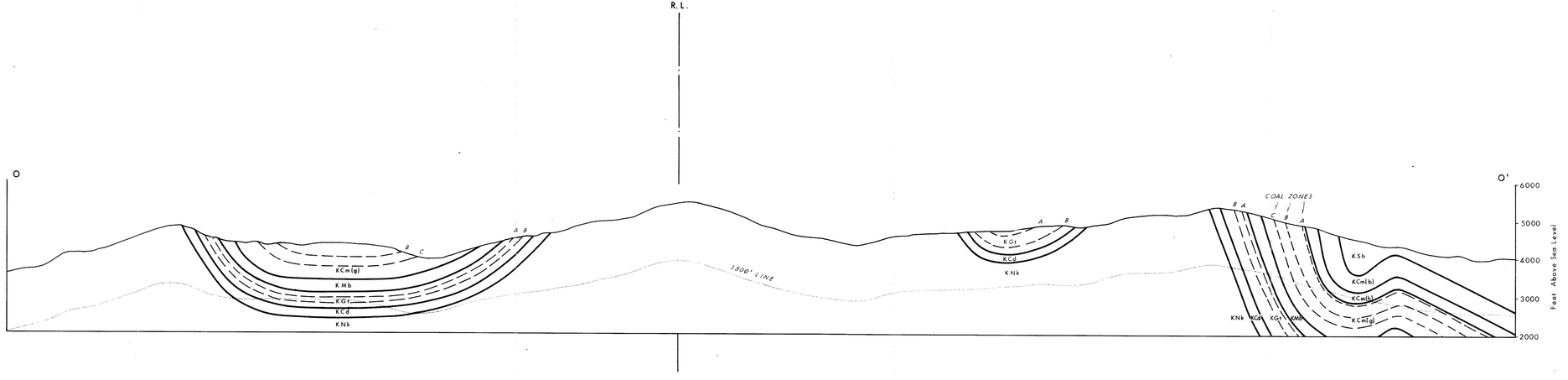

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RE: QUINTETTE 72(2)B.

CRETACEOUS

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
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(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: O - O'

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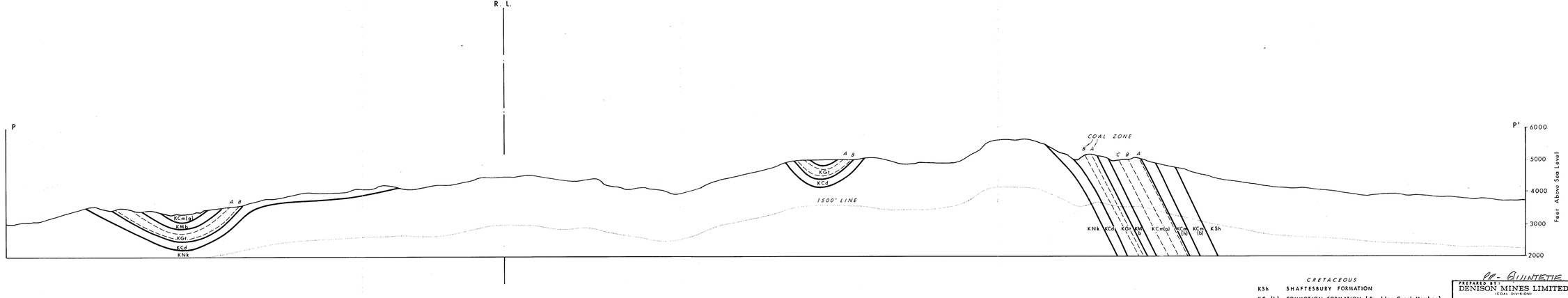

601

re- QUINTETTE 72(2)B.

CRETACEOUS

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KCm(h)	COMMOTION FORMATION (Hullcross Member)
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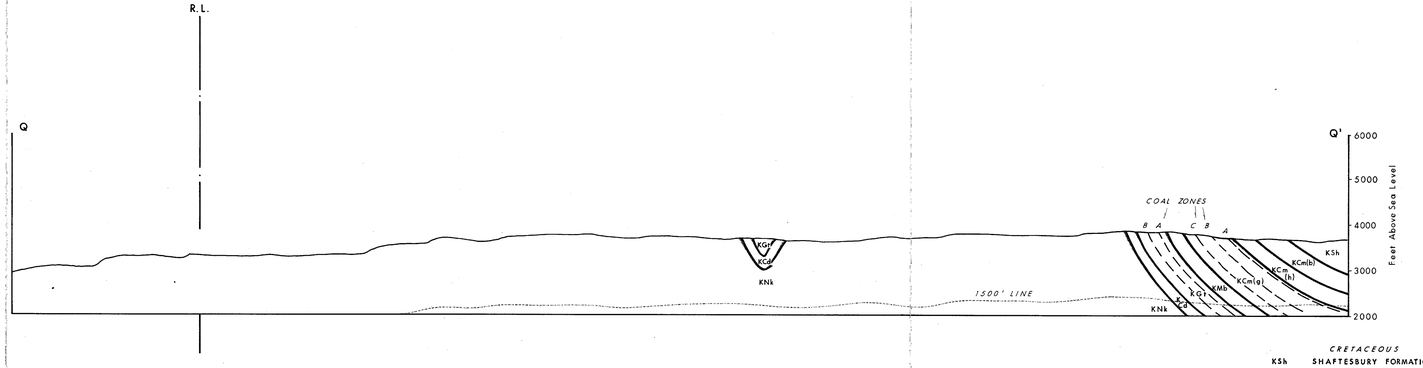
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

PREPARED BY:
DENISON MINES LIMITED (COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: P - P'

DRAWN BY: E. TOTH | DATE: AUG 1971 | SCALE: 1" = 1320'
APPROVED BY: R. Lee | DRAWING No: QNTT 71-124-RC2



CRETACEOUS

KSh	SHAFTESSURY FORMATION
KCm(b)	COMMOTION FORMATION (Boulder Creek Member)
KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGr	GETHING FORMATION
KCd	CADOMIN FORMATION

601

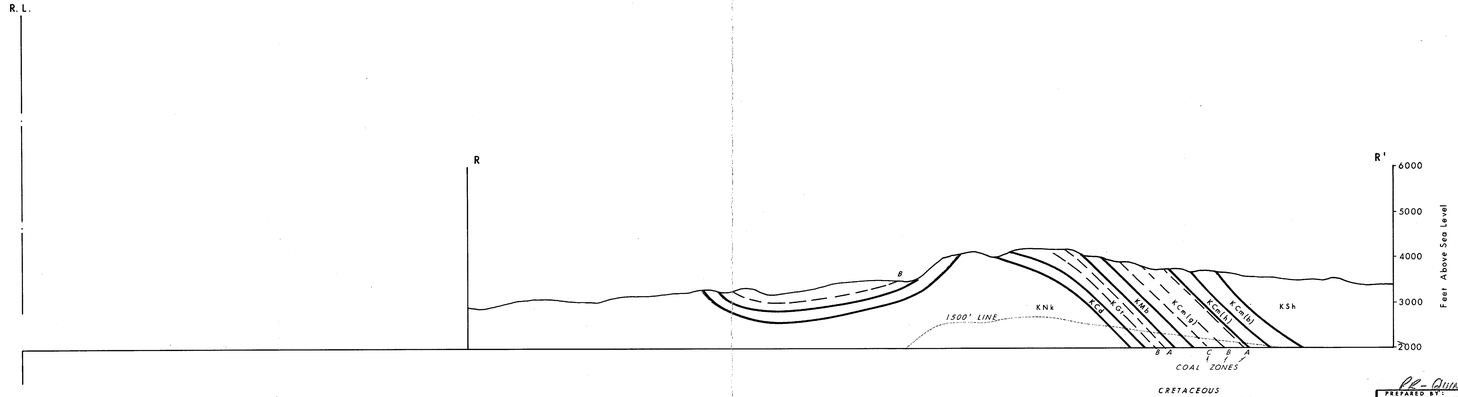
Re- Quintette 72(2)B.

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: Q - Q'

DRAWN BY: E.T.S.Th.	DATE: AUG 1971	SCALE: 1" = 1320'
APPROVED BY: C.Gee	DRAWING No:	QNTT 71-125-R02



CRETACEOUS

KSh	SHAFTESBURY FORMATION
KCm(b)	COMMOTION FORMATION (Boulder Creek Member)
KCm(h)	COMMOTION FORMATION (Hullcross Member)
KCm(g)	COMMOTION FORMATION (Gates Member)
KMb	MOOSEBAR FORMATION
KGt	GETHING FORMATION
KCd	CADOMIN FORMATION

601

Re- Quintette 72(e)B

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

Cross Section: R - R'

DRAWN BY: E.J.T.	DATE: AUG 1971	SCALE: 1" = 1320'
APPROVED BY: R.G.G.	DRAWING No:	QNTT 71-126-R02

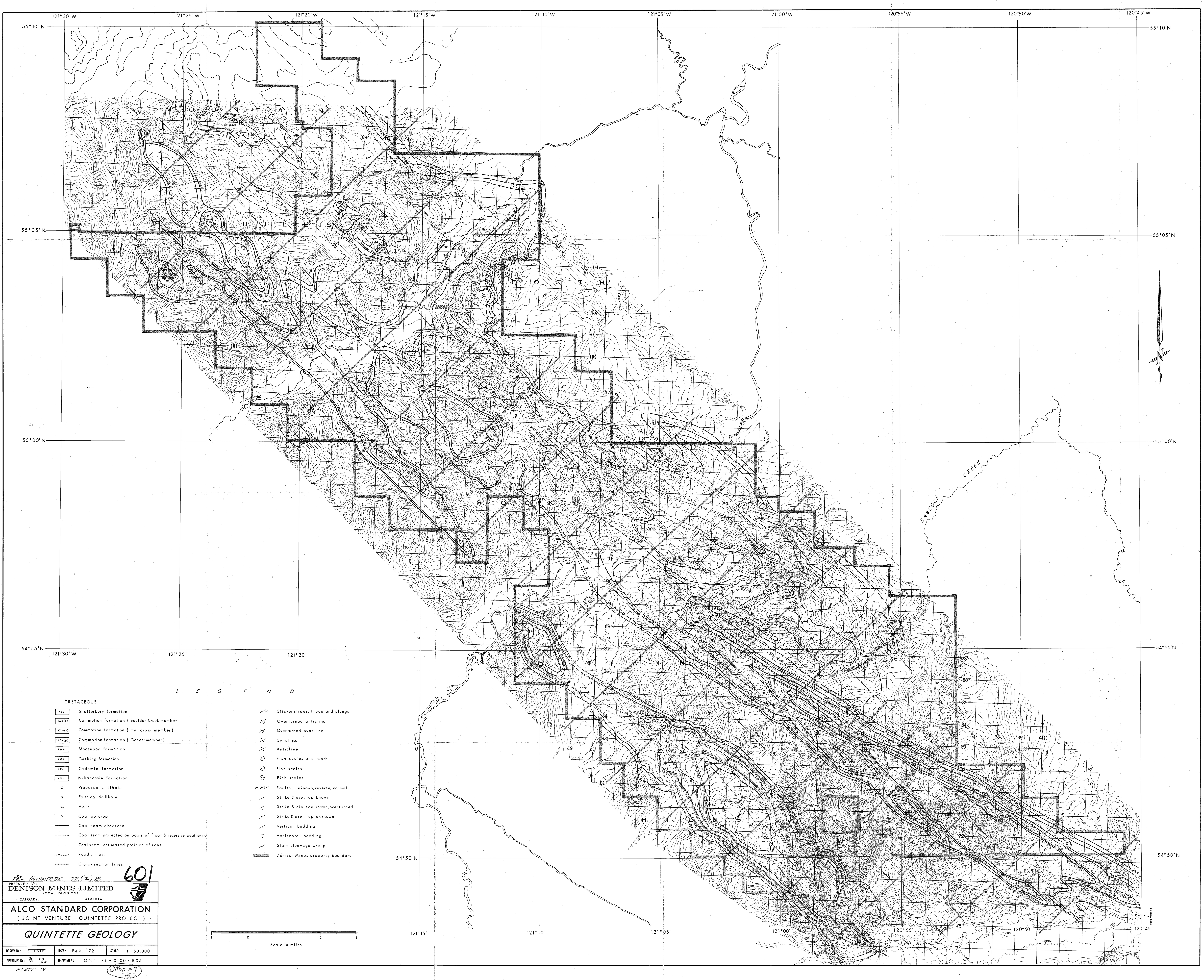


PLATE IV

QMap #7

121° 30' W
121°15'
121°00'
120°45' W
55° 05' N
55°00'
54°55'
54°50' N
54°50'
121°30'W
121°15'
121°00'
120°45'W

WOLVERINE NORTH
WOLVERINE SOUTH
BABCOCK
FIVE CABIN SYNCLINE
QUINTETTE
MOUNTAINS
FOOTHILLS
ROCKY

Re-Quintette 72-(2)-B 601

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

TARGET AREAS

Drawn by: [illegible]	Date: SEPT. '71	Scale: 1:50,000
Approved by:	Drawing No: QNTT 71 - 0208- R02	

L E G E N D

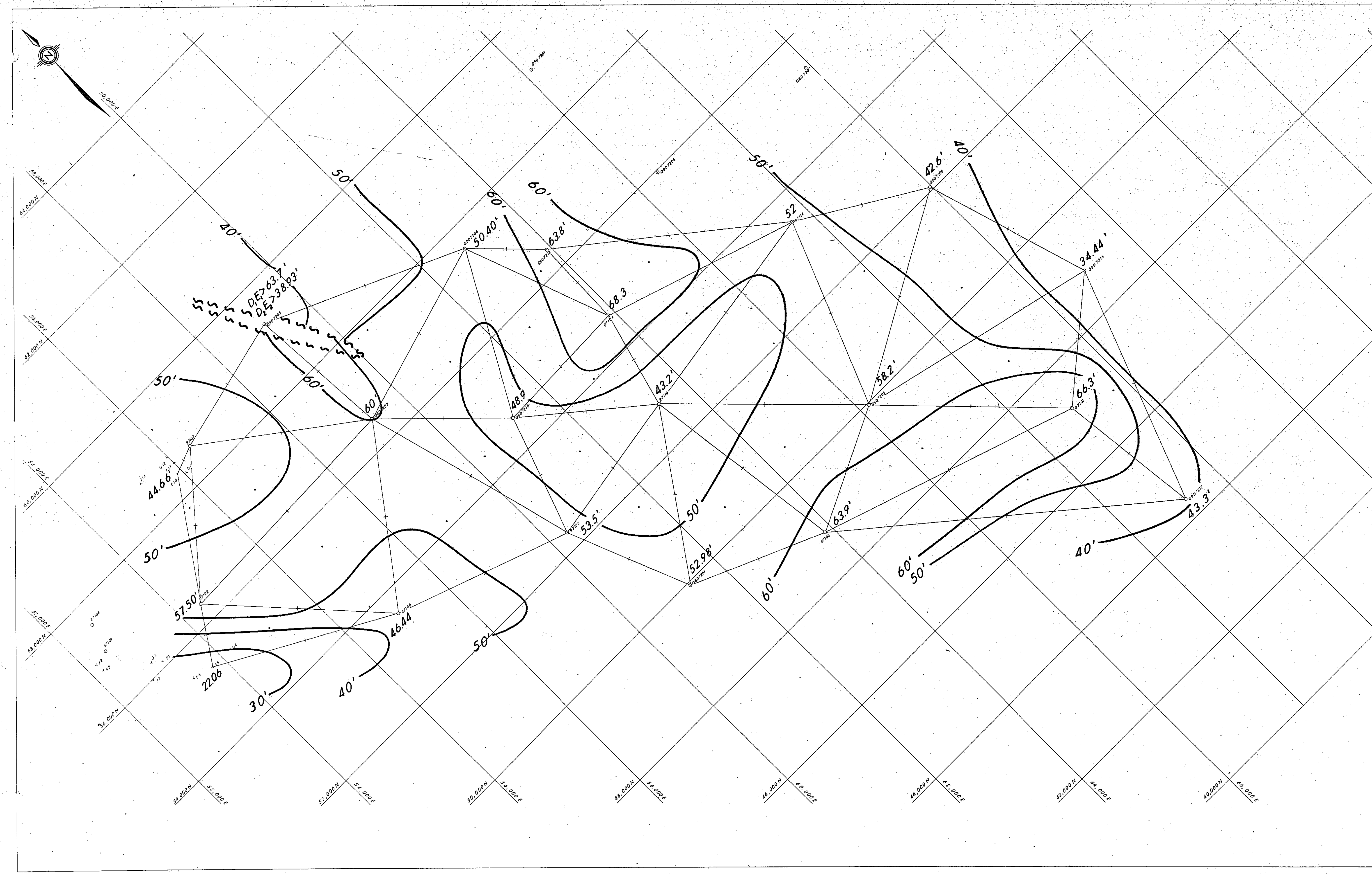
CRETACEOUS

- ksh — Shaftesbury formation
- kcm(a) — Commation formation (Boulder Creek member)
- kcm(u) — Commation formation (Hullcross member)
- kcm(g) — Commation formation (Gates member)
- kmb — Moosebar formation
- kgt — Gething formation
- kcd — Cadomin formation
- kNk — Nikanassin formation

- Existing drillhole
- Proposed drillhole
- Adit
- Coal outcrop
- Coal seam observed
- Coal seam projected on basis of float and recessive weathering
- Coal seam, estimated position of zone
- Road , trail
- Cross - section lines

- Property boundary , Denison Mines staked 1970
- Property boundary , Denison Mines staked 1971
- Faults : unknown, reverse, normal
- Strike & dip, top known
- Strike & dip, top known, overturned
- Strike & dip, top unknown
- Vertical bedding
- Horizontal bedding
- Slaty cleavage w/dip

- Slickenslides, trace and plunge
- Overturned anticline
- Overturned syncline
- Syncline
- Anticline
- Fish scales and teeth
- Fish scales
- Fish scales



D-E INTER SEAM STRATIGRAPHIC ISOPACH

C.I. = 10'

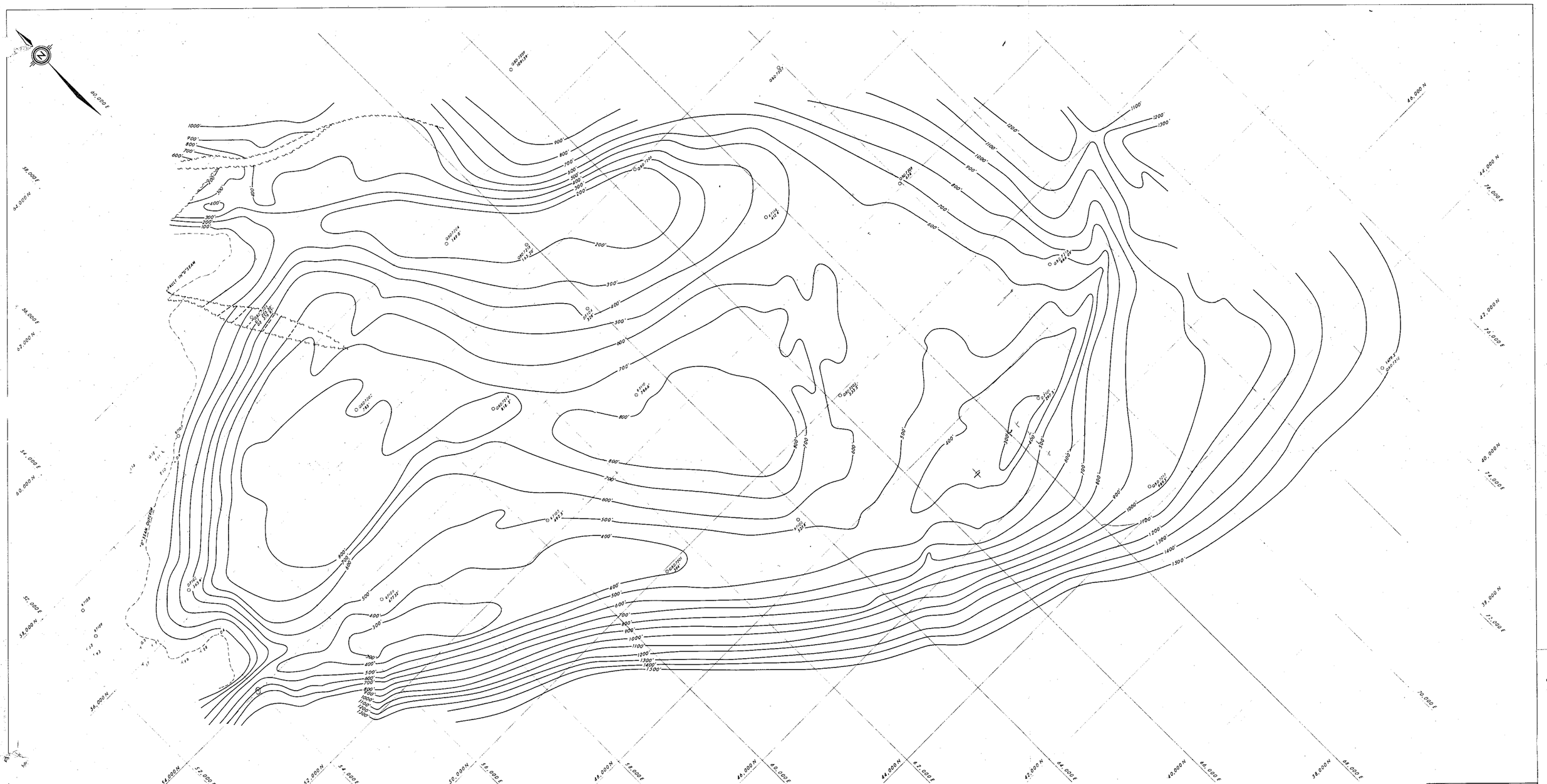
PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
E SEAM NET

Sept. '72 | 1:20000
BBCK 72-0399-201

PR- QUINTETTE 72 (5) A



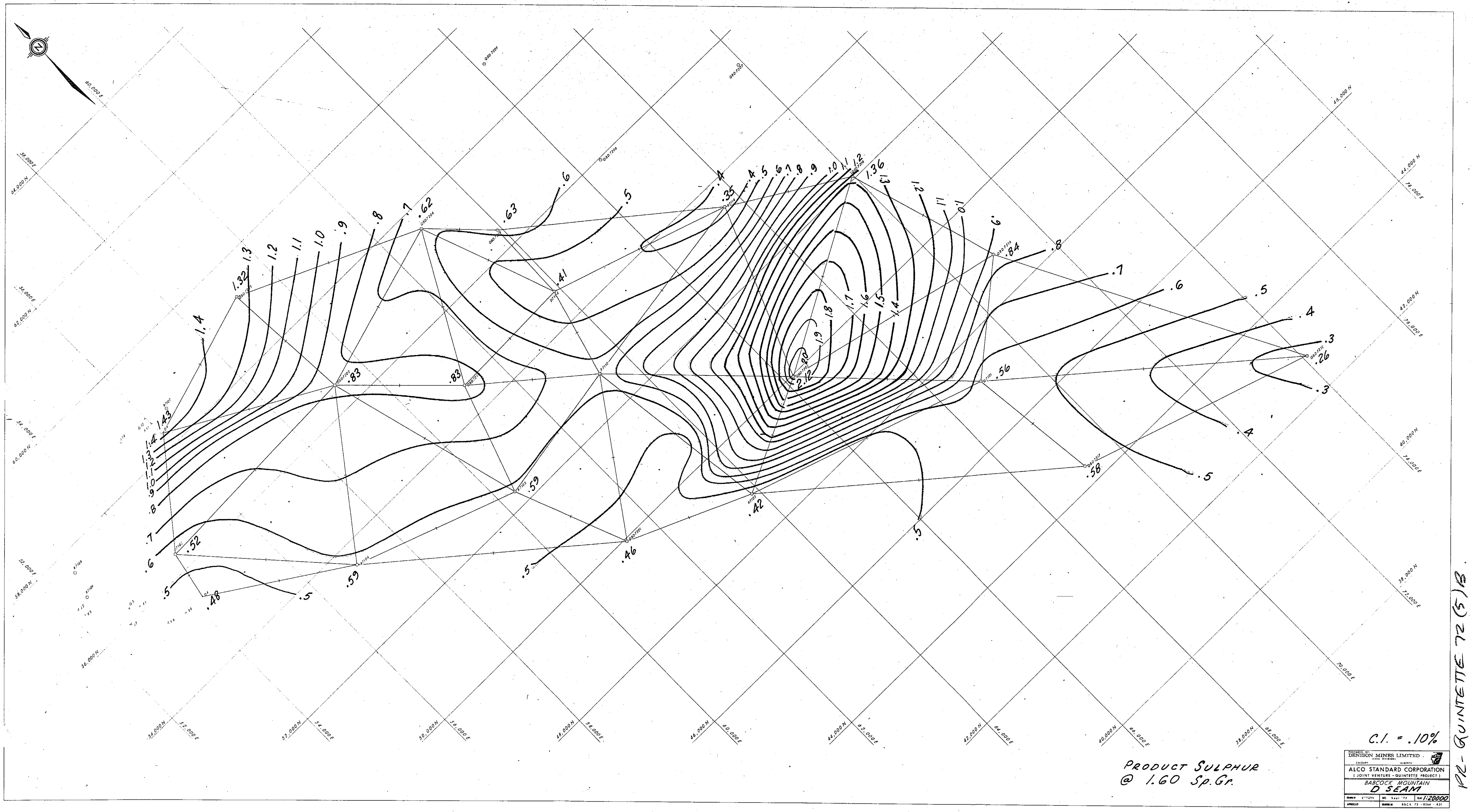
DEPARTMENT OF
DENISON MINES LIMITED
CALGARY COAL DIVISION ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

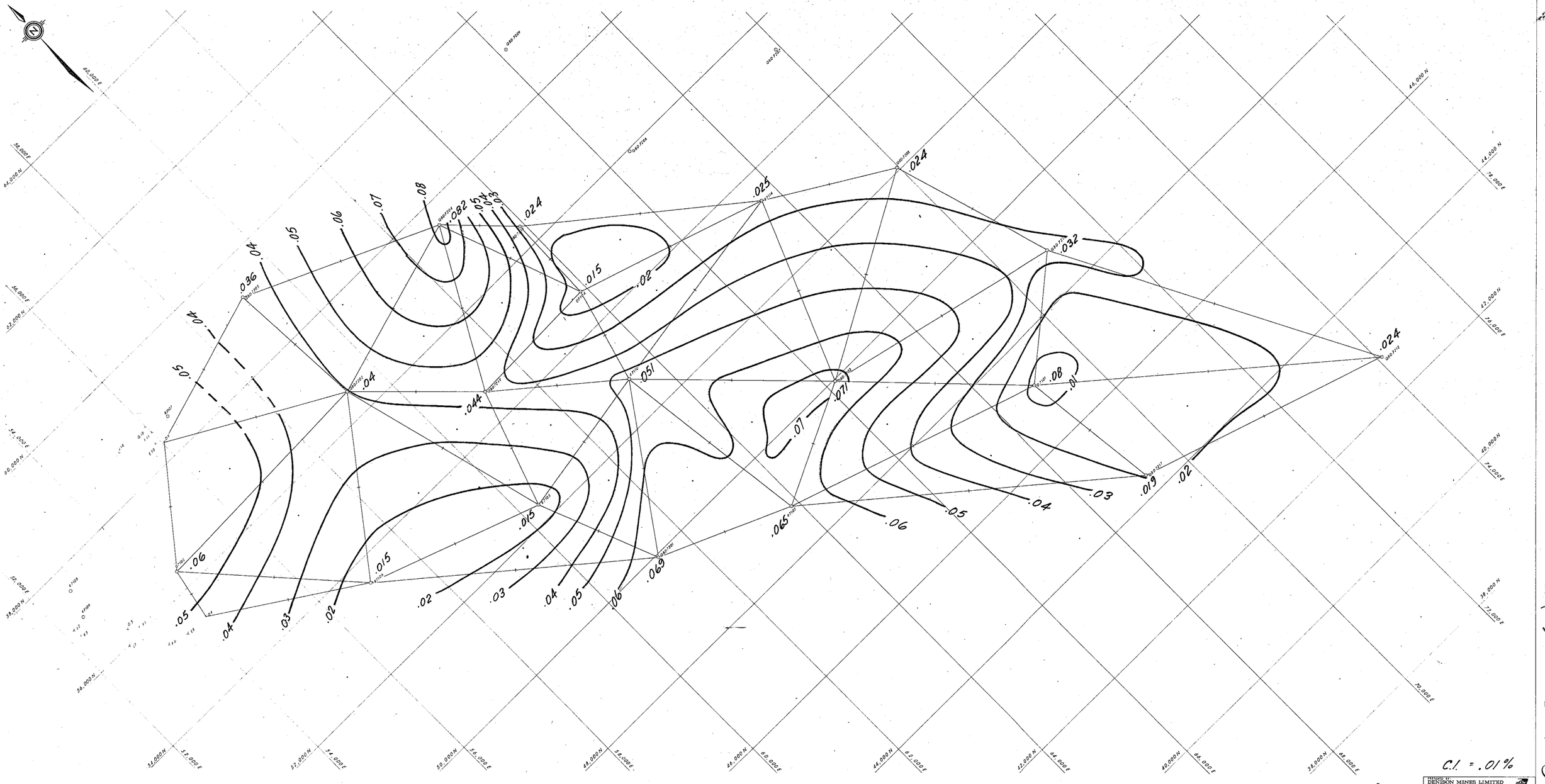
BABCOCK MOUNTAIN
DEPTH OF COVER TO 10' SEAM

DRAWN	[illegible]	DATE MAY 73	SCALE 1" = 400'
DRAWING		DRG. NO. BBCK 73 - 0430 - 901	

PR-QUINTETTE 72(5) B.



PR-QUINTETTE 72(5)B


.04
.05
.06
.07
.08
.082
.025
.024
.036
.015
.02
.032
.051
.044
.017
.08
.01
.065
.069
.03
.019
.02
C.I. = .01%
% PHOSPHOROUS OF PRODUCT COAL
@ APPROX. 7% ASH (D.B.)
PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)
BABCOCK MOUNTAIN
D SEAM
SCALE 1:20000
DRAWING NO. BBCK 73 - 0364 - 801
PR - QUINTETTE 72 (5) 18.

PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

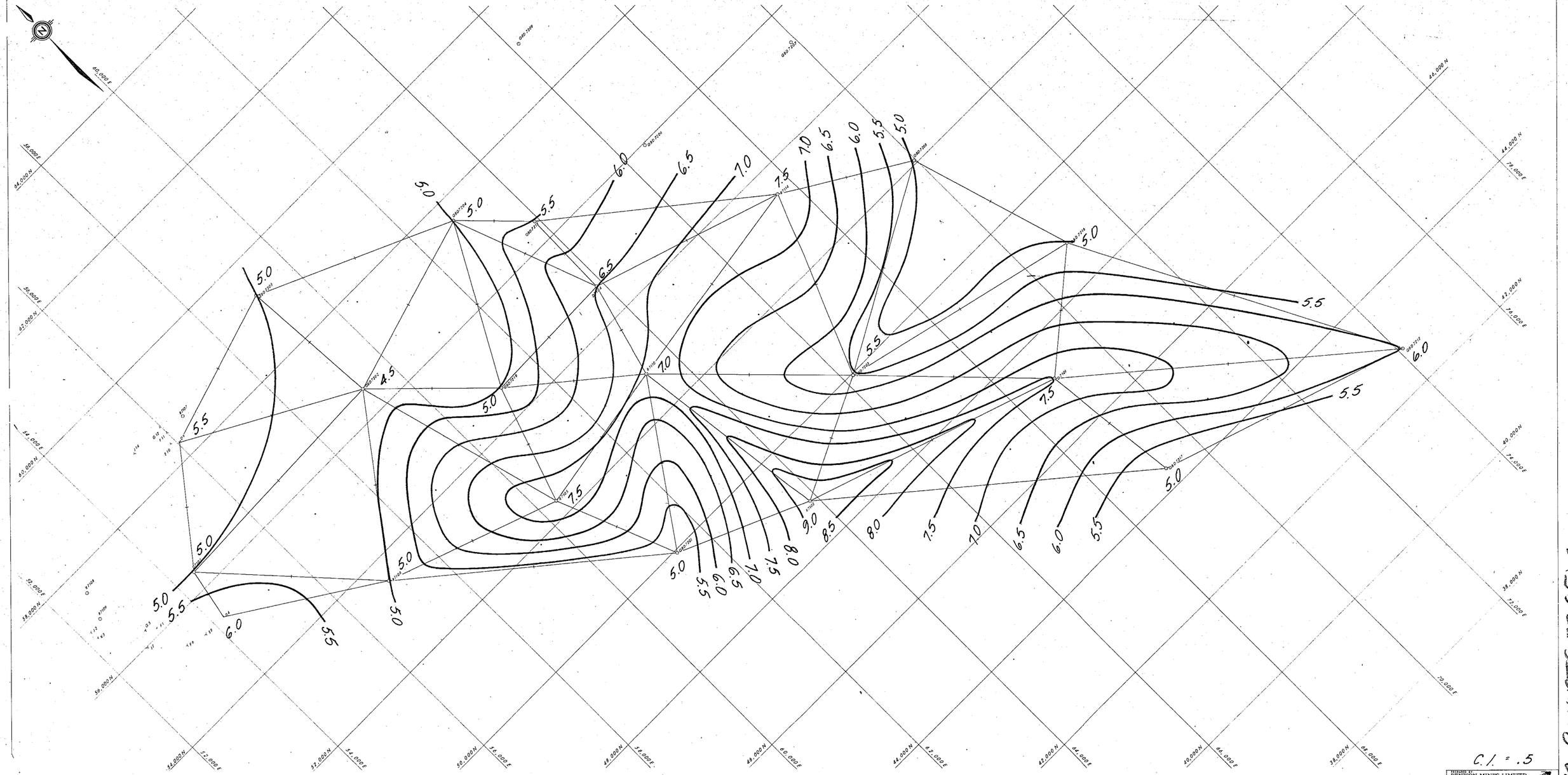
BABCOCK MOUNTAIN
D SEAM

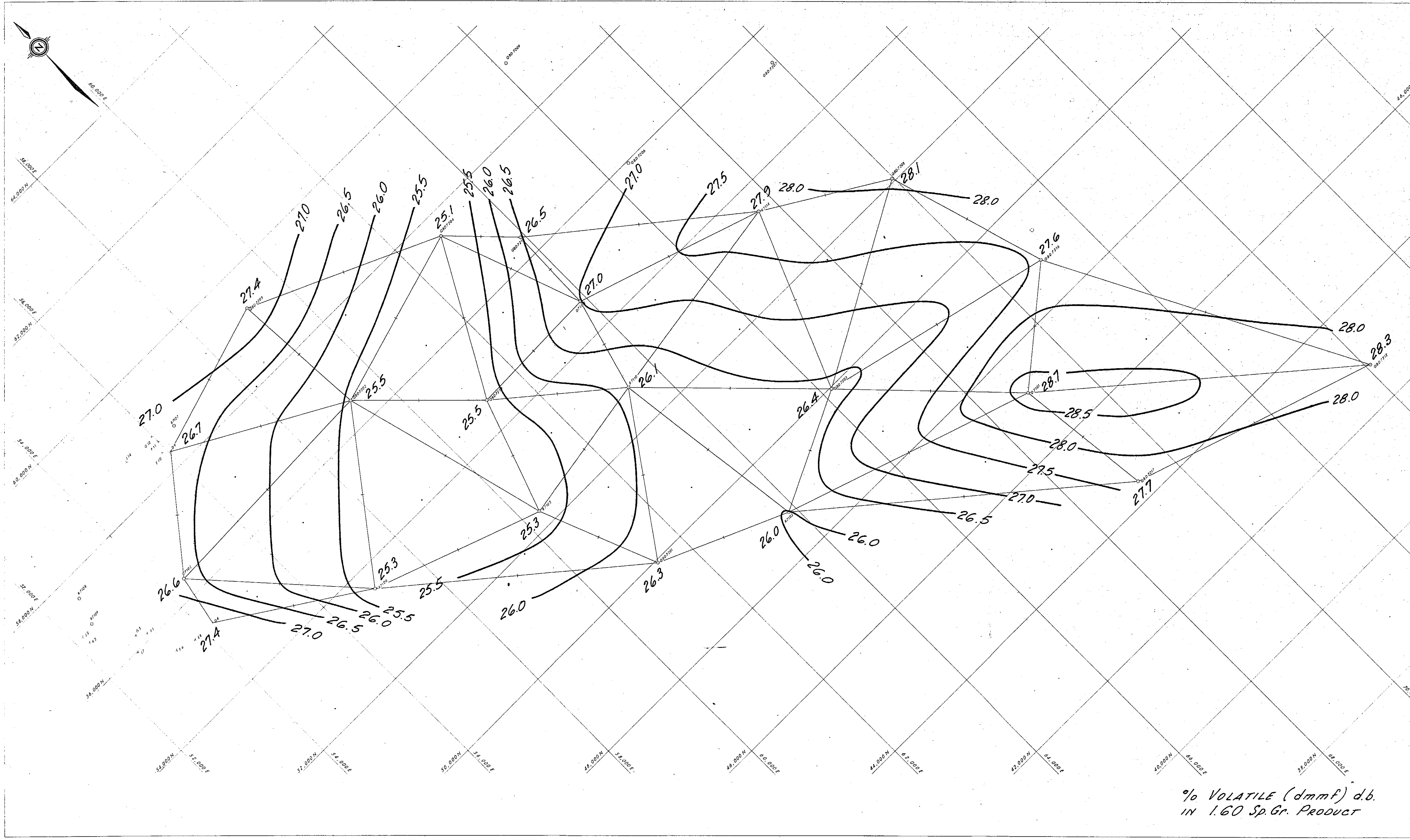
DRAWN | SCALE 1:20000
CHECKED | DRAWING NO. BBCK 72-03A-001

C.I. .5%

PRODUCT VOLATILES
@ 1.60 Sp. Gr.

P12 - QUINTETTE 72(5)18.


5.0
5.5
6.0
6.5
7.0
7.5
8.0
9.0
8.5
4.5
C.I. = .5
PRODUCT F.S.I. AT 1.60 Sp.Gr.
FSI VALUES ON ROTARY HOLES MAY BE HIGH.
DENISON MINES LIMITED
CALGARY ALBERTA
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)
BABCOCK MOUNTAIN
D SEAM
Sept. '77
1:20000
BBCM 77 - D3m - R01
MR-QUINTETTE 77(5)M.



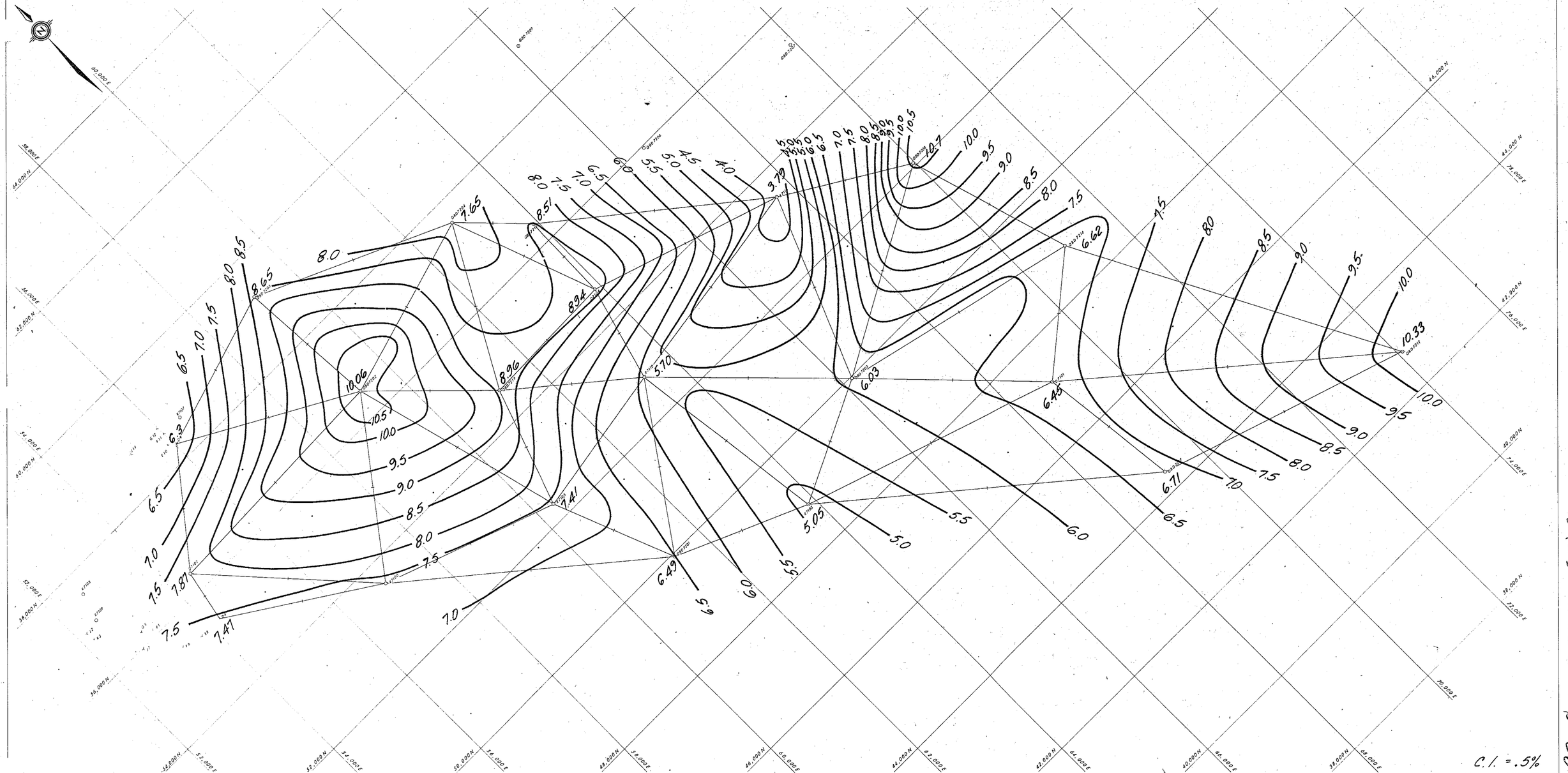
PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
D SEAM

DRAWN BY E. Toth | DATE Sept '72 | SCALE 1:20000
APPROVED BY | DRAWING NO. BBCK 72 - 0364 - R01

PR- QUINTETTE 72(5)B.


C.I. = .5%
PRODUCT ASH
@ 1.60 Sp. Gr.
PROJECTED BY
DENISON MINES LIMITED
CALGARY ALBERTA
ALCO STANDARD CORPORATION
[JOINT VENTURE - QUINTETTE PROJECT]
BABCOCK MOUNTAIN
D SEAM
SCALE 1"=1000' | DATE Sept 77 | SCALE 1:20000
APPROVED | DRAWING BBCK 77 - 0364 - 001
AR-QUINTETTE 77 (5)18.

PREPARED BY
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

STRUCTURE CONTOUR MAP
"D" SEAM

DRAWN E.T.Y.S. | DATE Sept. 72 | SCALE 1:20,000

APPROVED | DRAWING QNTT 72 - 0327 - 803

PRE - QUINTETTE 72(5)8

D SEAM OUTCROP

25% CUTOFF

1500' CUTOFF

D SEAM-ISOPACH OF SEAM DILUTION

D SEAM-ISOPACH OF MINING THICKNESS

D SEAM-AREA OF INFLUENCE

PRE-QUINTETTE 72 (5)12.

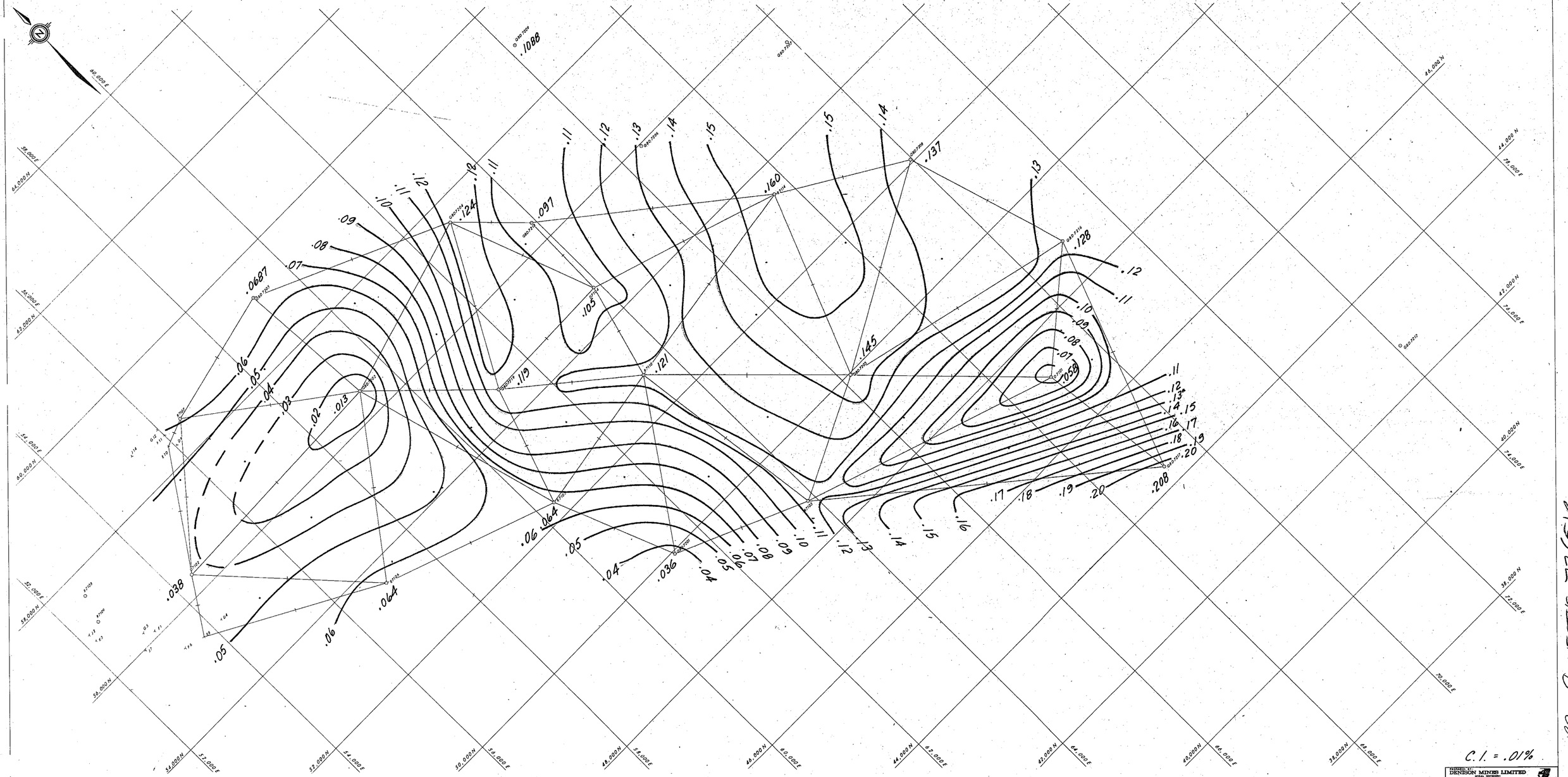
PREPARED BY
DENISON MINES LIMITED
CALGARY COAL DIVISION ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
D SEAM NET

DRAWN: F.T.T.T.	DATE: Sept. '77	SCALE: 1:20000
APPROVED	DRAWING: BSCK 77 - D3a4 - NET	

P22 - QUINTETTE 77-(51) 18.



% PHOSPHOROUS OF PRODUCT COAL
@ APPROX. 7% ASH (D.B.)

C.I. = .01%

PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA

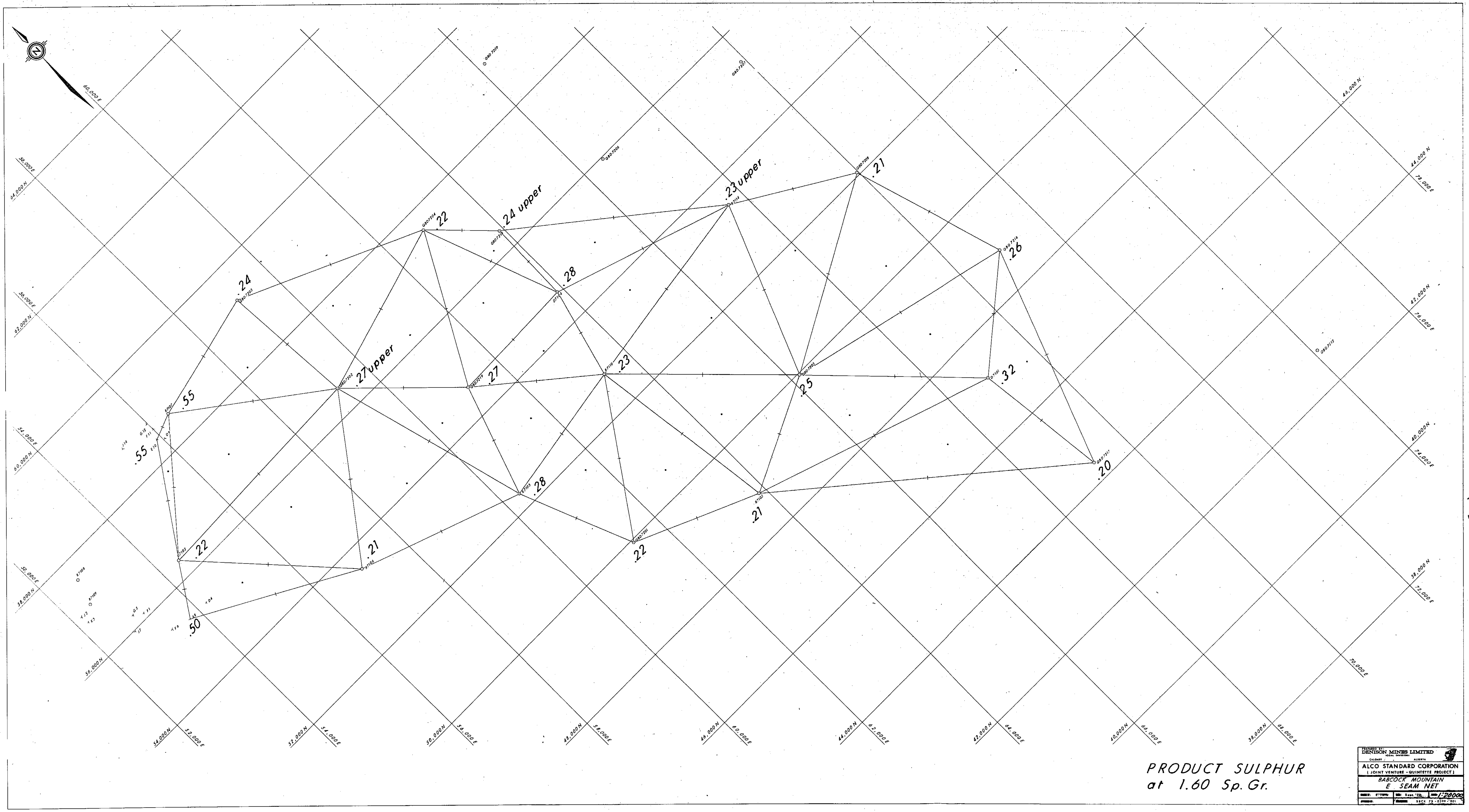
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
E SEAM

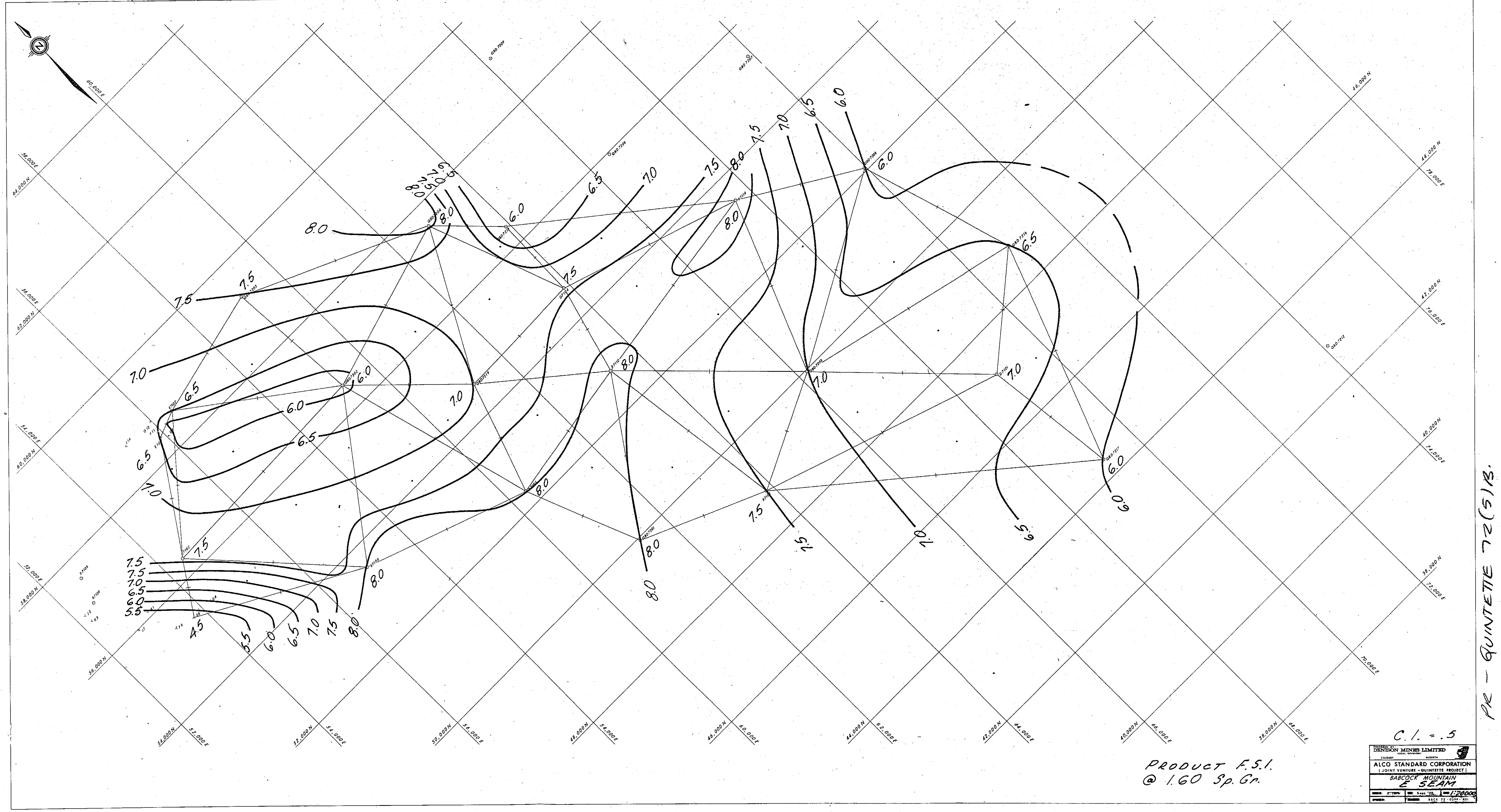
DRAWN: [illegible] | SCALE: 1:20000

DRAWING: BBCK 72-0399-801

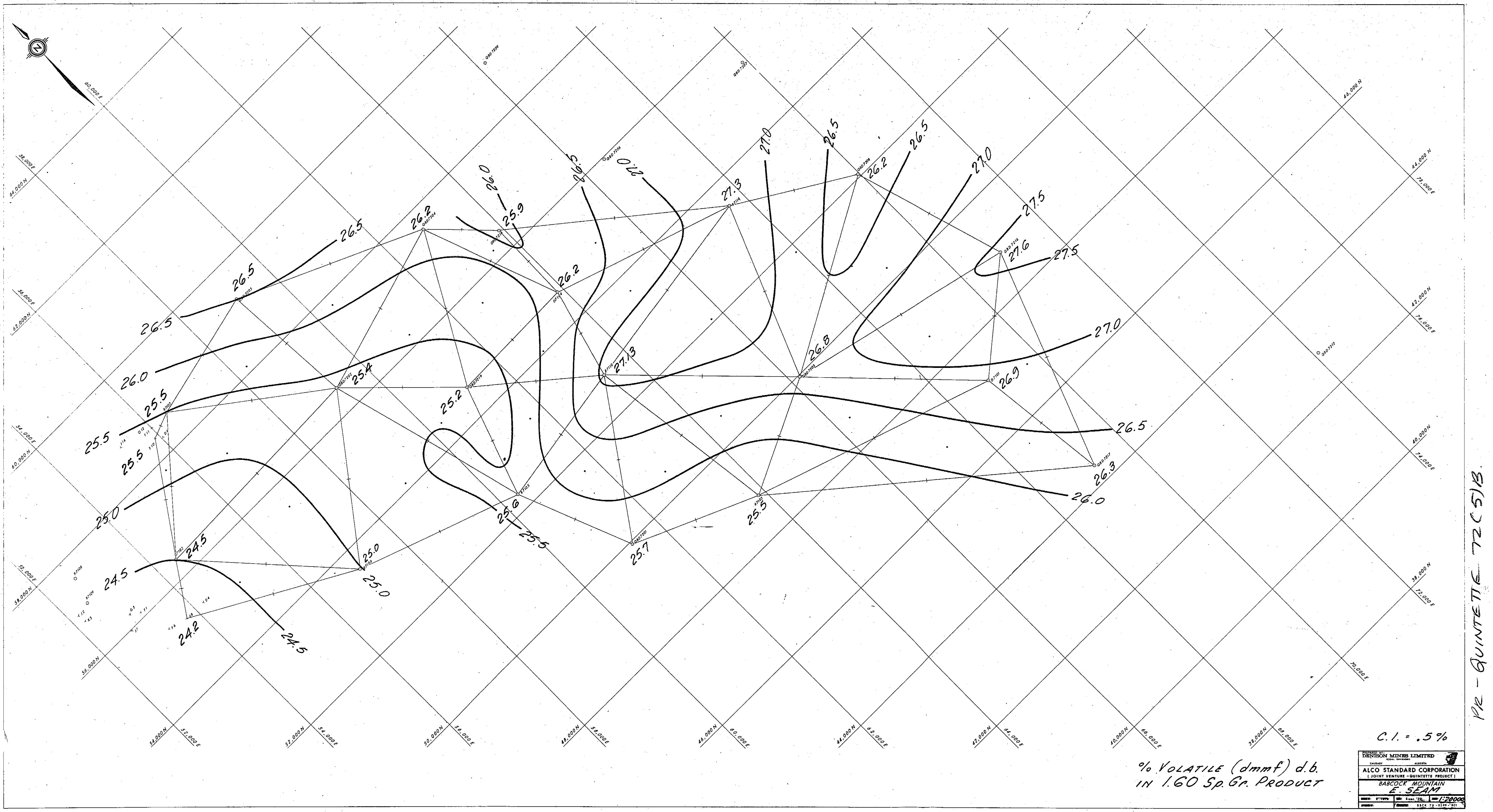
PR - QUINTETTE 72(518).



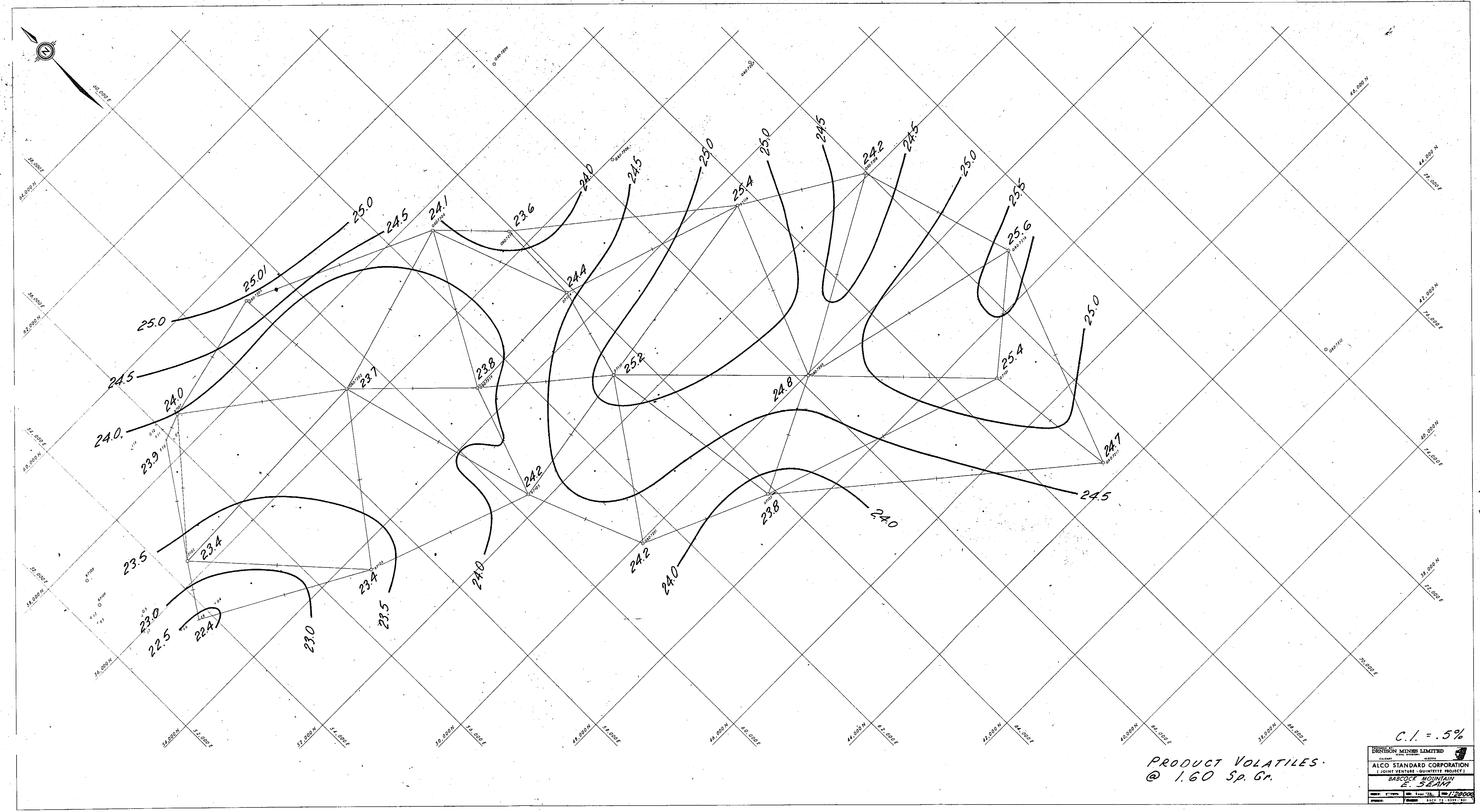
PR- QUINTETTE 72(5)B.



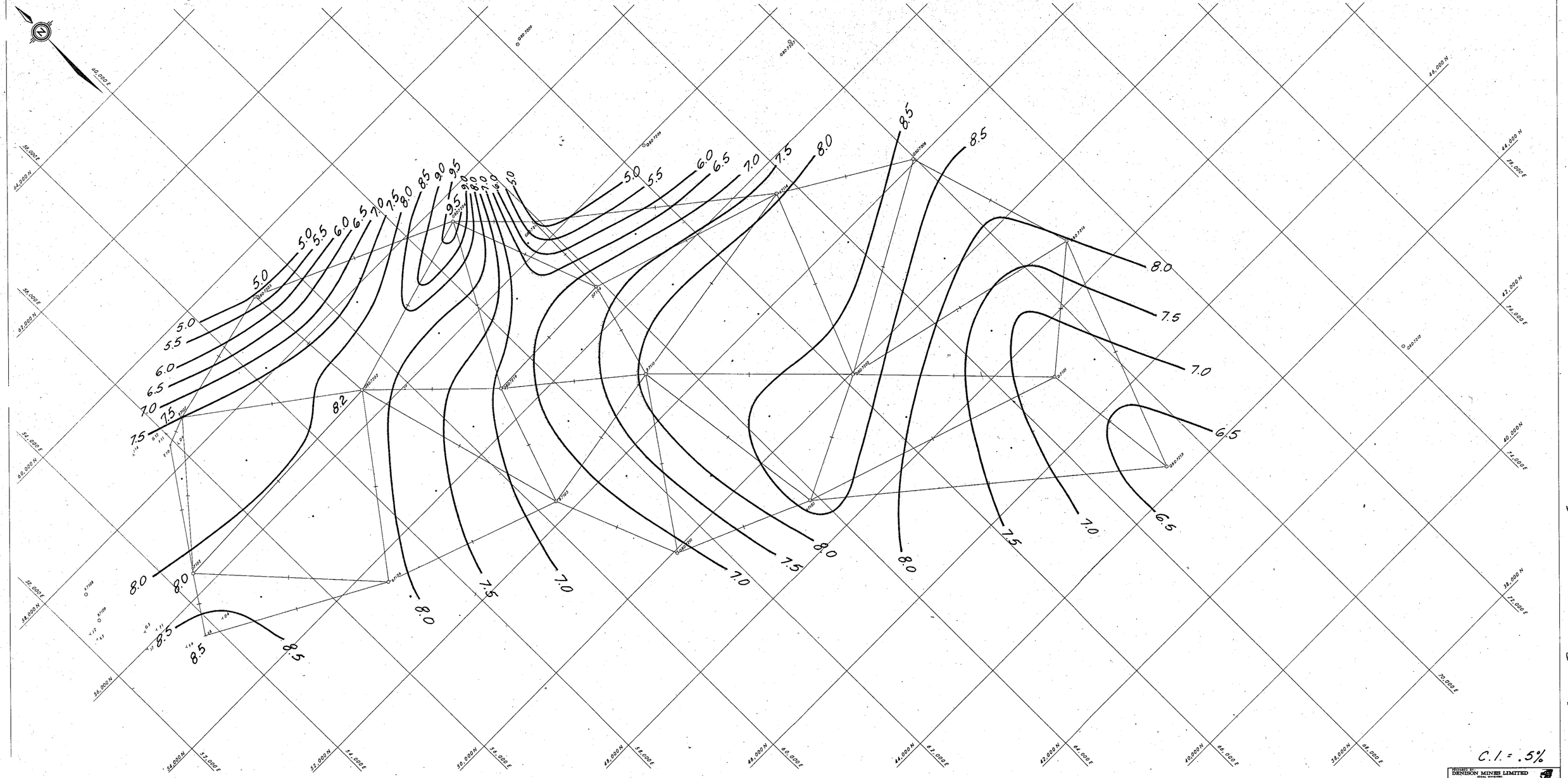
PR - QUINTETTE 72(5)B.



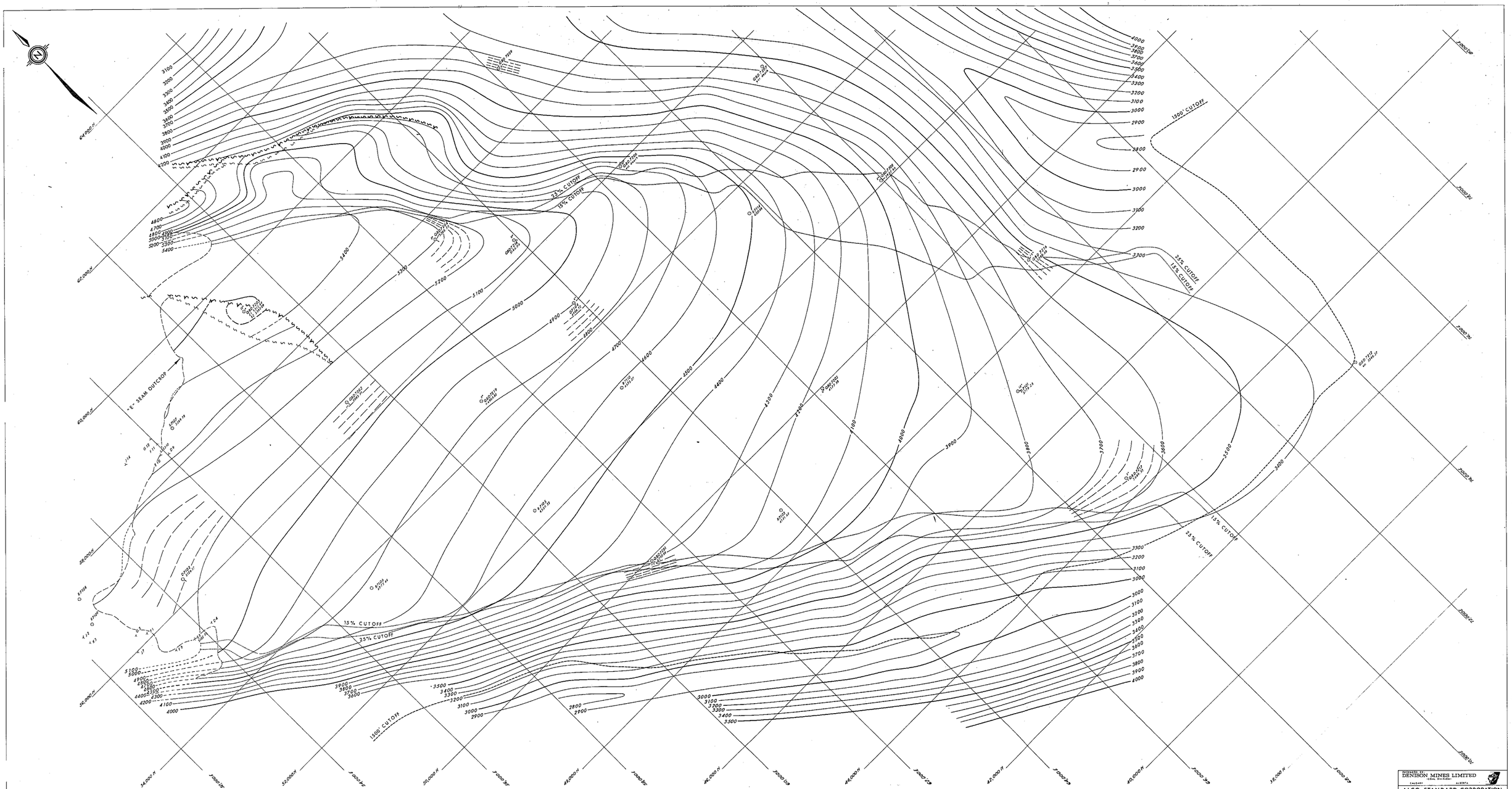
PR - QUINTETTE 72(5)B.



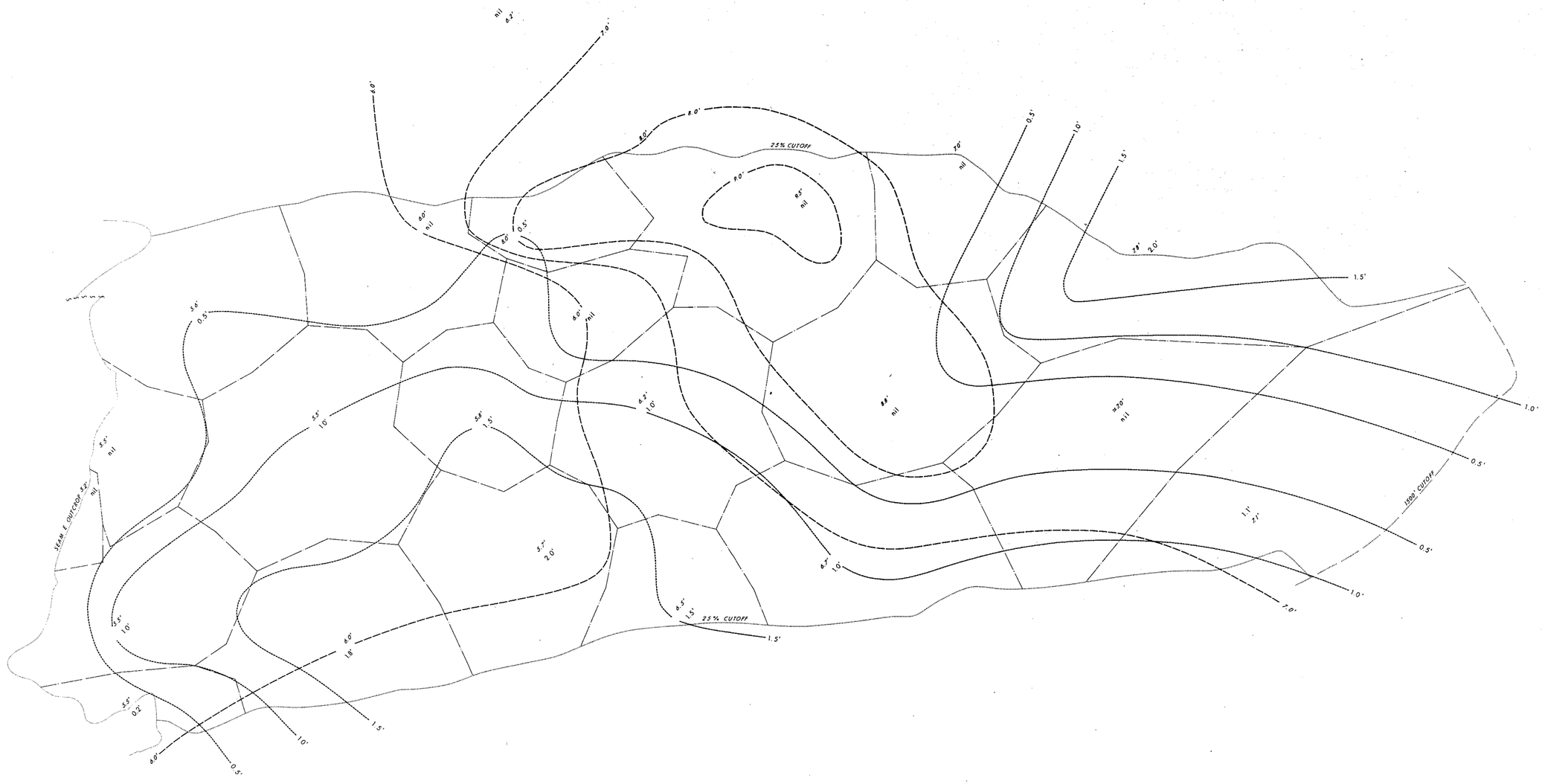
PR- QUINTETTE 72(5)B.



P12 - QUINTETTE 72 (5) 13.



P2 - QUINTETTE 72(S)18.



PRE- QUINTETTE 72 (5) 15'

60,000 E

56,000 E

46,000 N

44,000 N

76,000 E

42,000 N

74,000 E

54,000 E

50,000 N

40,000 N

72,000 E

58,000 E

52,000 N

38,000 N

70,000 E

56,000 W

54,000 N

52,000 E

52,000 N

54,000 E

50,000 N

56,000 E

48,000 N

58,000 E

46,000 N

60,000 E

44,000 N

62,000 E

42,000 N

64,000 E

40,000 N

66,000 E

38,000 N

68,000 E

72 - QUINTETTE 72(5)18.

PREPARED BY:
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
E SEAM NET

1:20000

BCK 73 - 0295 - 201

TRACE OF "E" SEAM FAULT

E. 1640'
E.F. 37.2

40
50
60
120
140
100
80
60
50
40'
50
60
60
87'
79.50'
84.5'
81.90'
90
59.8'
55.3'
52.03'
62.8'
72.10'
71.70'
85.9'
90.06'
58.6'
58.72'
120.3'
99.60'
69.0'
60
70
80
90
100
110
100

E-F INTER SEAM
STRATIGRAPHIC ISOPACH
C.I. = 10'

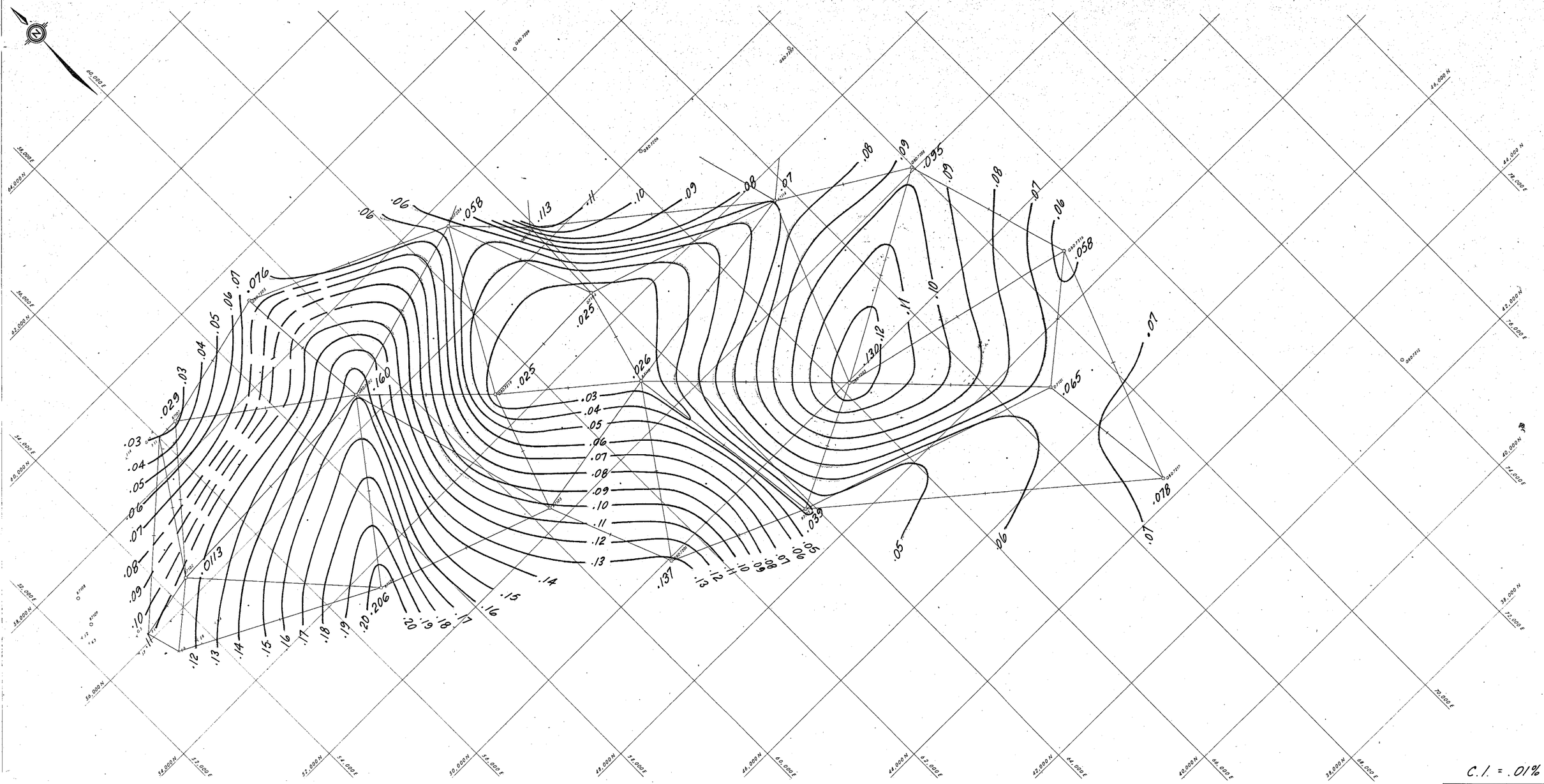
PREPARED BY
DENISON MINES LIMITED
Calgary Alberta

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
F SEAM NET

DRAWN: CTOTS | DES: Sept '72 | SCALE: 1"=2000'
APPROVED: | DRAWING NO: BBCK 72-0352-R02

PR - QUINTETTE 72 (S) 13.



P2 - QUINTETTE 72(5)18.

C.I. = .01%

% PHOSPHOROUS OF PRODUCT COAL
@ APPROX. 7% ASH (D.B.)

PREPARED BY:
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
F SEAM

DRAWN BY: E.T.V.S. | DATE: Sept '72 | SCALE: 1:20000
DRAWING NO.: BBCK 72 - 2052 - 402

PRODUCT SULPHUR
at 1.60 Sp. Gr.

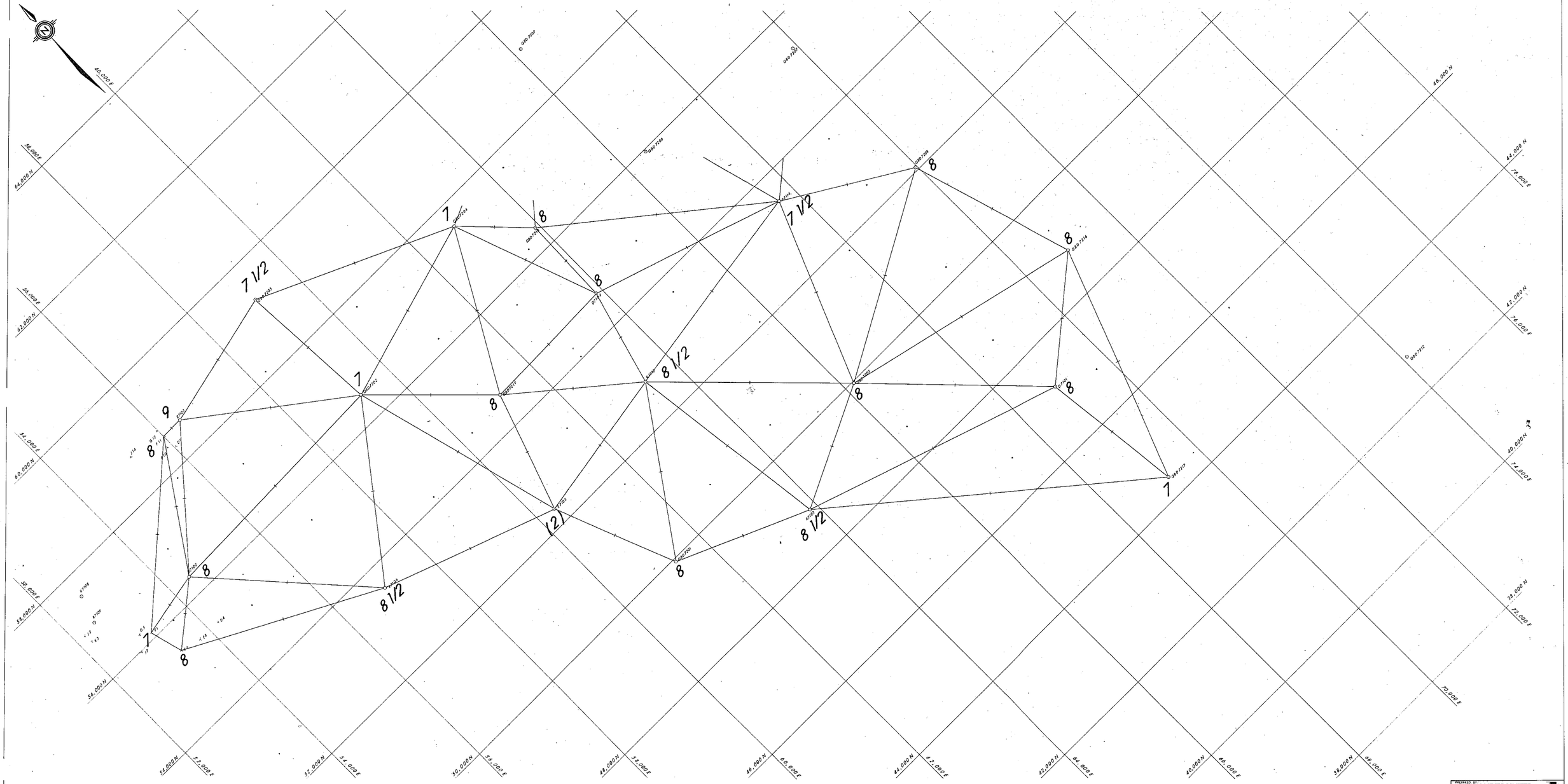
PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
F SEAM NET

DRAWN BY: E. TAYLOR | DATE: Sept '72 | SCALE: 1:20000
APPROVED BY: | DRAWING NO: 88CK 72 - 0369 - F03

PR - QUINTETTE 72 (5) 8.



PRODUCT F.S.I.
at 1.60 Sp. Gr.

PREPARED BY
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

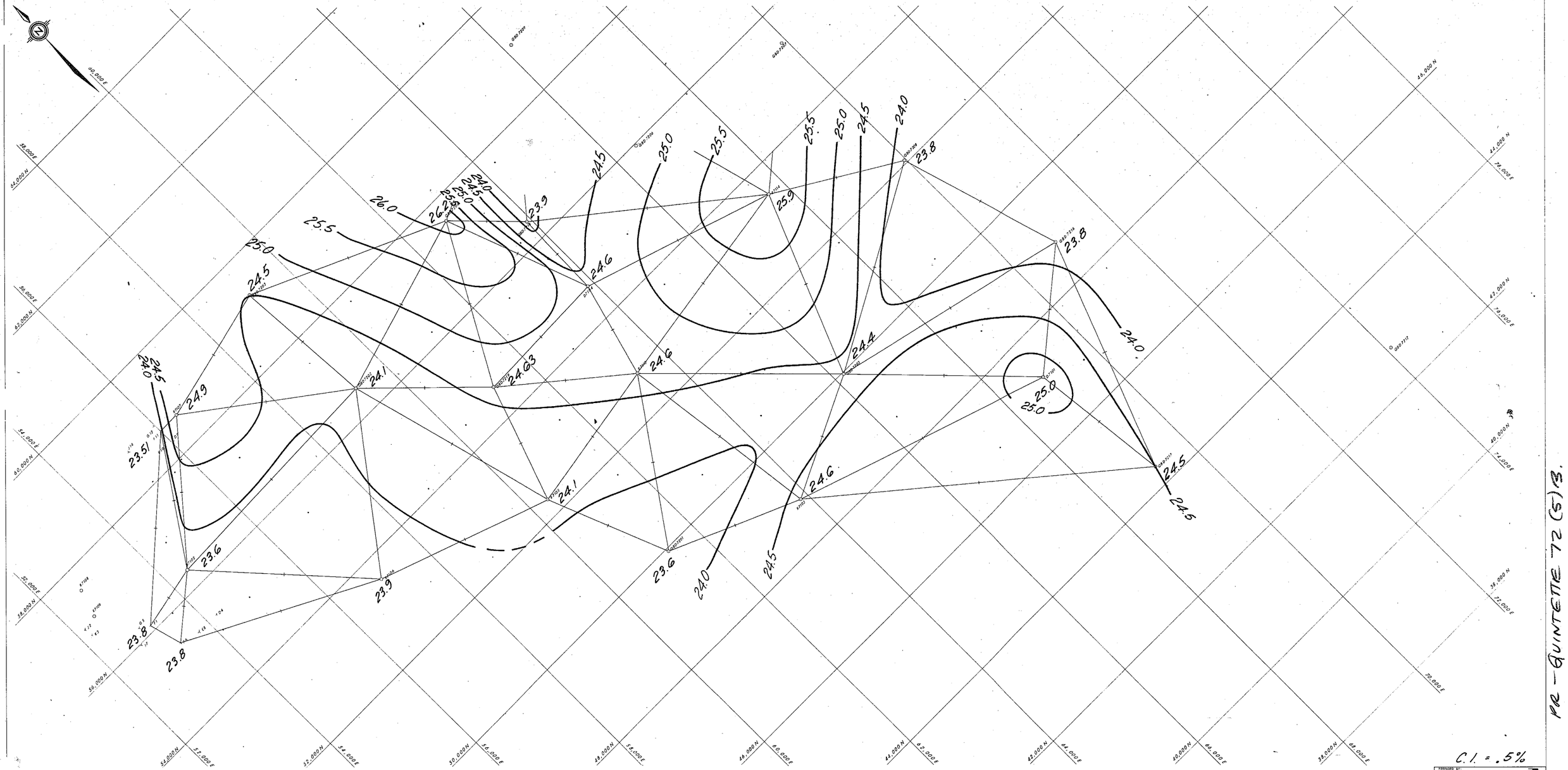
ALCO STANDARD CORPORATION
[JOINT VENTURE - QUINTETTE PROJECT]

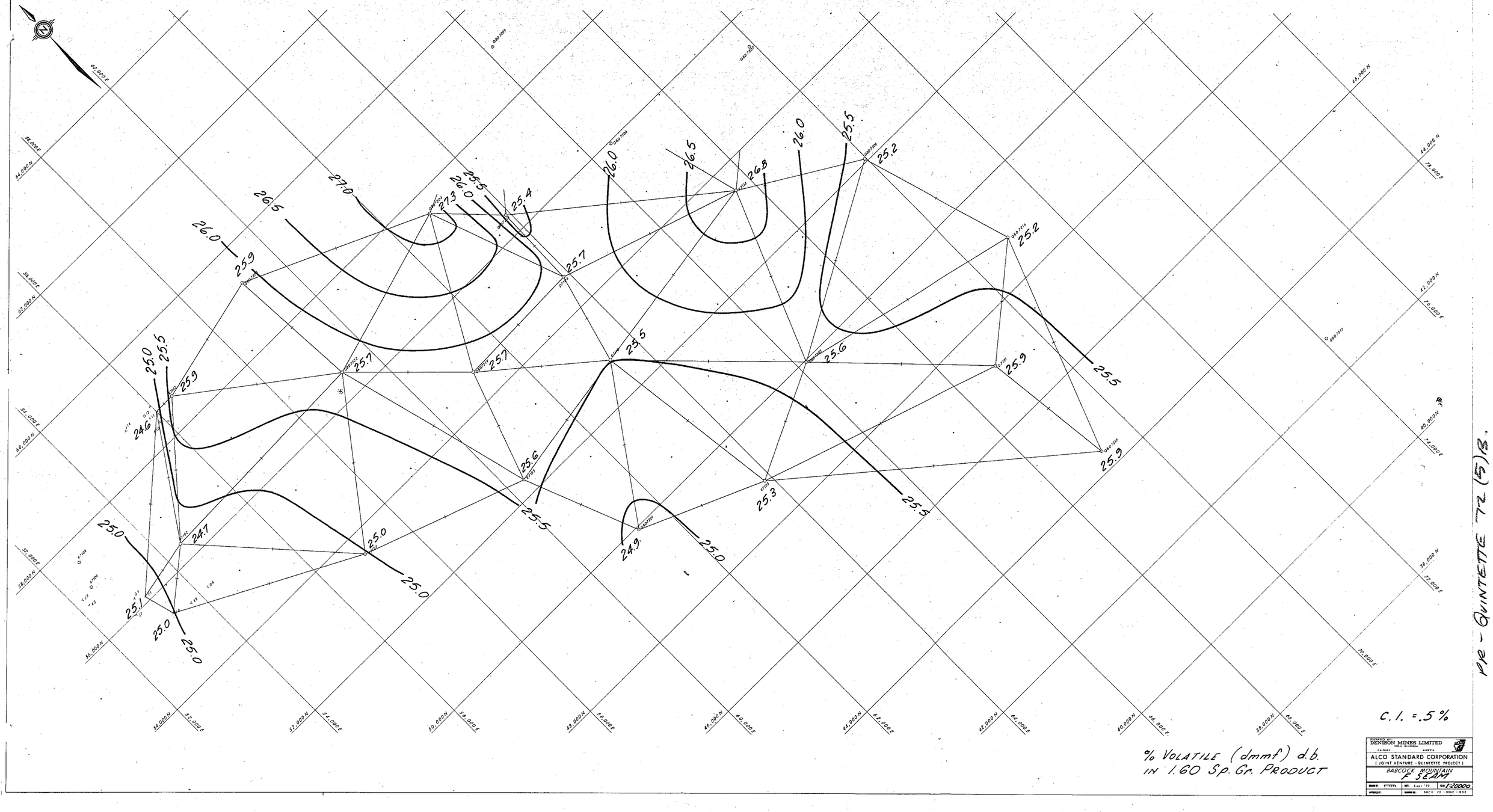
BABCOCK MOUNTAIN
F SEAM NET

SCALE 1" = 1000' | NO. 3 Nov '72 | SCALE 1:20000

APPROVED | DRAWING NO. BBCK 72 - 0142 - 802

MR - QUINTETTE 72 (51B).


PR-QUINTETTE 72 (S) 13.
C.I. = .5%
PRODUCT VOLATILES
@ 1.60 Sp. Gr.
PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA
ALCO STANDARD CORPORATION
[JOINT VENTURE - QUINTETTE PROJECT]
BABCOCK MOUNTAIN
F SEAM
SCALE 1:20000
DRAWN
APPROVED
DRAWING NO. BRCK 72 - 0343 - M12



C.I. = .5%

% VOLATILE (dmmf) d.b.
IN 1.60 Sp. Gr. PRODUCT

PREPARED BY
DENISON MINES LIMITED
CALGARY, ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
F SEAM

DRAWN: [illegible] | DATE: Sept '92 | SCALE: 1:20000

PROJECT: | DRAWING NO: BMCK 92 - 0302 - R02

Pie - Quintette 72 (5)13.

PREPARED FOR
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINETTE PROJECT)

BABCOCK MOUNTAIN
F SEAM

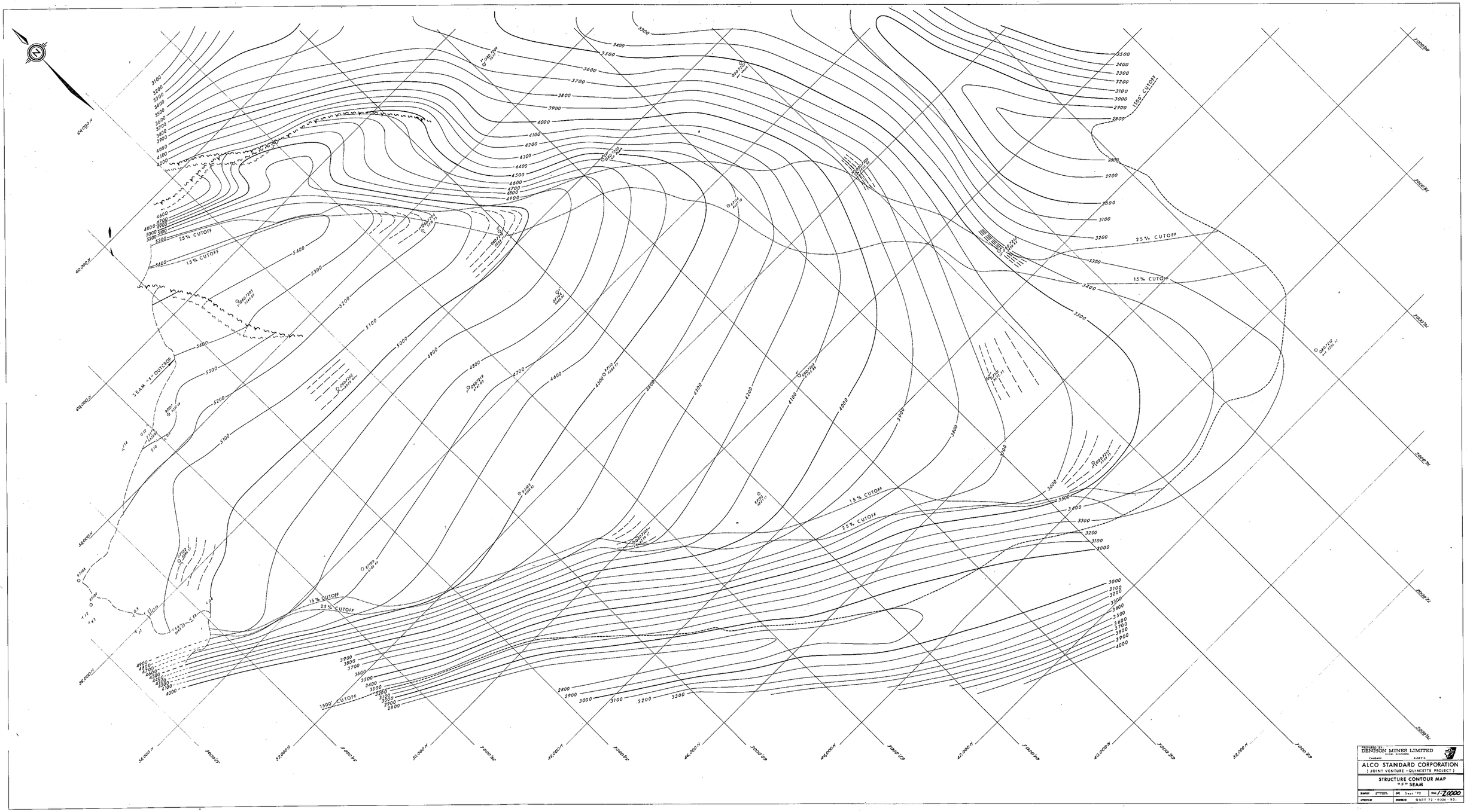
DRAWN: E.T.S.T.A. | SCALE: 1"=1000' | 1:20000

APPROVED: | DRAWING No. BBCK 72 - 8362 - 802

PRODUCT ASH
@ 1.60 Sp. Gr.

C.I. = .5%

PR - QUINETTE - 72 (5) 18.



PREPARED BY
DENISON MINES LIMITED
CALGARY GLOBAL DIVISION ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINIETTE PROJECT)

STRUCTURE CONTOUR MAP
"E" SEAM

DRAWN [illegible] | DATE Sept '72 | SCALE 1:20000
APPROVED | DRAWING QNTE 72 - 0324 - SD.

12 - QUINIETTE 72 (5) 15.

F SEAM-ISOPACH OF SEAM DILUTION

F SEAM-ISOPACH OF MINING THICKNESS

F SEAM-AREA OF INFLUENCE

PR-GUINTETTE-72(5)13

PR - QUINTETTE 72(S)13.

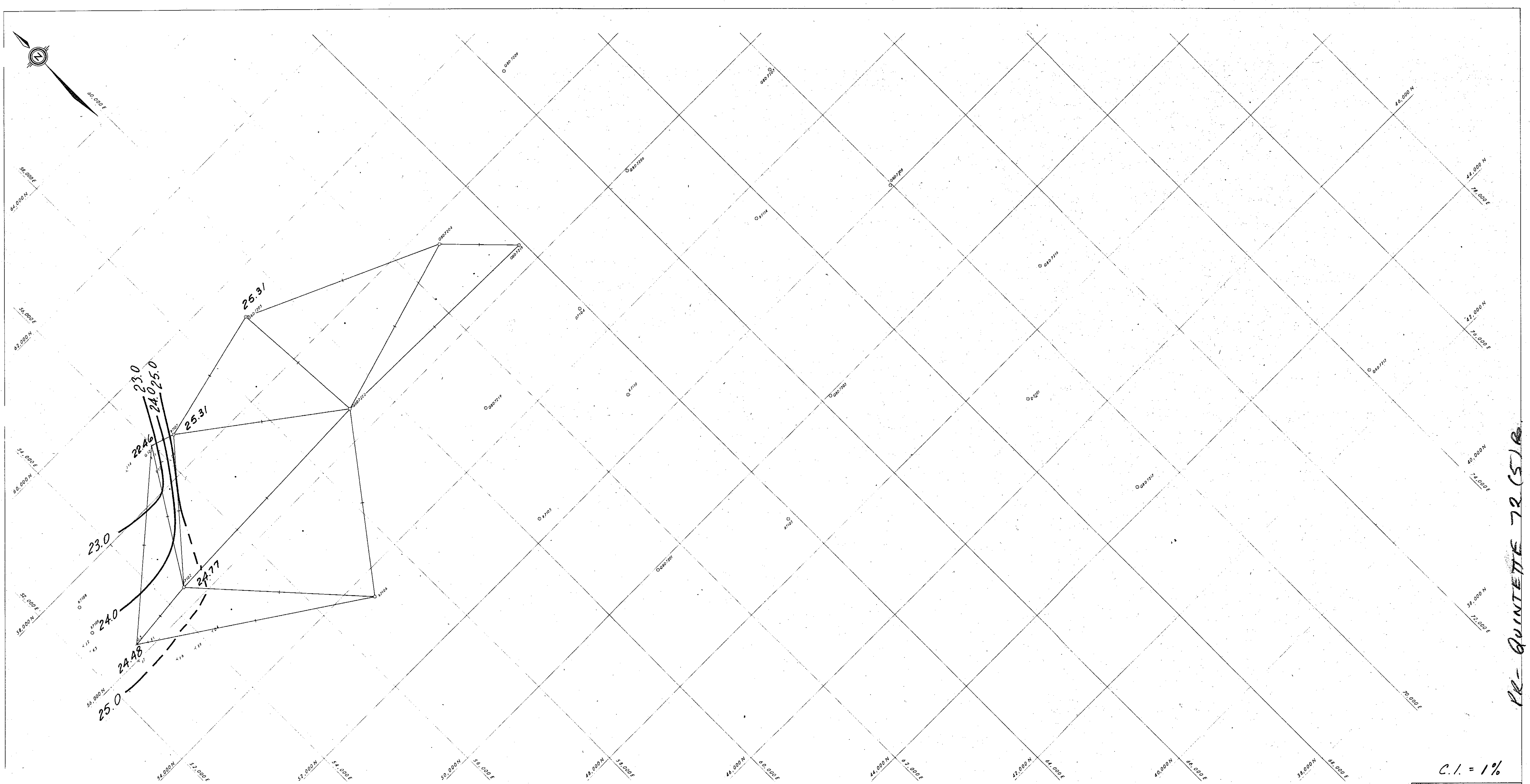
PREPARED BY:
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
[JOINT VENTURE - QUINETTE PROJECT]

BABCOCK MOUNTAIN
F SEAM NET

SURVEY: E.T.S. | MAP: Sept '72 | SCALE: 1:20000

APPROVED BY: | DRAWING NO: BBCK 72 - 0362 - 802



C.I. = 1%

% VOLATILE (dmmf) d.b.
IN 1.60 Sp. Gr. PRODUCT

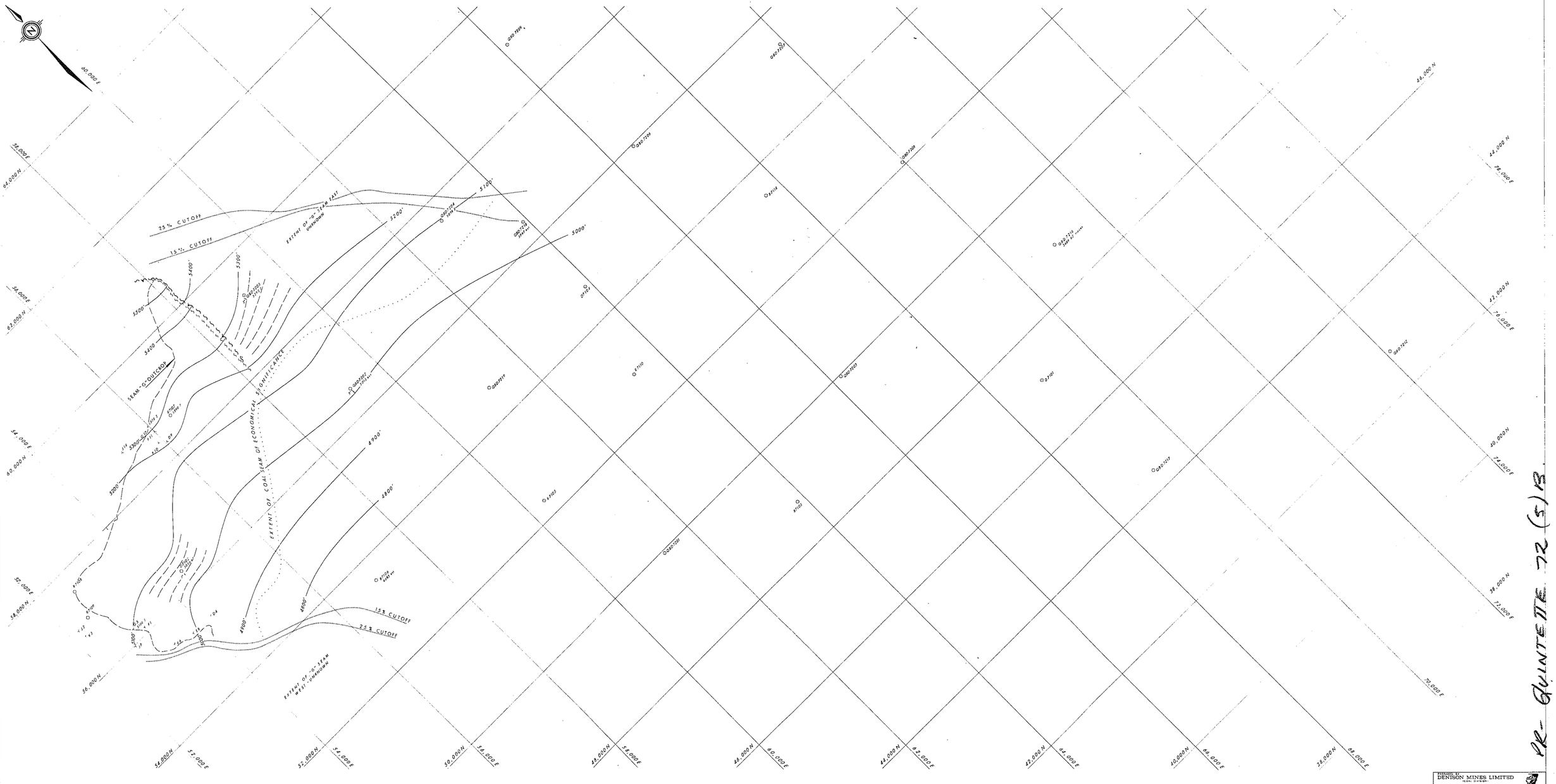
PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
G SEAM

Sept '72 | 1:20000
BBCK 72 - 0363 - R01

PR - QUINTETTE 72 (5) B



PREPARED BY
DENISON MINES LIMITED
CALGARY COAL DIVISION EDMONTON

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

STRUCTURE CONTOUR MAP
"G" SEAM

DRAWN BY		DATE Sept '72	SCALE 1:20000
APPROVED		DRAWING NO.	QNTT 72-2356-R01

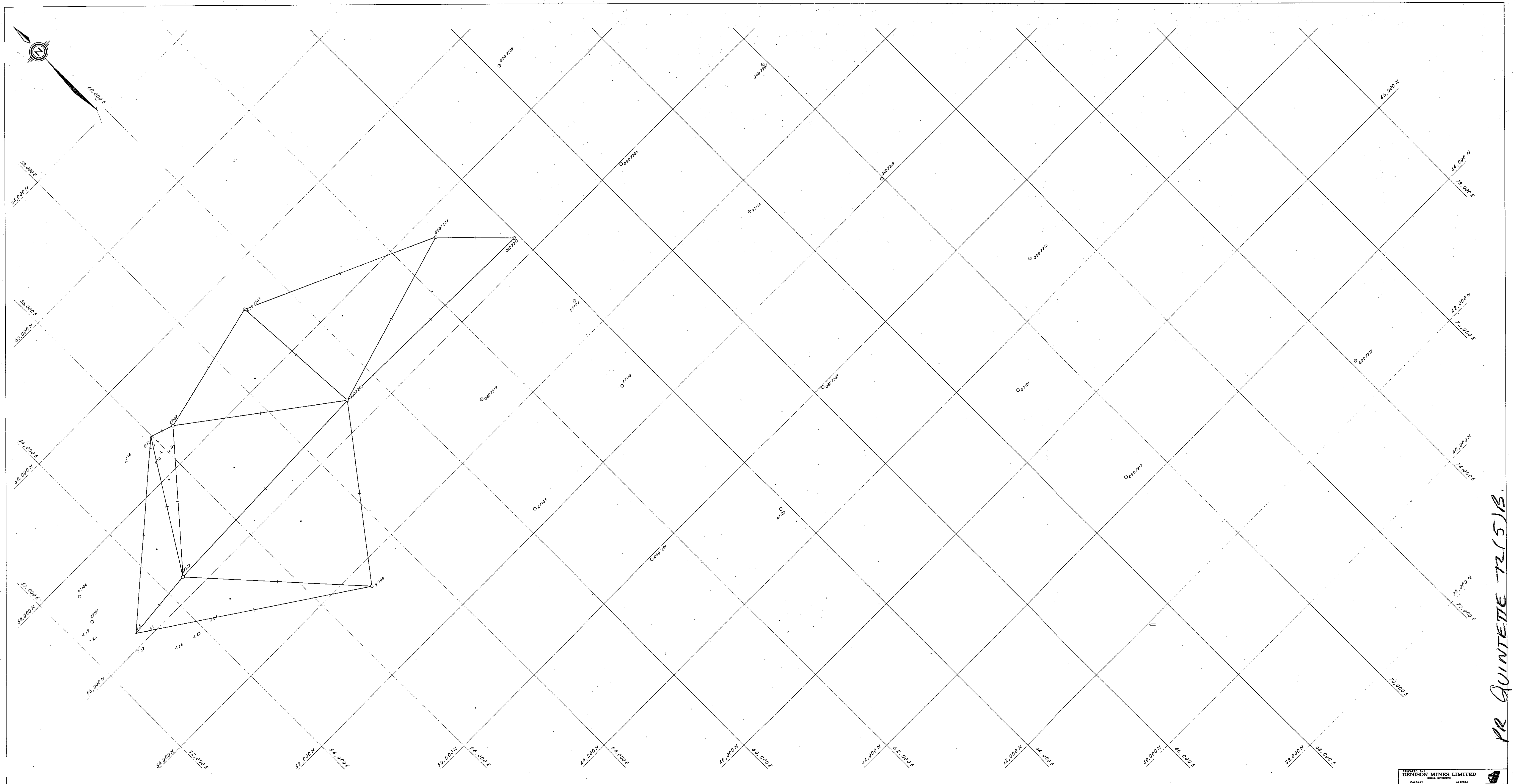
PR- QUINTETTE 72 (5) 13

G SEAM - ISOPACH OF SEAM DILUTION ————

G SEAM - ISOPACH OF MINING THICKNESS ——— —

G SEAM - AREA OF INFLUENCE —— — —

RE- GUINTETTE 72(5)18



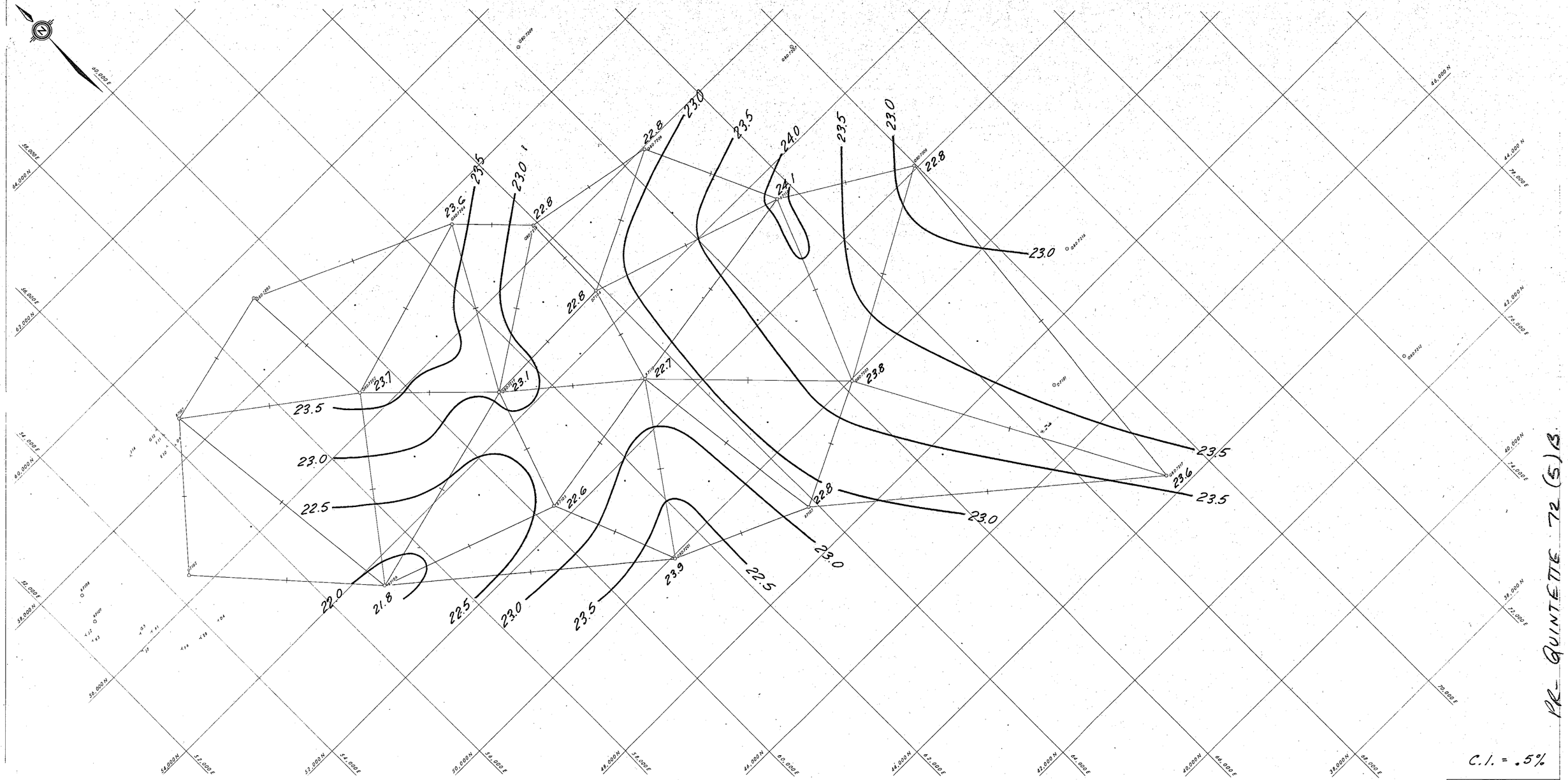
PR QUINTETTE 72(5)B.

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
G SEAM NET

DRAWN BY: E. TOTH	DATE: Sept. '72	SCALE: 1:20000
APPROVED BY:	DRAWING NO: BBCK 72 - 0363 - R01	



RE- QUINTETTE 72 (5) B.

C.I. = .5%

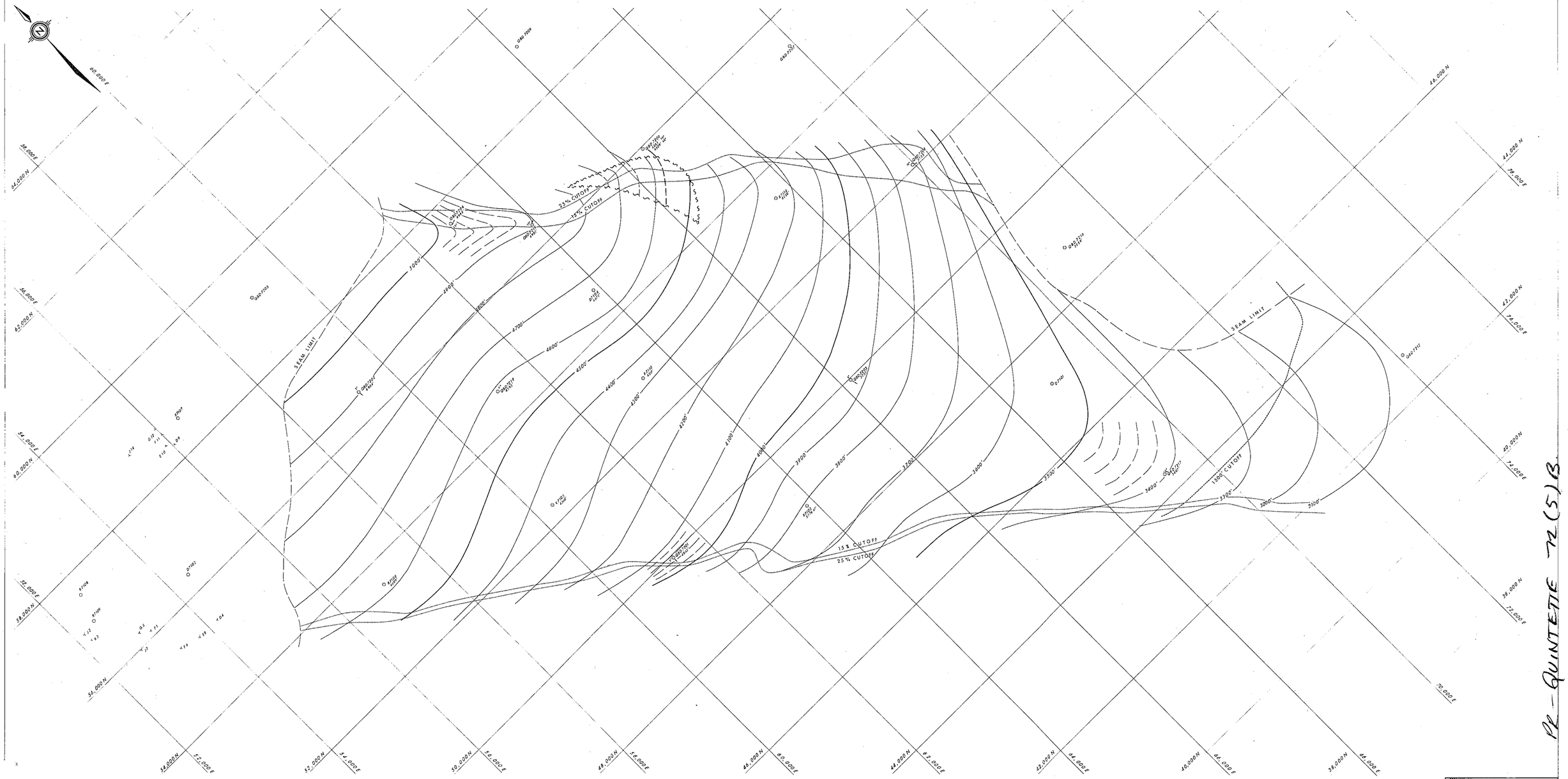
% VOLATILE (dmmf) d.b
IN 1.60 Sp. Gr. PRODUCT

PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
I SEAM

DRAWN BY	C.T.T.S.	DATE	Sept '72
SCALE	1:20000		
DRAWING NO.	BMCK 73 - 0400 - 401		



PREPARED BY
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

STRUCTURE CONTOUR MAP
"1" SEAM

DRAWN: E.T.S.Y.S.	DATE: Dec. 73	SCALE: 1/20000
APPROVED:	DRAWING NO: UNIT 73 - Cham. KSI	

12 - QUINTETTE 74 (5) 13.

SEAM CUTOFF 40'(45' AVERAGE)
SEAM CUTOFF 3FT DILUTION

25% CUTOFF

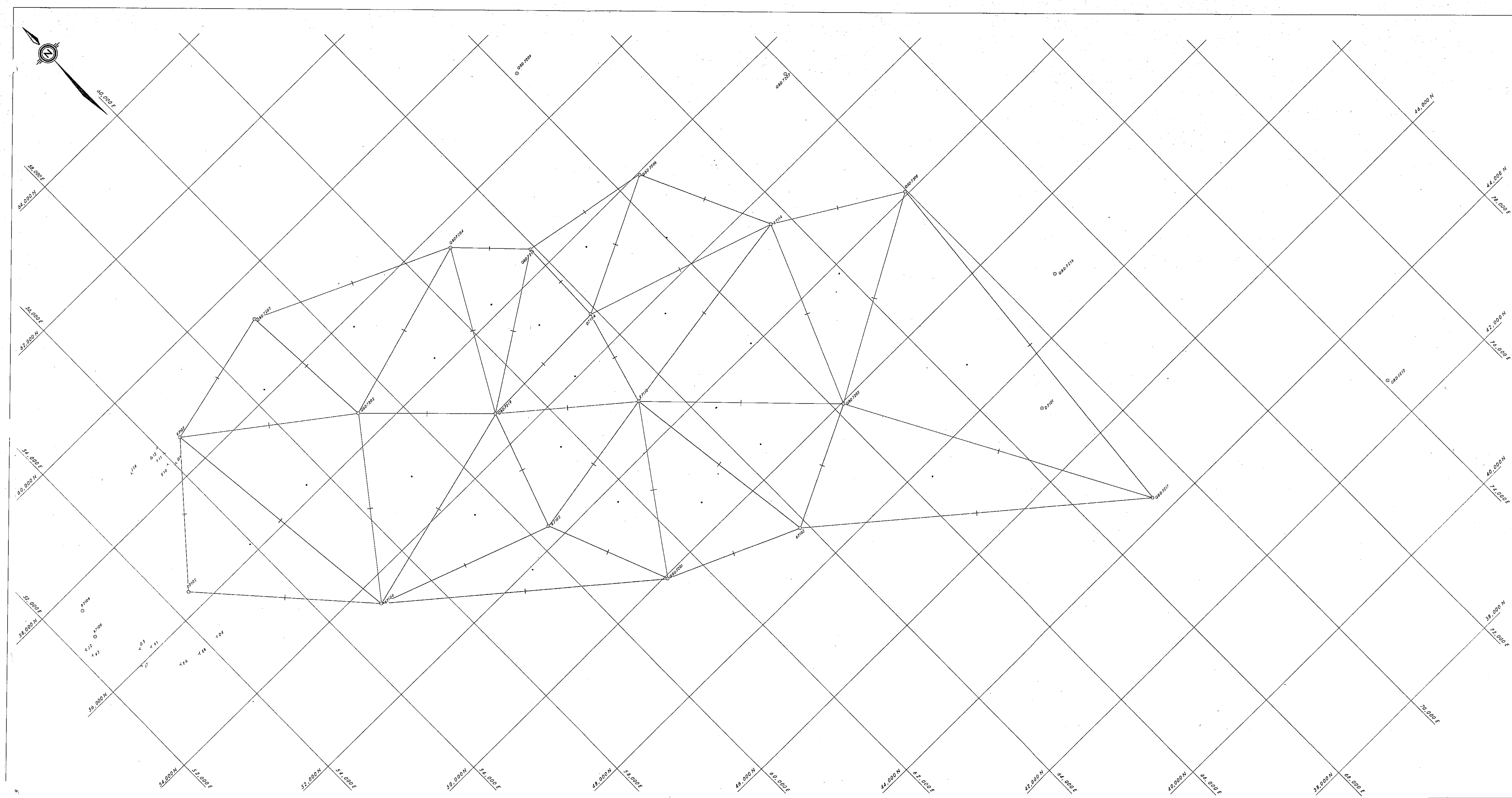
SEAM LIMIT

1590' CUTOFF

81' sectional combinations

1 SEAM - ISOPACH OF SEAM DILUTION ----------
1 SEAM - ISOPACH OF MINING THICKNESS - - - - -
1 SEAM - AREA OF INFLUENCE ——— —·— ———

RE-QUINTETTE 72(51)B.



PR-QUINTETTE 72 (5) B.

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
I SEAM NET

DRAWN BY: E. Toth	DATE: Sept '72	SCALE: 1:20000
APPROVED BY:	DRAWING NO: BBCK 73 - 0400 - R01	

F-J INTER SEAM STRATIGRAPHIC ISOPACH

C.I. = 10'

PREPARED BY
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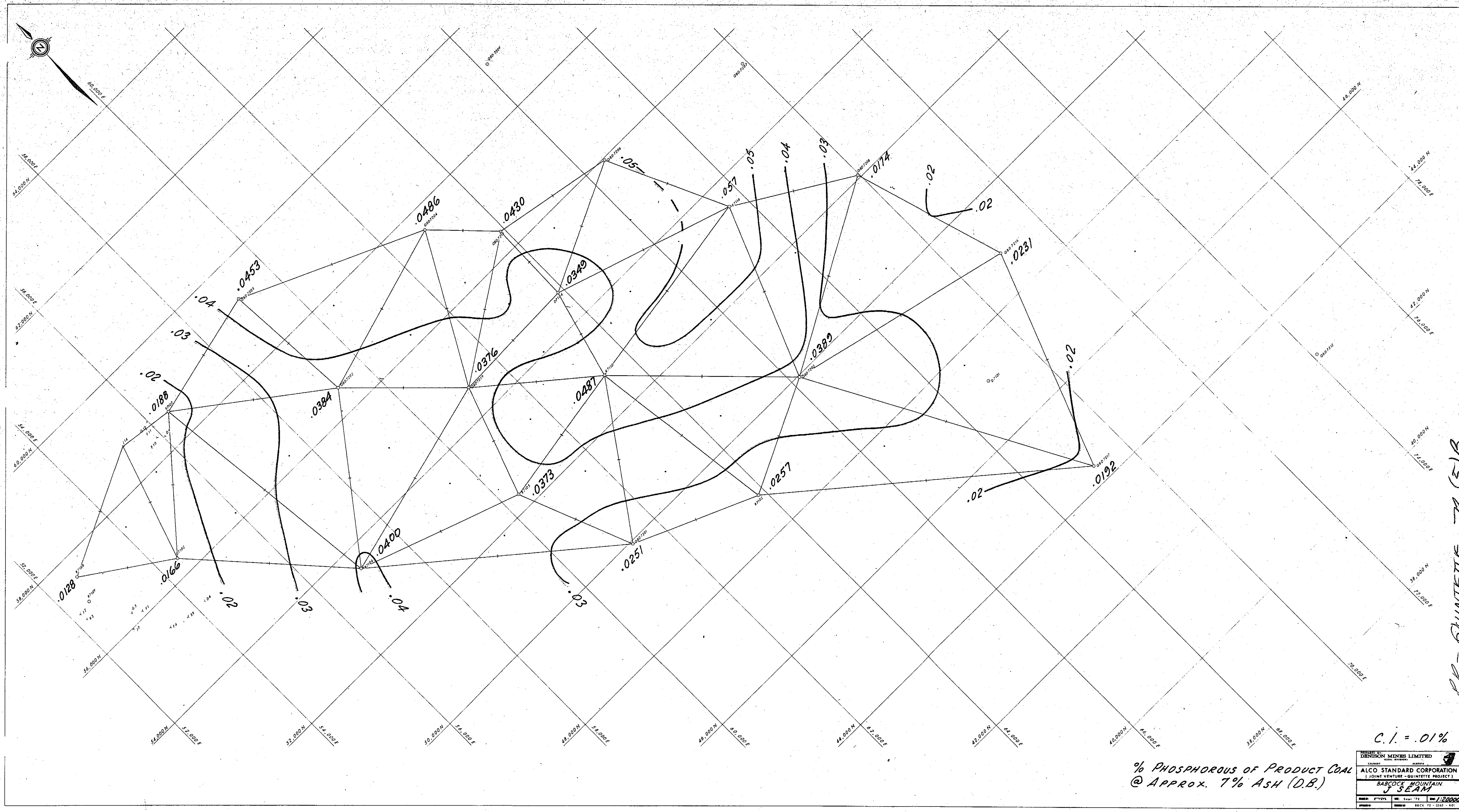
COAL DIVISION
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
J SEAM NET

DRAWN: E.T.S.T. | DATE: Sept '77 | SCALE: 1:20000
APPROVED: | DRAWING No: BBCK 77 - 0383 - R02

77 - QUINTETTE 77 (5) B.



.05
.057
.05
.04
.03
.0174
.02
.02
.0486
.0430
.0453
.0349
.0231
.04
.03
.0376
.0389
.02
.02
.0188
.0384
.0487
.0373
.0257
.0192
.02
.0400
.0251
.0128
.0166
.02
.03
.04
.03
C.I. = .01%
% PHOSPHOROUS OF PRODUCT COAL
@ APPROX. 7% ASH (D.B.)
PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)
BABCOCK MOUNTAIN
J SEAM
Sept. '72
1:20000
BBCX 72 - 0365 - R01
PR - QUINTETTE 72 (5) B.

.38 F
.26 L
.19 L
.20 F
.22 F
.26 F
.22 F
.21 F
.23 F
.16 F
.17 F
.18 F
.15 F
.29 F
.27 F
.31 F
.39 F
.16 F
.20 F
.12 L
.25 L

F = Full seam
L = Lower seam

PRODUCT SULPHUR
at 1.60 Sp. Gr.

PREPARED BY:
DENISON MINES LIMITED
CALGARY ALBERTA

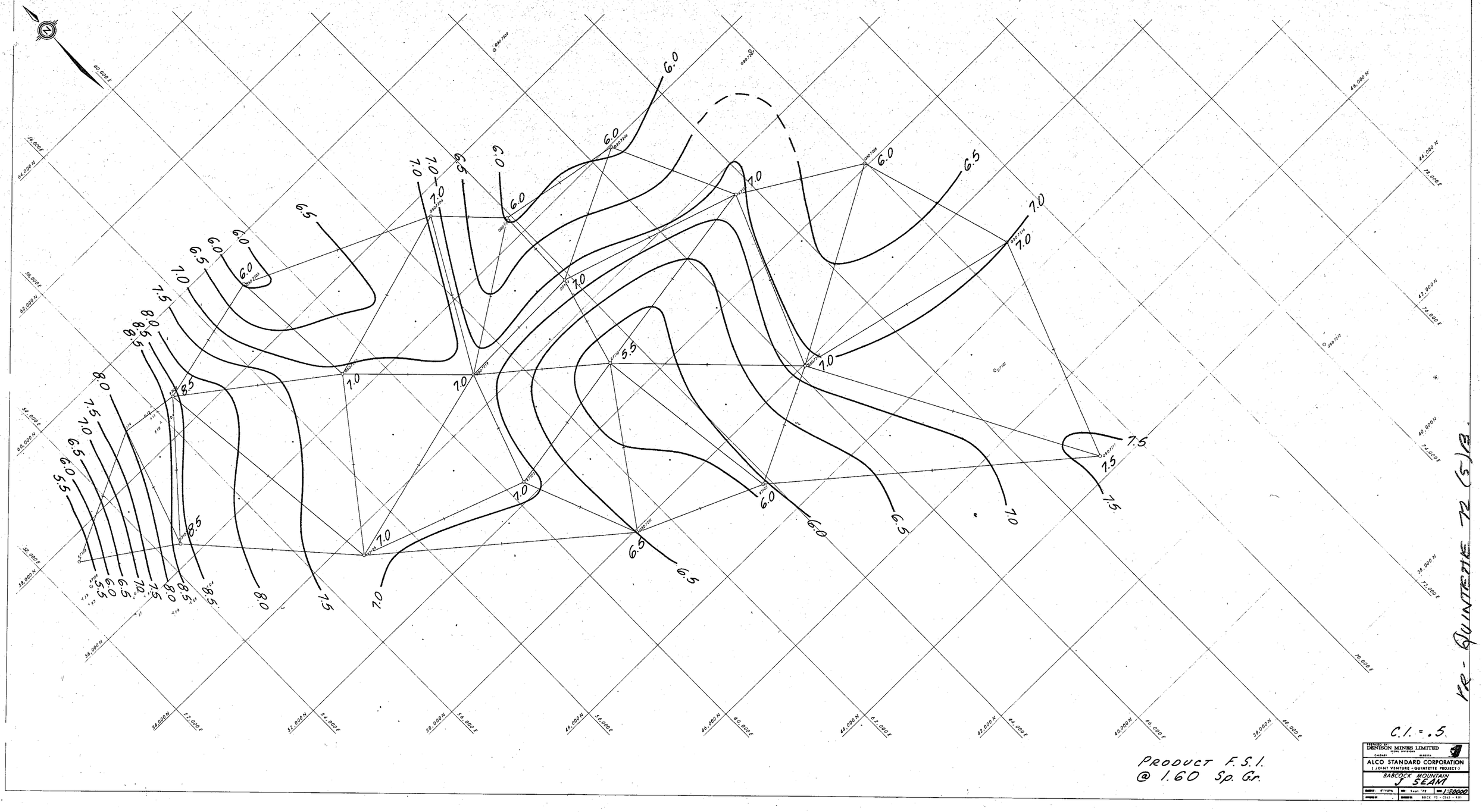
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
J SEAM NET

DRAWN: E.T.G.P.S. | DATE: Sept. '77 | SCALE: 1:20000

DRAWING: BRCK 77 - 0363 - 101

82 - QUINTETTE 22 (5) 18



C.I. = .5

PRODUCT F.S.I.
@ 1.60 Sp. Gr.

PREPARED BY
DENISON MINES LIMITED
TORONTO, ONTARIO
CALGARY, ALBERTA

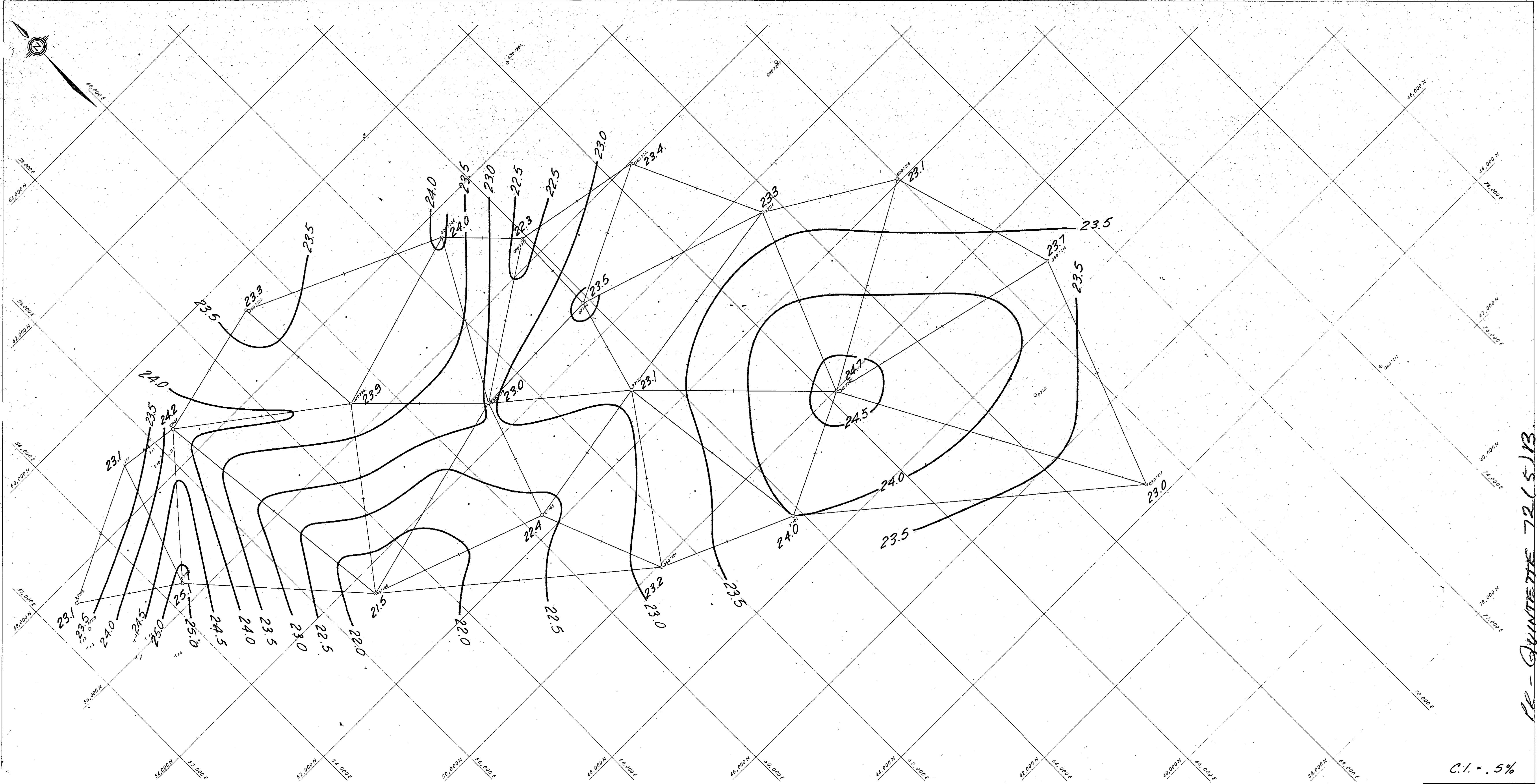
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
J SEAM

Sept '73 | 1:20000

BBCK 73 - 0343 - R01

QR - QUINTETTE 72 (5) 13



C.I. = .5%

% VOLATILE (dmmf) db
IN 1.60 Sp. Gr. PRODUCT

PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
J SEAM

Sept '72
1:20000
BBCK 72 - 0365 - R01

R- QUINTETTE 72(5)B

PRE-QUINTETTE 72(5)13

PRODUCT VOLATILES
@ 1.60 Sp. Gr.

C.I. = .5%

PREPARED BY:
DENISON MINES LIMITED
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
F. SEAM

Sept. '72 | 1:20000

EBCK 72 - 0165 #01

PREPARED BY
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

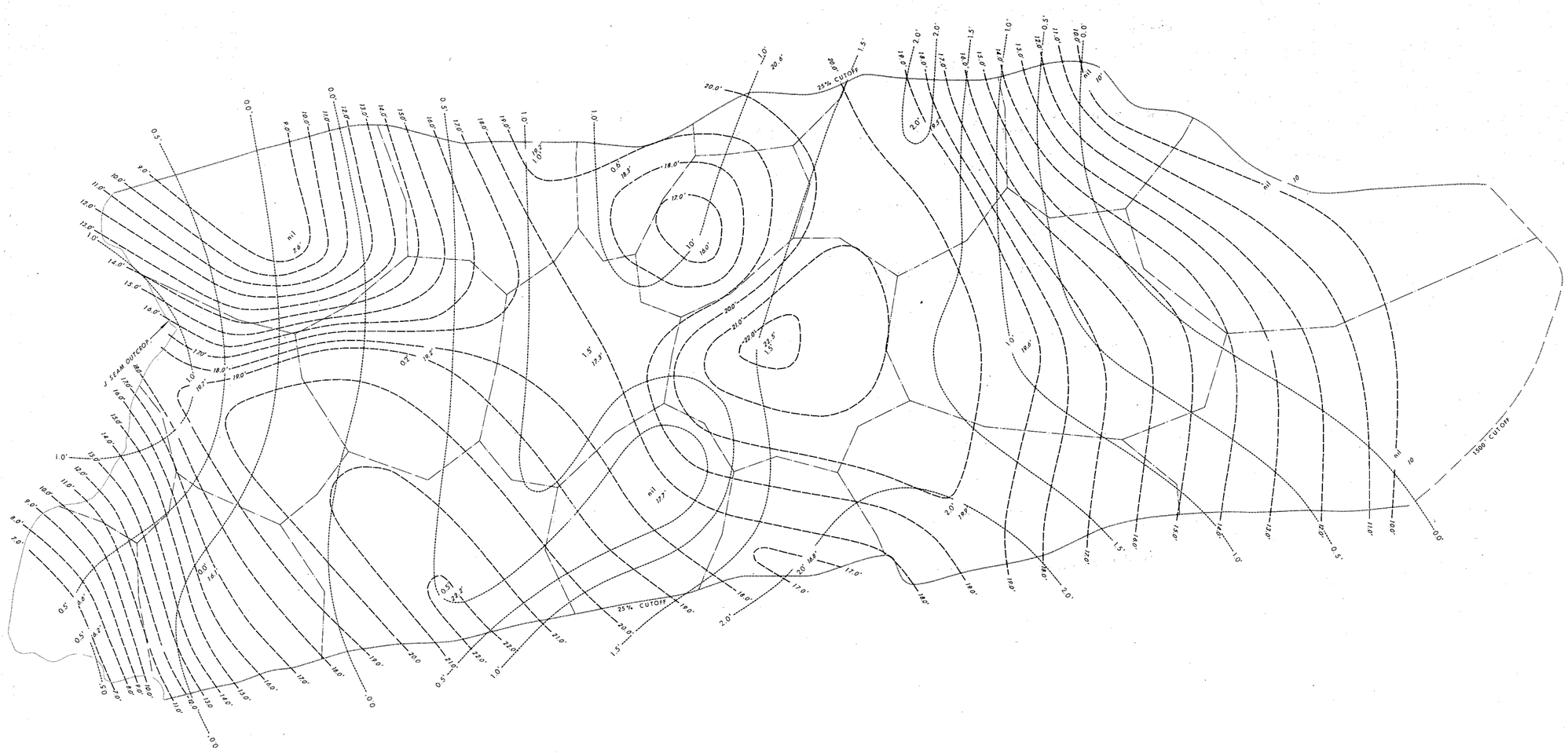
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

BABCOCK MOUNTAIN
J SEAM NET

DRAWN BY: E.T.S.T.R. | DATE: Sept. '72 | SCALE: 1:20000

DRAWING NO: BACK 72 - 0365 - R01

re - Quintette 72 (5) 15.



J SEAM - ISOPACH OF SEAM DILUTION ----------
J SEAM - ISOPACH OF MINING THICKNESS — — —
J SEAM - AREA OF INFLUENCE ——— · ———

Pe - Quintette 72 (5) 13

INTERPRETATION OF FAULTING IN THIS AREA INCOMPLETE

SEAM OUTCROP

15 % CUT OFF

25 % CUT OFF

1500' CUT OFF

NO INTERPRETATION LACK OF SUFFICIENT CONTROL

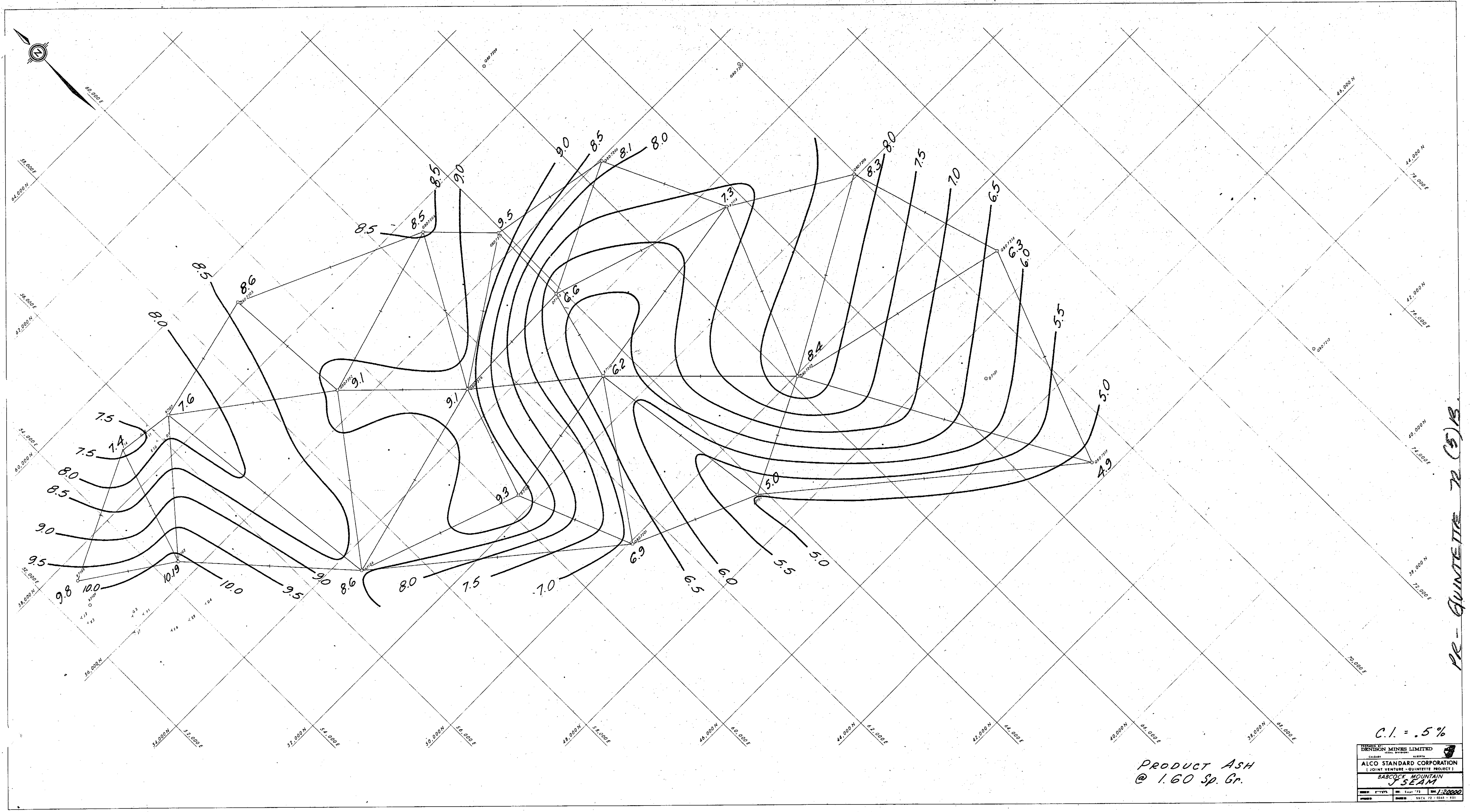
DENISON MINES LIMITED
COAL DIVISION
CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

STRUCTURE CONTOUR MAP
"J" SEAM

DRAWN BY A.C.A. DATE — SCALE 1:20000
APPROVED BY DRAWING NO. — —

K2 - QUINTETTE 22 (5) 18

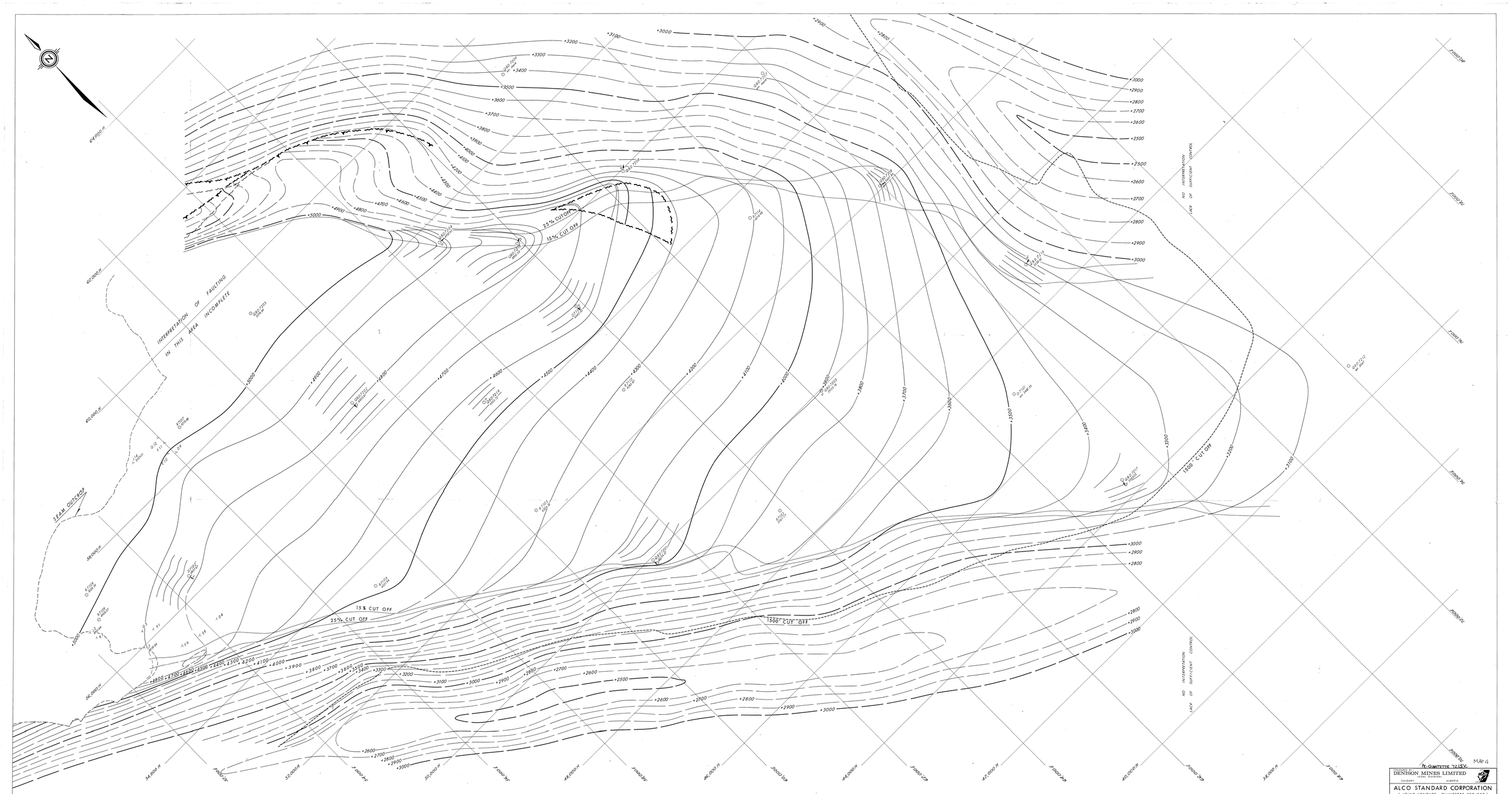

PRODUCT ASH
@ 1.60 Sp. Gr.
C.I. = .5%
PREPARED BY:
DENISON MINES LIMITED
(COAL DIVISION)
CALGARY ALBERTA
ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)
BABCOCK MOUNTAIN
J SEAM
Sept. '72
1:20000
BBCK 72 - 0365 - R01
PR - QUINTETTE 72 (5) 15

PR - QUINTETTE 72 (SIB.

C.I. = .05

SPECIFIC GRAVITY
@ APPROX. 7% ASH PRODUCT

DRAWN BY: DENISON MINES LIMITED
CLIENT: ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)
BABCOCK MOUNTAIN
J SEAM
SCALE 1:2000
SDCE 72 - 0165 - 101



MAP 4

N. QUINTETTE PROJECT

PREPARED BY DENISON MINES LIMITED (1968) SASKATOON CALGARY ALBERTA

ALCO STANDARD CORPORATION
(JOINT VENTURE - QUINTETTE PROJECT)

STRUCTURE CONTOUR MAP
"J" SEAM

DRAWN BY: AAA	DATE: Aug 72	SCALE: 1"=400'	
APPROVED BY:	DRAWING NO:	QNTT 72 - 0325 - R02	