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REPORT ON EVALUATION OF THREE SULPHUR PERMITS in the FORT VERMILION AREA, NORTHERN ALBERTA.

Prepared for

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By

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1. - INTRODUCTION

This report presents the results, conclusions, and recommendations of an evaluation of three sulphur permit areas held under option by Bow Valley Industries Ltd. The permit areas are located in the Fort Vermilion area of northern Alberta.

Following purchase of topographic maps, forest cover maps, and low order infrared air photographs at a scale of 1:31,680, Geophoto Services prepared uncontrolled air photo mosaics for each of the three permit areas on the enlarged scale of 1:15,840.

A six day field trip in November, 1967, to the Fort Vermilion area resulted in the inspection and sampling of each of the permit areas. Samples collected at this time were submitted for assay in elemental sulphur.

The air photographs were utilized to complete a terrain analysis of one permit area, No. 8, in order to determine (a) accessibility and (b) frequency of occurrence of clearings within the forested areas.

Twelve days were spent in the field in December, 1967, conducting a program of auger and core drilling using a truck mounted drilling rig. This work was performed on permit No. 8 and in an adjacent township. Auger, chip and core samples were collected and assayed. This report has now been prepared to summarize results obtained to date.

A summary economic review and a brief discussion of assay procedures are included. All assay results are (a) given in the Appendix, and

(b) plotted on the plans accompanying the report.

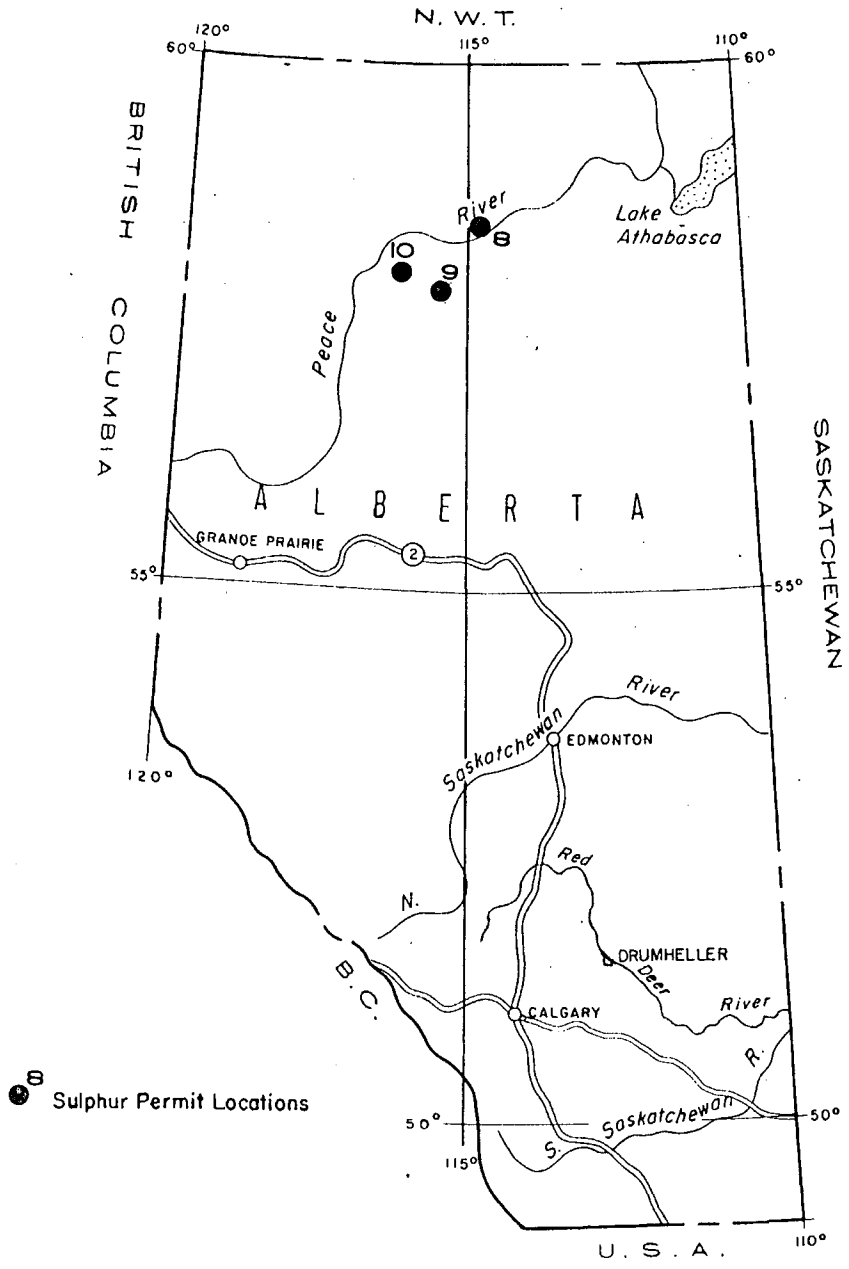

Figure 1

REGIONAL LOCATION MAP

SCALE: 1" = 130 MILES

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2. - GENERAL ECONOMIC CONSIDERATIONS

The three permit areas are located in the Peace River Valley in north-central Alberta (see Figure 1, Regional Location Map, opposite). These sulphur prospecting permits Nos. 8, 9 and 10, were granted late in 1967 to Mr. J. J. O'Connor of Calgary, with a 50% interest in them being later transferred to Madison Oils Ltd. Mr. H. L. Hunt, President of Madison Oils Ltd. conducted the field work in the summer and fall of 1967 which preceded the application for prospecting permits covering land which local Indians had known for many years to be sulphur-bearing.

The issuing of sulphur prospecting permits Nos. 8, 9 and 10 touched off a major land rush in the area. More than 150 permits have been applied for to date (each covering about 20,000 acres or 31 square miles). About four million acres have been taken up by oil and gas companies, chemical companies, mining companies and individuals, over an area lying immediately west of Wood Buffalo National Park, and situated between the Caribou Mountains to the north and the Buffalo Head Hills to the south.

This widespread interest arises from the current conditions of the sulphur market. Sulphur is in short supply in the free world and with the present high price a major discovery, such as has been envisaged in northern Alberta, is of singular importance to Canada. This country is the world's second largest producer of elemental sulphur with almost all the

output coming from big sour gas fields located in Alberta and British Columbia. Mr. H. Manley, President of Jefferson Lake Petrochemicals of Canada Limited, one of Canada's top sulphur companies, forecasts that free world consumption will rise to 33.2 million tons in 1970 compared with 25.3 million tons in 1966. Total free world sulphur output in 1966 was 24.5 million tons and estimated output in 1970 is placed at 31.7 million tons (Oil and Gas Journal, October 16, 1967).

Canadian production in 1966 was 2.04 million tons of elemental sulphur valued at $ 40.25 million; production in 1967 rose to 2.32 million tons valued at $ 70.02 million. These figures, issued by the Dominion Bureau of Statistics, show the recent increase in price of this comodity from an average $ 19.70/ton in 1966 to $ 30.25/ton in 1967. Current prices approximate $ 38 to $ 40 U.S./ton (Engineering and Mining Journal quotation, November, 1967) so for the purpose of this evaluation a F.O.B. mine price of $ 35 Canadian/ton has been adopted.

No detailed study has been done to forecast mining costs and operating returns for the exploitation of a sulphur deposit in this area of Alberta. Past mining experience would suggest that the following figures may be provisionally adopted for the preliminary study:

Mining Costs	- $ 1.50/ton
Milling Costs (steam-solvent extraction)	- $ 3.00 to $ 6.00/ton
Overhead and Administration	- $ 1.50/ton
Total Operating Cost	- $ 6.00 to $ 9.00/ton

These costs indicate that a minimum grade of 25% sulphur is required for an economical operation. Assuming a ten year life for a property, production of 30 tons / day of sulphur would require an ore reserve of approximately one-half million tons.

Sulphur permit No. 8 has therefore been evaluated within these guide lines. Assays of 15% and more in elemental sulphur are considered significant and a tonnage of half a million or more, close to surface for open pit mining, is considered desirable.

3. - THE PERMIT AREAS

Permit No. 8

This permit of 19,840 acres is located in Townships 109 and 110, Range 5, W5M, forty-five miles east-northeast of Fort Vermilion. Highway No. 58 running eastwards from Fort Vermilion approaches close to the permit area at its present point of construction in Township 110, Range 6, W5M. A private logging road continues easterly to the Wentzel River and actually passes through the northern limit of the permit area (see Plate 1).

Permit No. 9

This permit lies in Townships 100 and 101, Range 9, W5M. The 19,840 acres are centred on the intersection of the Wabasca River and the 26th Base Line, immediately east of Wadlin Lake. A new road is being constructed eastwards from Fort Vermilion and is presently stopped on the Wabasca River for bridge construction. The exact location of this road is not known but it is assumed to lie north of permit No. 9.

Permit No. 10

This permit lies in Townships 103 and 104, Ranges 14 and 15, W5M. A service road leading to the Buffalo Head Hills forestry lookout

tower crosses the northeast corner of the permit area.

The exact boundaries of the three permit areas are shown in Figures 2 and 3, copies of the lease application sketches provided by Mr. J. J. O'Connor.

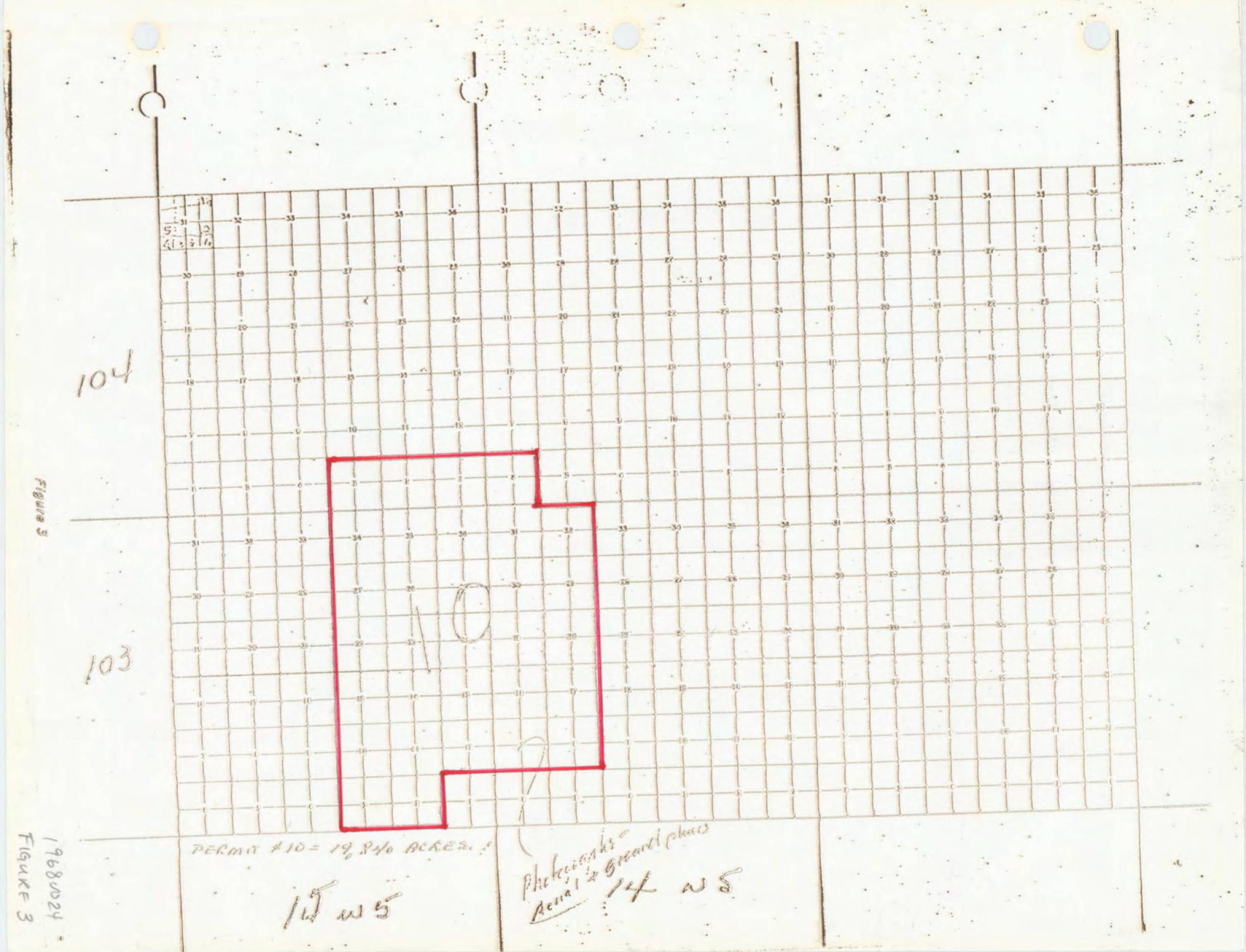

FIGURE 3

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FIGURE 3

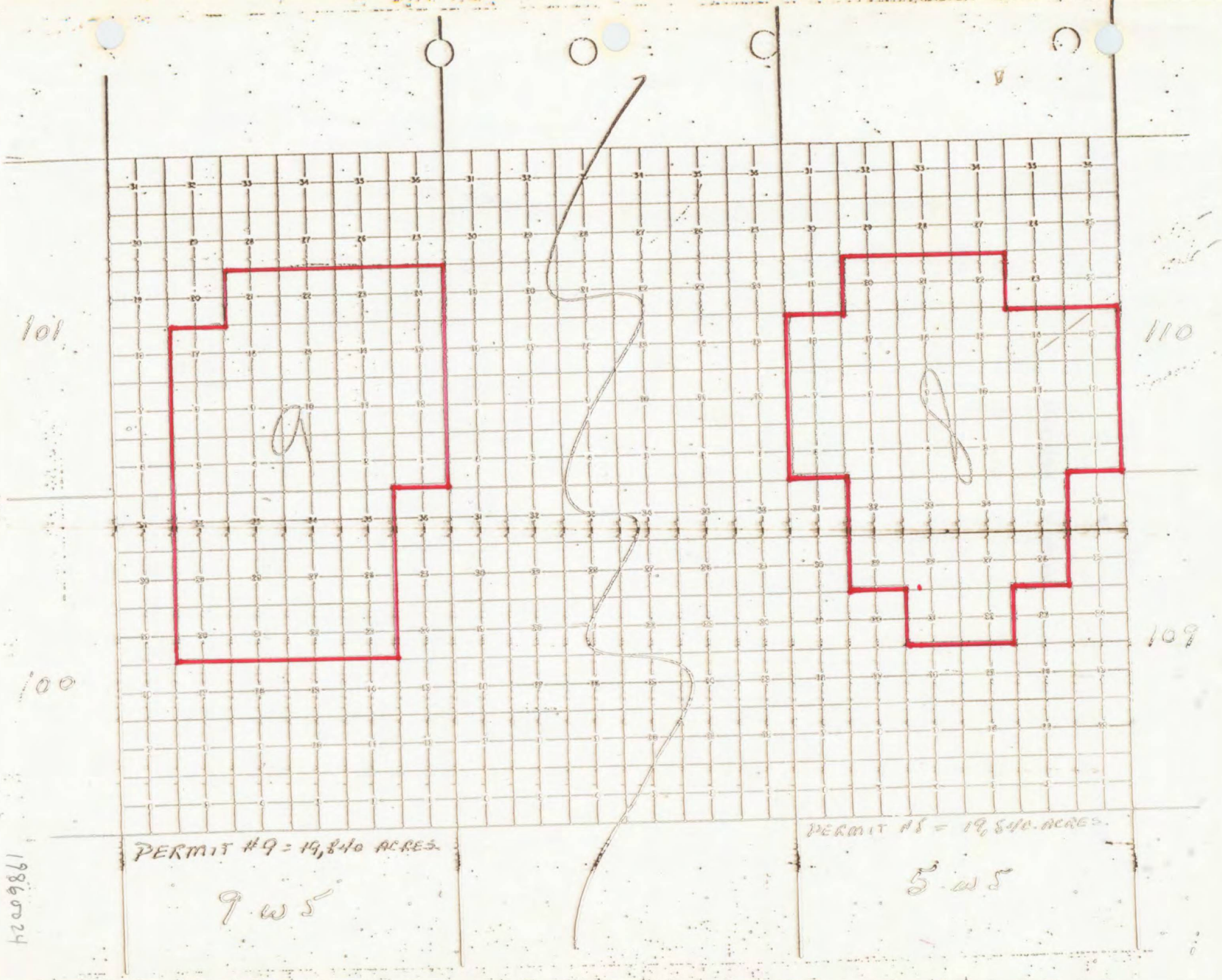

FIGURE 2

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FIGURE 2

4. - PRELIMINARY DATA SUPPLIED BY OPTIONORS

Besides providing location maps and permit application sketches for the three lease areas, the optionors Messrs. J. J. O'Connor and H.L. Hunt, handed over the following materials in support of their field investigations.

Polaroid photographs were provided showing the burning pit area on sulphur permit No. 10. It was stated that the area had been visited and the presence of sulphur had been confirmed in the burning pit. Neither samples nor assay results were offered at this time.

It was stated that sulphur occurred on permit No. 9 in slump blocks along the banks of the Wabasca River. Local Indians had served as guides to this locality but samples had not been taken.

Most of the 1967 summer field activities had taken place on permit No. 8 and a sketch map was presented (see Appendix A-1) which formed the basis for a description of the permit area. Local Indians had reportedly led Mr. Hunt to the sulphur discoveries in the northern part of the permit area. A program of power auger drilling had been completed. Several pits had been dug to expose sulphurous clay deposits at surface. Some samples had been taken and submitted for assay and the assay sheets (see Appendix A-2 to A-8 inclusive) showed sulphur values ranging from 0.58% to 89.28% elemental sulphur. A box of about a dozen samples of sulphurous clay material was supplied but due to confusion in sample numbering it was

impossible to correlate samples and assays with certainty.

In general summary, it was stated that permit No. 8 had been investigated in the field and results showed that an area of approximately 1,400 feet by 1,400 feet was underlain by sulphur-bearing clay to a depth of at least 9 feet. Not all auger holes had intersected sulphur material and apparently no holes had been assayed. Pits had been dug to three or four feet depth and these are noted on the preliminary sketch map. Most of the samples provided apparently came from these pits.

All this material was reviewed with Mr. Bebensee, Alcon Petroleums Ltd., and it was decided that, in view of the general uncertainty of the information provided, it remained only to check a few of the samples by assay before conducting an investigation in the field. Two samples were selected, previously submitted to Core Laboratories-Canada Ltd., as samples Nos. 2 and 3, and sent to Technical Service Laboratories, Toronto, as samples C2 and C3 together with a sample of "hard pan" which had not previously been assayed (sample G1). The assay results from Technical Service Laboratories, Toronto appear in the Appendix (A-9). Sample C3 was also run by Technical Service Laboratories for a thirty element semi-quantitative spectrographic analysis. This result appears in the Appendix (A-10).

5. - FIRST FIELD TRIP

Prior to the first field trip from November 16 to November 21 inclusive, the topographic maps and air photographs for the three areas had been purchased and air photo mosaics were thus available. I was accompanied on this field trip by Mr. L. Bebensee, Alcon Petroleums Ltd. and Mr. H. L. Hunt of Madison Oils Ltd., the original discoverer of the sulphur occurrences.

All three permit areas were visited and sampled but most of the work was accomplished on permit No. 8 where the more favourable showings were located. Plate 2, accompanying this report, shows the work completed on this field trip. On this plate has been plotted (by direct transfer) the data supplied on the original field sketch map of Mr. Hunt (Appendix A-1) together with the pits dug and the hand auger holes completed on this visit. The main showings may be said to be pits Nos. 1, 2, 3 and 4. Most of the other pits and power auger holes completed by Mr. Hunt were either not located or supplied insufficient evidence of sulphurous material. A rough base line was run from southwest to northeast through pits 1 and 4 and a line at right angles to it through pit 3 was also cut. These lines served as an approximate survey control in a pace location survey of the pits and hand auger holes.

Samples taken on permit No. 8 were submitted for assay to Technical Service Laboratories, Toronto, and the resulting data is plotted on

Plate 2. Weighted averages for the pits and auger holes have been calculated.

Areas of slumping on the banks of the Wabasca River were visited on permit No. 9. The slump material, reported to contain blocks of sulphurous clay material similar to that seen on permit No. 8, was under a foot of snow which prevented detailed examination. At no point in the slump ground was any sulphurous material noted beneath the snow. The river bank was climbed and two samples taken for assay. Sample T19 represents a black shale occurring in the upper part of the river bank. Sample A39 is a yellow clay material occurring in small seams and pockets both in and above the black shale horizon.

The burning pit on permit No. 10 was also visited by helicopter. Four samples were taken. Sample T20 is a specimen of ripple-marked "fire clay" which was picked up in the burning shale area. Sample T21 is black shale which forms most of the slump material within the burning pit. Sample T22 is a specimen of yellow streaked shale from the base of the cliff section. Samples A40 and A41 are selected fragments of black shale coated with sulphur crystals.

6. - RESULTS FROM FIRST FIELD TRIP

Permit No. 8 Sampling

In view of the uncertainty arising over the location and the assay of samples provided by the optionors, it was decided that the field work on this permit would be designed to accurately evaluate its potential. The pits dug by Mr. Hunt were still open so two of them were selected (Nos. 1 and 3), cleaned out and resampled. In addition, hand auger holes to a depth of approximately four feet were sunk in their bottoms. Four additional pits were dug and auger holes were sunk in three of these (see Plate 2). Two survey control lines, at right angles and centred on pit No. 3, were used to control the set of hand auger holes which were driven and sampled to allow appraisal of the overburden not only under open clearings but also within the tree covered areas.

All the pit and hand auger samples collected on permit No. 8 were submitted for assay to Technical Service Laboratories, Toronto (see Appendix A-11 to 13). The assay results have been plotted on Plate 2 and weighted averages calculated for both pit and auger sampling.

The following conclusions were reached:

1. Sulphur does occur in significant quantities at the surface on permit No. 8, but not to the extent originally propounded by the optionors. Pits 1, 2, 3 and 4 sunk in open clearings

expose sulphurous clay material which assays in excess of 15% sulphur to a depth of approximately four feet as shown by the resampling of pits 1 and 3 and the auger hole G-8 put down at the side of pit 2.

2. It is possible that the sulphurous clay material does not persist to any depth in view of the assays obtained from hand auger samples taken below the level of the pits. A sharp drop-off in assay value in apparent in this auger sampling but, it is conceded, this may be partially due to the small size of sample taken by the hand auger.

3. No samples taken outside of cleared areas show significant sulphur assays. Even in the case of pit G-9, which was sunk at the eastern boundary of a cleared area northwest of pit 3, low sulphur values were obtained in spite of its location a few feet from a power auger hole which was reported to contain good sulphur material. Note that the hand auger holes drilled southeast of pit 3 return no significant sulphur content until the most southeasterly hole (G-14) is reached. This hole was drilled in a gulley devoid of vegetation and connecting two small clearings.

4. Some data was obtained which suggests a working hypothesis as to the origin of the sulphur material. In the case of pit 1,

the hand auger penetrated a black liquid mud which liberated hydrogen sulphide gas in sufficient quantities to permit a small flame to be maintained for some period of time. Also there is a close connection between the presence of significant quantities of sulphur and the absence of vegetation. Where high sulphur assays were obtained close to surface, vegetation was non-existent except for short grass. The presence of gas and water beneath open clearings suggests that there could be a close link between the percolation of hydrogen sulphide gas (or gas-charged water) through the overburden and the deposition of secondary sulphur in toxic quantities.

Permit No. 9 Sampling

Only two samples were collected on permit No. 9. Sample T19 is typical of the black carbonaceous (?) Cretaceous shale in this area which would be expected to show a low sulphur content (assay result in Appendix, A-14). Sample A39, yellow clay material typical of small seams and segregations near the top of the black shale horizon and below the overburden, was sent out for assay and returned 11.65% elemental sulphur. This sample was also submitted to University of Calgary for qualitative analysis by Xray fluorescence spectrograph. The instrument is calibrated to detect those

elements of atomic weight greater than potassium. The only significant element detected was iron and it is therefore concluded that the sample is probably a variety of limonite (or siderite ?) and the sulphur content probably represents secondary deposition from the enclosing carbonaceous shales.

Permit No. 10 Sampling

The burning pit, the area of interest within this permit area, was visited by helicopter and closely inspected. Snowfall at the time was not a handicap. A cliff section on the west bank of a northerly flowing tributary stream exposed a good section of Upper Cretaceous shales capped by a few feet of overburden. Large blocks of thinly bedded black shale had slumped towards the stream bed and appreciable quantities of steam were emanating from them. At the same time, smoke (or steam ?) was seen to be issuing from one section of the cliff face. Most of the material in the slump area was black shale being slowly converted (after spontaneous combustion of the slumped blocks) into buff and red shale and ash. Four samples of shale material were collected. At no place was clay material observed similar to that seen on permit No. 8.

Sample T20 was of a ripple-marked block of shale which had undergone complete combustion. This sample was collected purely for specimen purpose. Sample T 21 is typical of the black shale material found

in the slumped blocks while Sample T22 is representative of black shale from the base of the cliffs section which had been stained on the bedding planes by a yellow ochre deposit. Samples A40 and A41 were bags of typical black shale encrusted with sulphur crystals which had been deposited at surface adjacent to vents from which steam was, or had been, issuing.

Samples T21 and T22 were submitted for assay. Both returned low sulphur content. The ash content of Sample T 21, suspected to be a carbonaceous shale, was approximately 91% (see Appendix, A-14).

No local assay firm was capable of assaying Sample T21 to determine if it was a carbonaceous or bitumous shale. The sample was therefore submitted to the Geological Survey of Canada, Calgary, but it could not be referred to the stratigraphic section with any detail by geologists acquainted with this area. The Research Council of Alberta returned the opinion (see Appendix, A-15) that the shale probably comes from below the base of the Dunvegan Formation, the sandstone horizon which caps the Buffalo Hills in this locality. Therefore the black shales are part of the Shaftesbury Formation (Upper Cretaceous age).

Sample T22 which assayed low in sulphur was submitted to the University of Calgary for identification of the yellow material associated with the black shale. X-ray diffraction techniques identified the mineral as carphosiderite ($3Fe_2O_3.4SO_3.7H_2O$?), a hydrated ferric sulphate of little economic value (see Dana-Ford, 1932, p. 767).

Photo Interpretation Studies

As previously mentioned, air photographs had been purchased to permit preparation of air mosaics covering each of the three permit areas. This photography is at a scale of 1:31,680 and it was flown between 1963 and 1967 using low order infrared film.

The first field trip suggested that the occurrence of sulphur on the permit areas may be attributed to differing modes of occurrence. In the case of permit No. 8, the sulphur-bearing clays on surface overlie either the easterly limits of the flat-lying Cretaceous strata in this part of the Peace River Valley or the westerly-dipping Paleozoic sediments which are exposed along the Peace River eastwards from Vermilion Chutes to the Precambrian Shield (see G.S.C. Memoir 313). Sulphur occurrences on permits Nos. 9 and 10 however, are related to carbonaceous shales of Upper Cretaceous age exposed on the banks of streams and rivers flowing north from the Buffalo Head Hills. The sulphur is regarded as secondary deposition resulting from the action of groundwaters or, in the case of the burning pit on permit No. 10, from gasses resulting from spontaneous combustion of slumped shale blocks and freshly exposed shale on stream banks.

On permits Nos. 9 and 10 it is suggested that the sulphur, because of its origin, will not occur in economic quantities. The permits could be prospected after the snow cover has melted for concentrations of

sulphur occuring in slumped areas, but the prospects of finding sulphur in economic quantities is rated poor.

On permit No. 8 the close relationship between concentrations of sulphur near surface and the absence of vegetation, probably resulting from the toxic nature of the soil, suggested that the best approach in evaluating this permit would be to explore any clearings within the tree cover in an attempt to repeat the sulphur concentrations present in the pits shown on Plan 2.

Additional air photographs were purchased to cover townships adjacent to permit No. 8 and a large mosaic at a scale of 1:31,680 was prepared. The photos were then studied stereoscopically.

Firstly, a terrain analysis study was carried out over the permit area. This study classified types of vegetation cover, defined clearings, and noted trails, seismic lines, and drainage patterns. The results of this terrain analysis study were annotated on a 1:15,840 air photo mosaic of the permit area, while the clearings annotated were classified according to type and transferred to the large 1:31,680 scale mosaic. Selected portions of the townships west of permit No. 8 were then studied stereoscopically and all clearings and scarp features annotated. These details were transferred to the 1:31,680 air photo mosaic.

A summary report prepared by the geologist conducting the terrain analysis study, appears in the Appendix (A-16 and 17).

Accepting that the presence of sulphur is probably dependent on the decomposition of calcareous material by hydrogen sulphide gas or hydrogen sulphide-charged ground water, it is possible that a study of the fracture pattern present on the permit No. 8 air photos could be utilized as a guide to further prospecting activities. The 1:31,680 scale air photo mosaic of the permit area was therefore studied and lineaments were annotated according to general northeasterly and northwesterly orientation. From this annotation a gross lineament density overlay was prepared which, when read in conjunction with the distribution of clearings, leads to a hypothetical distribution pattern assumed to be related to fracturing in the bedrock.

The photo interpretation studies were purely experimental and conducted in an attempt to define possible courses of action in further prospecting. Copies of the results do not accompany this report but are returned to Alcon Petroleums Ltd. separately. This preliminary work does point out that, if serious prospecting is to be attempted, further detailed studies of forest clearing distribution may be extremely useful.

Further Data from the Optionors

Following the receipt of assays of samples taken on the first field trip, a meeting was arranged in the offices of Mr. J.J. O'Connor. Present were Mr. J. J. O'Connor, Mr. H. L. Hunt, Mr. L. Bebensee and myself.

When, in the course of the discussion, the results of the work on permit No. 10 were reviewed, Messrs. O'Connor and Hunt produced a box of samples which they stated had been collected on permit No. 10 during the fall of 1967. Mr. Hunt also provided from his field notebook a sketch map showing the locations of samples collected in the base of the burning pit on this permit area. The box contained eleven samples, all of clay material ranging in colour from dark brown through buff to light grey. A rough sketch map in the bottom of the box showed a square with 100 yard sides, at the corner of which the samples appeared to have been taken. The numbering of these samples corresponded to that in or on the eleven sample bags. The field sketch provided by Mr. Hunt, however, showed that the samples had been collected along a traverse which ran from the northeast corner of the burning pit area along the base of the cliff to the southwest corner, then back northeastwards across the burning slump blocks themselves.

At the time of the first field trip, there was only light snow cover in the burning pit and most, if not all, of the material present was black shale. In some parts of the pit this shale had undergone almost complete combustion and had been reduced to an ash; but in no place was clay noted. Mr. Hunt stated, at the meeting, that he was in possession of this field sketch at the time of the inspection of the burning pit on the first field trip; but since he had not been asked, he had not pointed out the locations where these clay samples had been taken.

The eleven samples were sorted out and nine of them could be related to the four corners of the 100 foot square grid shown on the sketch map accompanying the samples. Each sample was tested for sulphur content by burning them over an open flame. One sample showed slight smoke and a sulphurous smell, three samples contained sufficient sulphur to support a blue flame, while the remainder of the samples tested negative.

This new material suggested that, if it had been collected on permit No. 10, the burning pit area may contain not only black carbonaceous shale, which on combustion could deposit traces of sulphur, but also lenses or beds of sulphur-bearing clay. A second visit to the burning pit therefore became imperative.

Conclusions

In summary, the first field trip suggested that permit No. 8 contained overburden material at surface which assayed significantly in elemental sulphur. Test pitting and hand augering suggested that this sulphurous material was confined to areas clear of vegetation and did not occupy a 1,400 foot by 1,400 foot area as had been stated originally by the optionors. Further work on permit No. 9 and permit No. 10 did not appear warranted until such time as the snow cover disappeared in 1968. However a further examination of permit No. 10, in spite of the snow cover, may lead to signs of clay deposits which would substantiate the new batch of

samples produced by the optionors.

It was also decided that a small drilling program should be mounted on permit No. 8, using a truck-mounted drilling rig, which would try to define the presence of sulphur at depth and the possible extension of the sulphur-bearing overburden to other parts of the permit area. A survey would also be run from the logging road in the north of the permit area to the clearing sampled on the first field trip so that some measure of control could be obtained should the drilling program continue for any length of time. It was also agreed that a second visit should be paid to permit No. 10 and, depending on the snow cover, a careful search would be made for clay-type material both in the base of the burning pit and in the cliff face to the west.

7. - SECOND FIELD TRIP

Sedco Drilling Company Limited moved a survey crew complete with six-man trailer into the Fort Vermilion area in early December. This party was supplied with one inch to one mile forest cover maps and instructed to establish a winter road into permit No. 8 from the present logging road (the easterly extension of Highway 58), to survey this road location into the clearings where the sample pits were located, to establish survey control over the pits, and to dig a sample trench to approximately four-foot depth right across the open clearings in the vicinity of pit 3.

Two Geophoto geologists were in the field from December 11 to December 22 inclusive to supervise the above work and the drilling program. Firstly, permit No. 10 was revisited by helicopter on two successive days and the burning pit, the cliff face, and the hill top above the cliff face were closely investigated for sulphurous clay occurrences. Snow cover was heavy but the northern part of the burning pit was investigated as close as possible to a location, taken from the field sketch map of Mr. Hunt, where a clay sample was reported to have been taken. The only material found in this locality was black carbonaceous shale. A sample was taken (T23) but it is essentially similar to Sample T21. The top part of the cliff face immediately above the slump area was inspected and sampled. Sample A42 represents a two to three foot horizon of soil with roots. Sample A43

represents a three foot shale horizon below the soil horizon. Shales underlay this section but were not accessible. A third sample A44 represents some yellowish clay inclusions which were sparsely distributed through the shale horizon. At no point were sulphurous clays seen which resembled the samples collected by Mr. Hunt but, it should be emphasized, snow cover was appreciable and a thorough inspection was impossible.

Surveying on Permit No. 8

The Sedco survey party established a road connecting the sample area shown on Plate 2 with the logging road to the north. The location of this winter road is shown on Plate 1. The logging road from the point where it leaves Highway 58 in Township 110, Range 6 W5M, to where it crosses the Wentzel River is shown as an approximate location. This data was obtained from Department of Lands and Forests office in Fort Vermilion — no official highways survey exists for this private road. The survey was brought into the pit area and permanent hubs established. Location of these hubs is shown on Plate 3. The cut lines which were used for control on the first field visit were bulldozed out to a 40 foot width. Plate 3 shows location of all pits and hand auger holes put down by Geophoto, the trench dug across the clearing of pit 3, and the location of drill holes completed with the heavy drill rig. The pits and power auger holes put down by the optionors have not been repeated on this plan.

Trenching

A trench was excavated, nearly four feet deep, in a southeast to northwest direction across the location of pit 3. This trench was sampled at five foot intervals with particular attention being paid to the varying types of clay occuring in the trench. Because of the frozen ground these samples were channelled and are therefore considered to be truly representative of the material present. The section of the trench, with exaggerated vertical scale, is shown in Plate 4 together with sample numbers, sample widths, and assays for elemental sulphur. Also noted are the boundaries of the original clearing in which pit 3 was located. It is to be noted that significant sulphur assays do not occur outside the limits of the original cleared area. Note that pit 3 was not resampled – the assays shown on Plate 4 are those obtained from the sampling done on the first field trip.

Core Drilling Program

Sedco Drilling Company Limited moved in a truck-mounted oil drilling rig of medium capacity to perform the drilling to bedrock on permit No. 8. The drill was equipped for auger sampling, bedrock drilling by non-coring bit, and bedrock drilling with coring bit.

The drilling program was designed to

(a) discover depth of overburden in the clearing area,

(b) core the immediate bedrock to determine the Paleozoic

strata present, and

(c) determine the distribution of sulphurous clay material not only in the cleared areas but also in bush-covered areas of the permit.

Drill holes D-1 and D-2 were put down to bedrock in locations adjacent to pits 3 and 1 respectively. Drill holes D-3, D-4, D-5, and D-6 were located 450 to 500 feet from pit 3 near the extremities of the survey control lines centred on pit 3. Each of these four drill holes was also taken to bedrock. The drilling was then extended further afield, by a succession of holes along the winter road and along the logging road out to Highway 58. Drill holes D-7, D-8, D-9, D-10 and D-11 are shown on Plate 1. The drill rig returned to the clearing area to drill two further holes. D-12 was drilled approximately 1,100 feet southwest of drill hole D-3 and its location is shown on Plate1. Drill hole D-13 was drilled 170 feet northeast of drill hole D-4 and its location is shown on Plate 3.

In general, samples were taken in each of the drill holes at 2 to 6 foot interval with the auger bit until the ground either became too hard, too wet, or too sandy for good samples to be recovered. A conversion was then made to a non-coring bit and the hole was carefully flushed each time before a sample of cuttings was taken. Boulders were struck in two or three holes and these were cored through. Careful check of the samples taken with the cutting bit permitted accurate determination of the location

of bedrock and this was greatly assisted by the presence of a distinctive green coloured, argillaceous sand which normally occurred immediately above bedrock. In drill holes D-1, D-3 and D-4 the bedrock was cored to obtain representative samples of the Paleozoic strata. Plate 5 shows the data obtained in the drilling of the thirteen holes. Sample numbers, sample widths in feet, and elemental sulphur assays are shown together with diagrammatic presentation of the beds penetrated and the type of drill bit employed.

The drill program concluded after the drilling of thirteen holes and the drill rig and bunk house trailer were stored in High Level pending further developments. More than 250 samples were obtained in this program and the samples were returned to Calgary for inspection and assay.

8. - RESULTS FROM SECOND FIELD TRIP

Review of Assay Procedures

Samples collected on the first field trip were assayed by Technical Service Laboratories, Toronto, because this company is one of the leading assayers in Canada and in the past has performed satisfactorly for Geophoto Services in their mineral exploration programs. The optionors had used local firms for their assaying — Crest Laboratories Ltd. in Edmonton and Core Laboratories-Canada Ltd. of Calgary. A fourth assay company, Chemical and Geological Laboratories Ltd., of Calgary and Edmonton, was also reported to be experienced in the field of sulphur assaying.

In discussions with the first three assay offices mentioned above, it was apparent that discrepancies could occur unless it was specifically stated as to what type of sulphur assaying was required. Assays for <u>total sulphur</u> included elemental sulphur present plus sulphur present in the form of sulphides and sulphates. An assay for <u>elemental sulphur</u> reported elemental sulphur only and it is this sulphur that would be recovered in a milling process established on a deposit similar to the type envisaged in permit No. 8. Relative cost between different assay offices for sulphur assays in quantity was determined.

Check assaying was run by selecting four samples and submitting

these to three separate assay offices. Samples T6, T7 and T18 were selected from material obtained on the first field trip and to these was added a further sample, designated L2, which was one of the group of samples originally provided by the optionors. This latter sample was assayed by Crest Laboratories as client sample No. 2 (Lab No. 977-2) and reported 75.8%S. The assay sheet of Crest Laboratories Ltd. for this sample appears in the Appendix (A-8).

Results of the check assay procedure are shown in the Appendix (A-18) together with the appropriate assay sheets of the laboratories concerned (A-19 to A-21 inclusive). Generally speaking, there is little discrepancy between assay offices. In the case of Chemical and Geological Laboratories Ltd., Mr. W. M. Morrison stated he had devised a method, based on past experience and using special solvents, which would extract more elemental sulphur than that obtained by standard assay procedures. The results show, however, that for exploration purposes there is no significant increase in sulphur content when using this special method. Cost per sulphur assay varies slightly between assay offices and for an appreciable number of samples the lowest price was obtained from Chemical and Geological Laboratories Ltd. Therefore, 262 samples obtained on the second field trip were submitted to this assay office and results appear in the Appendix (A-22 to A-25 inclusive).

Results of Trenching

The sampling completed on the 92 ft.-long trench dug on permit No. 8 is shown on Plate 4. Weighted averages have been calculated for those sections which show significant sulphur assays.

At the time of sampling the trench it was noted that the more sulphurous looking clay material occurred between sections 9 and 11 and it was in this area that a sulphur smell was most prominent. To the northeast and to the southeast of these sections the clays exposed in the trench were brown and purple speckled rather than light yellow and buff.

It is concluded that

(a) significant sulphur values occur only within the original clearing area and therefore the link between appreciable quantities of sulphur and the absence of vegetation is substantiated,

(b) where brown clays are exposed, both in the areas covered by vegetation and at the edges of the clearings, sulphur content is low, and

(c) the disposition of yellow sulphur-clay in narrow vertical bands supports the contention that the sulphur results from secondary deposition by percolating hydrogen sulphide gas or gas-charged ground water.

Results of Drilling Program

Twelve drill holes were put down on permit No. 8 and one hole on an adjoining permit area in Township 110, Range 6, W5M. Location of these thirteen holes are shown on Plates 1 and 3 while Plate 5 shows sections of each of the drill holes.

Drill hole D-1, collared 25 feet northeast of pit 3, cut 25 feet of brown clay followed by a distinctive green-colored argillaceous sand to bedrock at 41 feet. Pale green, vuggy, argillaceous limestone was cored from 41 to 51 feet. The brown clay occurring in D-1 plus its low assays in sulphur are considered highly significant in view of the close location to pit 3. The high grade sulphurous material in pit 3 and the adjoining sections sampled in the trench apparently do not persist over any appreciable area.

Drill hole D-2 was collared within a few feet of pit 1 and again, brown clays followed by greenish sand were encountered above bedrock at 35 feet. The limestone bedrock was sampled with a cutting bit from 35 to 37.5 feet. The light colored clay cut in the first 6 feet of this hole assayed high in sulphur and the values are comparable with those obtained in the sampling of pit 1. Gas and water did not occur in this hole.

Drill holes D-3, D-4, D-5 and D-6 were drilled at the extremities of the survey lines, each hole being located approximately 450 to 500 feet from pit 3. All of these four holes were collared in previously bush-covered

areas. Bedrock was encountered in the holes between 33 and 35 feet and in each instance the distinctive greenish sand was present above the bedrock surface. All samples taken returned low values in sulphur.

Drill holes D-7, D-8, D-9, D-10, D-11 and D-12 were all drilled at appreciable distances from the pit clearings with the purpose of determining if sulphurous material was present in other parts of the permit area or adjacent lands. Bedrock was encountered at varying distances from 48 to 84 feet down drill holes D-7 to D-10 inclusive. D-11 was finally abandoned in brown clay at 140 feet due to difficulty in re-entering the hole repeatedly through several granitic boulders. All of this drilling yielded low sulphur values except for one sample in D-11 from 30 to 36 feet (assay 21.4% S.). This value may be of significance but, following receipt of the assay, a retained portion of the sample was checked by burning over an open flame and no trace of sulphur could be detected. For the time being, the assay is regarded as suspect. The sample has been submitted to Core Laboratories-Canada Ltd. for check assay.

Drill hole D-12 is located 1,200 feet southwest of the cleared area on a slight rise of ground bordering a large open clearing of muskeg. The hole was taken to 23 feet to check for presence of sulphur near the surface but the sampling shows low values only.

Drill hole D-13 was put down in a muskeg area southeast of pit 3 to check if a line of natural surface drainage, from the sulphurous clearing

southeastwards towards Dummy Creek, was also a line of sulphur-bearing overburden. The hole was taken to 21 feet but no significant values in sulphur resulted.

In summary, this drilling program of thirteen holes is considered to be an adequate testing of the critical area on permit No. 8 together with an adequate "wildcatting" of varying types of terrain in the northern part of the permit area. Bedrock occurs reasonably close to surface in the permit area and it is reasonable to assume that the source of hydrogen sulphide gas lies in the underlying Paleozoic limestones. The reconnaissance Geological Survey of Canada mapping (see G.S.C. Memoir 313, figures 3 and 12) shows the permit area to be underlain by the lower limestone member of the Mikkwa Formation of Upper Devonian age. The description in the Memoir (pp. 132 - 136) of the Upper Devonian strata exposed along the Peace River to the south of the permit area, suggests that the Mikkwa Formation probably underlies most of the permit No. 8 area. The limestone cored in the drilling program is not sufficiently diagnostic to confirm that the Mikkwa Formation was cut. The possibility also exists that, by change of strike and dip or by a local high in the subsurface, the Grossmont Formation may have been intersected.

9. - CONCLUSIONS AND RECOMMENDATIONS

A - Conclusions

This report evaluates all the work done on the permit areas Nos. 8, 9 and I0 to the end of I967, together with assay results received by February 8, I968. The following conclusions are made.

I. Sulphur does occur on the permit areas, as claimed by the optioners, but not necessarily in economic quantities. Since the conditions of deposition of sulphur vary between permit No. 8 and the other two permits, the economic significances of each area is different.

2. Permits 9 and I0 would appear to contain, on preliminary investigation, secondary sulphur in local, uneconomic amounts resulting from ground water percolation through and combustion of, black carbonaceous shales of upper Cretaceous age. While it is conceded that more detailed examinations after the snow cover has cleared may show the presence of sulphur masses, the geological setting is such that sulphur deposits of significant grade and appreciable tonnage are not considered likely.

3. Sulphur occurrences on permit No. 8 appear to be related to secondary deposition following the action of hydrogen sulphide or gas-charged waters on carbonaceous material

in the overburden. The surficial, lacustrine or alluvial clays (less than 100 feet thick) lie on a Paleozoic bedrock of fractured limestone. Geologic field data from the surrounding area eastwards to the borders of the Canadian Shield suggest that hydrogen sulphide gas, generated by decomposing sulphide bodies in the Paleozoic or Precambrian subsurface, is not uncommon.

4. The field program undertaken in November and December, 1967, consisting of pitting, hand augering, trenching, and core drilling to bedrock, is considered exhaustive enough to prove that extensive deposits of sulphur near surface do not exist on permit No. 8 in those areas tested.

B - RECOMMENDATIONS

If, under the terms of the option agreement, further work is required on these permits, certain recommendations can be made.

1. The slump areas on permits Nos. 9 and 10 can be inspected in the field after the snow clears to establish for sure that, as claimed by the optioners, blocks of sulphur material of significant grade occur.

2. The terrain analysis study should be used as a guide to prospect most, if not all, the clearings occurring in the

forest cover on permit No. 8. These clearings can be quickly tested by sinking 4 ft. pits and hand augering to eight feet below them, to determine if sulphur exists outside of the original clearing area.

The latter work could be effected quite cheaply, operating on foot, but access to permits Nos. 9 and I0 is more difficult and the higher costs of a helicopter should be allowed.

Respectfully submitted,

GEOPHOTO SERVICES, LTD.

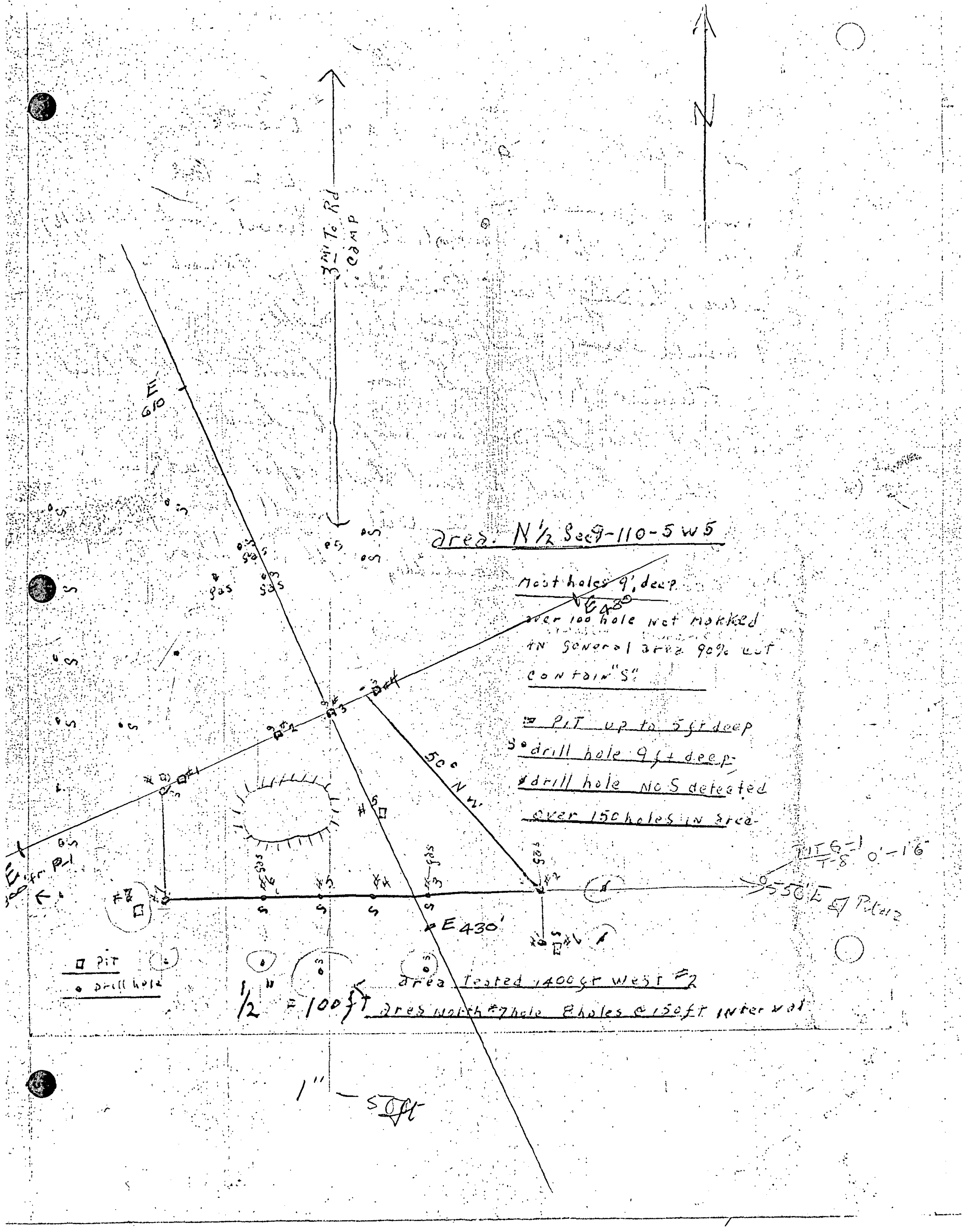
[redacted]

E. J. Hooke

[redacted]

Paul Fuenning

APPENDIX


N
3 mi To Rd camp
area. N 1/2 Sec 9-110-5 W5
Most holes 9' deep
over 100 hole not marked in general area 90% out contain "S"
PIT up to 5 ft deep
drill hole 9 ft deep
drill hole No S detected
over 150 holes in area
500 N
E 430'
PIT 6-1 T-8 0'-1'6"
550' E
E 610
gas
PIT
drill hole
1/2" = 100 ft
area tested 1400 ft west #2
area north #7 hole 8 holes @ 150 ft interval
1" - 50 ft

PHONE 469-2591

ATLAS TESTING LABORATORIES LTD.

INDUSTRIAL AND RESEARCH CHEMISTS
TESTING AND INSPECTION SERVICES

7911 ARGYLL ROAD
EDMONTON, ALBERTA

April 10, 1967.

Madison Oils Ltd.,
516 Lancaster Building,
Calgary, Alberta.

Lab No. 606 - Sample No. 2.

Dear Sirs:

The results of the spectrographic analysis of the above sample are as follows:

SPECTROGRAPHIC ANALYSIS

Major Constituents	Nil
Intermediate Constituents	Silica, Calcium.
Approximately 1 %	Magnesium, Iron, Aluminum, Sodium.
0.01 % - 0.1 %	Manganese, Lead, Titanium.
0.001 % - 0.01 %	Vanadium, Copper.

Yours very truly,
ATLAS TESTING LABORATORIES LTD.

[redacted]

R. Sawyer
Chemist.

RS/bb

PHONE 469-2301

ATLAS TESTING LABORATORIES LTD.

INDUSTRIAL AND RESEARCH CHEMISTS
TESTING AND INSPECTION SERVICES

7911 ARGYLL ROAD
EDMONTON, ALBERTA

April 10, 1967.

Madison Oils Ltd.,
516 Lancaster Building,
Calgary, Alberta.

Lab No. 606 - Sample No. 3

Dear Sirs:

The results of the spectrographic analysis of the above sample are as follows:

SPECTROGRAPHIC ANALYSIS

Major Constituents	Nil
Intermediate Constituents	Calcium.
Approximately 1 %	Silica.
0.01 % - 0.1 %	Magnesium, Aluminum.
0.001 % - 0.01 %	Iron, Copper.
Traces	Manganese.

Yours very truly,
ATLAS TESTING LABORATORIES LTD.

[redacted]

R. Sawyer,
Chemist.

RS/bb

ATLAS TESTING LABORATORIES LTD.

7911 Argyll Road ° EDMONTON, ALBERTA ° Phone 469-2391

CERTIFICATE OF ASSAY

TO Madison Oil Ltd,
516 Lancaster Building,
Calgary, Alberta.

Lab No. 606

April 7, 1967.

I hereby certify that the following are the results of assays made by me upon the herein described samples.

MARKED	GOLD		SILVER		SULPHUR						TOTAL VALUE PER TON (2000 LBS.)
	Ounces per Ton	Value per Ton	Ounces per Ton	Value per Ton	Percent ✓		Percent		Percent		
10004 # 3				A	70.92 ✓						
10005 # 2				B	30.88 ✓						
10006 # 1				A	77.13 ✓						

Gold calculated at $..... per ounce

Silver calculated at $..... per ounce

Calculated at ..... per lb.

Calculated at ..... per lb.

NOTE:
Rejects retained one month.
Pulps retained three months unless otherwise arranged.

[redacted]

Registered Assayer, Province of British Columbia

A - 4

ATLAS TESTING LABORATORIES LTD.

7911 Argyll Road • EDMONTON, ALBERTA • Phone 469-2391

CERTIFICATE OF ASSAY

TO Madison Oils Ltd.,
516 Lancaster Building,
Calgary, Alberta.

Lab. No. 606
May 30, 1967.

I hereby certify that the following are the results of assays made by me upon the herein described samples.

MARKED	GOLD		SILVER		TELLURIUM		SELENIUM		ARSENIC		TOTAL VALUE PER TON (2000 LBS.)
	Ounces per Ton	Value per Ton	Ounces per Ton	Value per Ton	Percent		Percent		Percent		
10004					Not detected		Not detected		<0.0001		
10005					Not detected		Not detected		0.0002		
10006					Not detected		Not detected		<0.0001		

Gold calculated at $..... per ounce

Silver calculated at $..... per ounce

Calculated at ..... per lb.

Calculated at ..... per lb.

NOTE:
Rejects retained one month.
Pulps retained three months unless otherwise arranged.

[redacted]
Registered Assayer, Province of British Columbia

A-15

CORE LABORATORIES-CANADA LTD.
CALGARY ALBERTA

ANALYSIS SULFUR

Company Madison Oils Limited — Page 1 of 1

Well — File CBH-2- 1986

Field — Date September 20, 1967.

Location — Analysts HP & JG

SAMPLING CONDITIONS

Formation — Depths

Sampled from — By — Of

Date Sampled — Date Received Sept.16-67 — Date Analyzed Sept.19-67

Pressure psig. Temperature °F Atmospheric Temp. °F

DST Recovery or Flowrate

	SAMPLE #1	SAMPLE #2
Elemental sulfur %	0.58	70.47
Ash Content	65.54	26.18
Selenium	nil	nil
Tellurium	nil	nil
Arsenic	nil	nil

[redacted]

J. Gerner, Chemist.

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering

201-736 EIGHTH AVENUE S.W.
CALGARY, ALBERTA

7501 STEMMONS FREEWAY
DALLAS, TEXAS

2425 - 2a Street S.E.
Calgary, Alberta.

September 22, 1967.

J. J. O'Connor,
602 Lancaster Building,
Calgary, Alberta.

Date Received - Sept. 20-67
Date Analyzed - Sept. 21-67

File No. CBH-2-1998

Analyst - J.G.

SAMPLE NO.	WT % ELEMENTAL SULFUR	WT % ASH
3	80.76	15.92
4	36.34	60.08
5	89.28	8.02

[redacted]
J. GARNER, Chemist

PHONE 469-2391

CREST LABORATORIES LTD.

B.C. REGISTERED ASSAYERS
INDUSTRIAL and RESEARCH CHEMISTS

7911 ARGYLL ROAD
EDMONTON, ALBERTA

September 28, 1967.

Mr. J.J. O'Connor,
c/o Madison Oils Ltd.,
516 Lancaster Building,
Calgary, Alberta.

Lab No. 977

Dear Sir:

The results of the sulphur analyses are as follows:

Lab No.	Client No.	Sulphur %
977-1	1.	64.0 %
977-2	2.	75.8 %

Yours very truly,

CREST LABORATORIES LTD.

[redacted]

R. Sawyer,
Chemist.

RS/bb

• CHEMICAL RESEARCH AND ANALYSIS
• INSTRUMENT SALES AND SERVICE

TECHNICAL SERVICE LABORATORIES
DIVISION OF BURGENER TECHNICAL ENTERPRISES LIMITED
355 KING ST. W., TORONTO 2B, ONT., CANADA
TELEPHONE : 362-4248

Representing . . .
JARRELL-ASH COMPANY
HILGER & WATTS LIMITED
SADTLER RESEARCH
ULTRA CARBON CORPORATION
METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Limited,
706 - 6th Street S.W.,
Calgary, Alberta.

REPORT NO. T-09163

SAMPLE(S) OF PULP

Attn: Mr. E.J. Hooke

Sample No.	Total Sulphur (S)%
G - 1	74.28
C - 2	73.12
C - 3	70.80

Samples, Pulps and Rejects discarded after six months

DATE Nov. 20'67

SIGNED [redacted]
C.S. JOYCE, B.Sc., Manager of Laboratories

CTA

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• INSTRUMENT SALES AND SERVICE

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METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Limited,
706 - 6th Street S.W.,
Calgary, Alberta.

REPORT NO. T-09163

SAMPLE(S) OF PULP

Attn: Mr. E.J. Hooke

Semiquantitative Spectrographic Analysis:

	Sample C 3	Sample	Sample		Sample C 3	Sample	Sample
Antimony	–			Lithium (Li_2O)	–		
Arsenic	–			Manganese	.001%		
Barium	.01%			Mercury	–		
Beryllium (BeO)	–			Molybdenum	–		
Bismuth	–			Nickel	.001%		
[illegible]mium	–			Silver	–		
Cerium (CeO_2)	–			Tantalum (Ta_2O_5)	–		
Chromium	–			Thorium (ThO_2)	–		
Cobalt	–			Tin	.002%		
Columbium (Cb_2O_5)	–			Titanium	.05%		
Copper	.0005%			Tungsten	–		
Gallium	–			Uranium (U_3O_8)	–		
Germanium	–			Vanadium	.001%		
Indium	–			Zinc	–		
Iron	.01%			Zirconium (ZrO_2)	.002%		
Lead	.0005%						

Figures are approximate:

Samples, Pulps and Rejects discarded after six months

CODE

H	: High	– 10 – 100%	approx.
MH	: Medium High	– 5 – 50%	approx.
M	: Medium	– 1 – 10%	approx.
LM	: Low Medium	– .5 – 5%	approx.
L	: Low	– .1 – 1%	approx.
TL	: Trace Low	– .05 – .5%	approx.
T	: Trace	– .01 – .1%	approx.
FT	: Faint Trace	– approx. less than .01%.	
PT	: Possible Trace	– Presence not certain.	
–	: Not Detected	– Elements looked for but not found.	

DATE Nov. 20'67

SIGNED [redacted]
C.S. JOYCE, B.Sc., Manager of Laboratories

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ULTRA CARBON CORPORATION
METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Limited,
706 - 6th Street S.W.,
Calgary, Alberta.

REPORT NO.
T-09466

SAMPLE(S) OF PULPS

Attn: Mr. G. Raham

Sample No.	Total Sulphur (S)%
A - 1	5.12
A - 2	6.77
A - 3	3.89
A - 4	4.13
A - 5	0.21
A - 6	1.94
A - 7	0.27
A - 8	3.64
A - 9	2.39
A - 10	0.20
A - 11	0.13
A - 12	0.10
A - 13	0.12
A - 14	0.24
A - 15	18.58
A - 16	6.07
A - 17	5.87
A - 18	1.28
A - 19	1.61
A - 20	1.28
A - 21	1.47
A - 22	0.93
A - 23	1.20

Native or elemental Sulphur @ 6.00 per assay

Samples, Pulps and Rejects discarded after six months

DATE Dec. 13/67

SIGNED [redacted]

C.S. JOYCE, B.Sc., Manager of Laboratories

CTA

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• INSTRUMENT SALES AND SERVICE

TECHNICAL SERVICE LABORATORIES
DIVISION OF BURGENER TECHNICAL ENTERPRISES LIMITED
355 KING ST. W., TORONTO 2B, ONT., CANADA
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SADTLER RESEARCH
ULTRA CARBON CORPORATION
METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Ltd.,

REPORT NO. T-09466

SAMPLE(S) OF PULPS

Attn: Mr. G. Raham

Sample No.	Total Sulphur (S)%
A - 24	1.33
A - 25	4.82
A - 26	1.58
A - 27	1.26
A - 28	0.25
A - 29	0.23
A - 30	0.22
A - 31	1.93
A - 32	0.54
A - 33	0.25
A - 34	0.32
A - 35	1.71
A - 36	10.66
A - 37	21.12
A - 38	15.62
A - 39	11.65
T - 1	15.86
T - 2	61.83
T - 3	42.30
T - 4	20.11
T - 5	12.55
T - 6	75.35
T - 7	33.03

Samples, Pulps and Rejects discarded after six months

DATE Dec. 13/67

SIGNED [redacted]

C.S. JOYCE, B.Sc., Manager of Laboratories

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DIVISION OF BURGENER TECHNICAL ENTERPRISES LIMITED
355 KING ST. W., TORONTO 2B, ONT., CANADA
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HILGER & WATTS LIMITED
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ULTRA CARBON CORPORATION
METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Ltd.,

REPORT NO. T-09466

SAMPLE(S) OF PULPS

Attn: Mr. G. Raham

Sample No.	Total Sulphur (S)%
T - 8	8.30
T - 9	0.41
T - 10	0.13
T - 11	0.41
T - 12	1.83
T - 13	6.23
T - 14	4.59
T - 15	0.72
T - 16	5.93
T - 17	8.24
✓T - 18	0.66

mples, Pulps and Rejects discarded after six months

DATE ~~Dec. 13/67~~

SIGNED [redacted]
C.S. JOYCE, B.Sc., Manager of Laboratories

CTA

CORE LABORATORIES-CANADA LTD.
Petroleum Reservoir Engineering

201-736 EIGHTH AVENUE S.W.
CALGARY, ALBERTA

7501 STEMMONS FREEWAY
DALLAS, TEXAS

2425 - 2a Street S.E.
Calgary, Alberta.

December 15, 1967.

GeoPhoto Services,
706 - 6th St. S.W.
Calgary, Alberta.

SAMPLE NO.	ELEMENTAL SULPHUR %	TOTAL SULPHUR %	ASH %
T21 #1	nil	1.47	90.9
#T19	nil	3.18	-
#T22	nil	4.19	-

G. PRIEST - Assayer.

PROVINCE OF ALBERTA

RESEARCH COUNCIL OF ALBERTA

87TH AVENUE AND 114TH STREET
EDMONTON, ALBERTA, CANADA

EARTH SCIENCES BRANCH

OUR REF: MAC/bb

December 7, 1967.

Mr. G. Raham,
Geophoto Services, Ltd.,
706 Sixth Street S.W.,
CALGARY, Alberta.

Dear Mr. Raham,

Re: your inquiry about a shale sample from northwestern Alberta, the outcrops in this area have been mapped as upper Shaftesbury Formation (upper Cretaceous) by Research Council staff in 1962. Actually, from the position given by you, the sample would appear to have come from just below the base of the Dunvegan Formation (mainly sandstone).

Yours very truly,

[redacted]

M. A. CARRIGY.

T21 — Burning pit black shale.

SCIENCE SERVICES DIVISION
TEXAS INSTRUMENTS
INCORPORATED

GEOPHOTO SERVICES, LTD.
world-wide natural resources evaluation

TERRAIN ANALYSIS OF SULPHUR PERMIT NO. 8

Preliminary Terrain Analysis of Alcon Petroleums Ltd., Sulphur Permit Area 8 (T. 109 and 110, R. 5, W5M) north-central Alberta has been completed by stereoscopic examination of Infrared photography taken in 1964 by the Alberta Department of Lands and Forests. This photography has a scale of 1:35,000 and is good quality.

Sulphur bearing strata is located in small clearings according to Mr. Eric Hooke of Geophoto. Therefore the purpose of this study was to identify as many such clearings as possible, within the coverage of the photography, and ascertain the relationship of the small unvegetated clearings and surrounding topography, drainage and vegetation.

The project area is very flat topographically and small drainage channels are intermittent, often draining into closed muskeg depressions. Major streams drain southeasterly into Peace River. Vegetal cover ranges from sparce to very dense. Tree types are both coniferous (black and white spruce) and deciduous (poplar, balsom (?) and birch). Mixed stands are not uncommon. A large part of the area is covered by muskeg and treed muskeg. The trees range from sparsely stocked to fully stocked and the large spruce trees may be 80 feet in height in the east part of the project area. Small deciduous trees and brush are also present over much of the area.

Known sulphur bearing strata have been identified in the field and outlined on the mosaic. This strata is distinctive by absence of vegetation and its close proximity to stands of deciduous trees. The known locations of sulphur appear as white flat areas within the deciduous forest, and have an overall "doughnut" appearance due to a slightly wetter central area which in some places appears to contain isolated brush or a single tree. The central area may indicate a saucer shape cross-section through these "flat" areas. The clearings may have any outline in plan view ranging from elongate to arcuate, as well as circular.

Many clearings have been found in the photo analysis and appear to be identical to the field observed clearings. These areas are shown in red on the mosaic. The most prospective clearings are believed to be those surrounded by deciduous trees. Many clearings are located on the edge of muskeg areas. These clearings may represent the presence of recent aluvium.

The project area slopes at a low gradient southeasterly towards Peace River. The southeastern and lower part of the permit area contains few clearings, much muskeg, treed muskeg and stands of white spruce (indicating slightly sandier soil). Mixed stands of "scrub" brush and small deciduous trees are present. Soil conditions in the east and southeast parts of the project area are quite variable.

A much greater number of clearings occur in the west and northwest parts of Permit "8", where dense stands of relatively large deciduous trees are common. The clearings appear to increase in abundance and size westward beyond the project boundary.

It is recommended that a detailed Terrain Analysis of the entire region be undertaken. Further, clearings delineated in this study should be field checked to determine potentiality of these areas. Numerous vegetal and indistinct drainage alignments indicate an area of fault tectonics which may be controlling factors in the occurrence of sulphur. Therefore, it may be advisable to undertake a detailed Fracture Analysis of the area utilizing both stereoscopic analysis and mosaic analysis.

Respectfully submitted,

GEOPHOTO SERVICES, LTD.

[redacted]

T. J. French

ELEMENTAL SULFHUR ASSAYS

Sample No.	TSL	Core Lab	Chem & Geol Lab
T6	75.35	70.8	74.97 75.70 special
T7	33.03	33.4	30.19 30.48 special
T18	.66	1.5	.05 .06 special
L2	71.40	73.4	76.85 78.60 special

Given to Ed Bonsall 1/9/68

1/9/68

• CHEMICAL RESEARCH AND ANALYSIS
• INSTRUMENT SALES AND SERVICE

TECHNICAL SERVICE LABORATORIES
DIVISION OF BURGENER TECHNICAL ENTERPRISES LIMITED
355 KING ST. W., TORONTO 2B, ONT., CANADA
TELEPHONE : 362-4248

Representing . . .
JARRELL-ASH COMPANY
HILGER & WATTS LIMITED
SADTLER RESEARCH
ULTRA CARBON CORPORATION
METALS RESEARCH LIMITED

CERTIFICATE OF ANALYSIS

SAMPLE(S) FROM Geophoto Services Limited,
706 - 6th Street S. W.,
Calgary, Alberta.

REPORT NO. T-09808

SAMPLE(S) OF PULP

Attn: Mr. G.O. Raham

Sample No.	Elemental Sulphur (S)%
L - 2	71.40

Samples, Pulps and Rejects discarded after six months

DATE Jan. 5/68

SIGNED [redacted]
C.S. JOYCE, B.Sc., Manager of Laboratories

CTA

CORE LABORATORIES-CANADA LTD.
Petroleum Reservoir Engineering

201-736 EIGHTH AVENUE S.W.
CALGARY, ALBERTA

7501 STEMMONS FREEWAY
DALLAS, TEXAS

2425 - 2a Street S.E.
Calgary, Alberta

January 9, 1968

Geophoto Services, Ltd.
706 - Sixth St. S.W.
Calgary, Alberta

CBH-2-2439

SAMPLE NUMBER	ELEMENTAL SULPHUR %
L-2	73.4
T-6	70.8
T-7	33.4
T-18	1.5

[redacted]
G. Priest - Assayer

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

14240 - 115 AVENUE, EDMONTON, ALBERTA

January 11, 1968

Mr. G. O. Raham
Geophoto Services Ltd.,
706 - 6th Street S.W.,
Calgary, Alberta.

Re: Laboratory Report Number: C68-3212
4 Sulphur Soils (T6; T7; T18; L2)

Dear Sir:

The samples described above have been analyzed for sulphur content as per our telephone arrangement and we give you the following results:

SAMPLE	STANDARD METHOD % Sulphur by weight	SPECIAL METHOD % Sulphur by weight
T6	74.97%	75.70%
T7	30.19%	30.48%
T18	0.05%	0.06%
L2	76.85%	78.60%

Note:

The samples were pulverized then dried at 82°C. overnight. The samples were then riffled and a representative portion of each taken for the analyses.

Thank you for considering our services.

Yours truly,

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

[redacted]

W.M. Morrison

C.G.L. 64

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

OPERATOR: GEOPHOTO SERVICES LTD.
KIND OF SAMPLE: Sulphur Soils and Rock Cores

REPORT NUMBER: C68-3247
Date Reported: January 26, 1968

SAMPLE NUMBER	ELEMENTAL SULPHUR %
D1	2.2
D2	0.37
D3	Traces only
D4	0.90
D5	4.35
D6	0.70
D7	1.25
D8	Traces only
D9	0.45
D10	0.51
D11	0.72
D12	0.56
D13	0.64
D14	Traces only
D15	Traces only
D16	40.26
D17	26.66
D18	5.17
D19	1.51
D20	0.50
D21	Traces only
D22	0.32
D23	Traces only
D24	0.20
D25	0.35
D26	2.00
D27	2.94
D28	1.77
D29	1.80
D30	1.61
D31	1.45
D32	3.00
D33	0.23
D34	1.01
D35	1.56
D36	2.62
D37	0.28
D38	Traces only
D39	0.13
D40	1.16
D41	Traces only
D42	2.50
D43	1.00
D44	Traces only
D45	Traces only
D46	Traces only
D47	0.71
D48	1.66
D49	3.71
D50	1.20
D51	0.35
D52	0.42
D53	2.78
D54	0.99
D55	0.97
D56	0.76
D57	1.35
D58	2.50
D59	3.62
D60	1.65
D61	1.93
D62	1.43
D63	1.37
D64	1.00
D65	0.36
D66	1.25
D67	1.28
D68	No sample
D69	0.43
D70	0.75
D71	2.13
D72	0.66
D73	0.32
D74	2.75
D75	1.00
D76	1.75
D77	3.00
D78	1.16
D79	1.07
D80	1.11
D81	3.50
D82	0.39
D83	0.71
D84	0.93
D85	2.74
D86	2.42
D87	2.62
D88	3.05
D89	1.29
D90	1.05
D91	1.27
D92	2.02
D93	0.78
D94	1.21
D95	0.89
D96	0.57
D97	Traces only
D98	Traces only
D99	Traces only
D100	Traces only
D101	0.73

C.G.L. 64

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

OPERATOR: GEOPHOTO SERVICES LTD.
KIND OF SAMPLE: Sulphur Soils and Rock Cores

REPORT NUMBER: C68-3247-1
Date Reported: February 1st, 1968

SAMPLE NUMBER	ELEMENTAL SULPHUR %
D 102	Traces only
D 103	Traces only
D 104	Traces only
D 105	Traces only
D 106	Traces only
D 107	Traces only
D 108	1.81
D 109	2.45
D 110	1.82
D 111	Traces only
D 112	1.51
D 113	1.39
D 114	2.05
D 115	1.51
D 116	1.77
D 117	0.47
D 118	1.40
D 119	Traces only
D 120	0.49
D 121	0.68
D 122	0.40
D 123	0.71
D 124	1.06
D 125	Traces only
D 126	0.40
D 127	1.00
D 128	Traces only
D 129	1.38
D 130	0.65
D 131	1.04
D 132	Traces only
D 133	Traces only
D 134	0.75
D 135	1.36
D 136	1.55
D 137	1.28
D 138	1.41
D 139	0.94
D 140	Traces only
D 141	0.64
D 142	0.41
D 143	Traces only
D 144	0.64
D 145	1.15
D 146	0.81
D 147	0.95
D 148	1.32
D 149	1.14
D 150	1.24
D 151	1.14
D 152	1.36
D 153	1.32
D 154	0.57
D 155	0.89
D 156	0.42
D 157	0.70
D 158	Traces only
D 159	0.43
D 160	Traces only
D 161	Traces only
D 162	0.73
D 163	2.70
D 164	2.57
D 165	2.65
D 166	Traces only
D 167	3.28
D 168	3.38
D 169	4.98
D 170	21.40
D 171	3.09
D 172	1.97
D 173	1.10
D 174	Traces only
D 175	Traces only
D 176	Traces only
D 177	0.30
D 178	2.92
D 179	1.02
D 180	2.03
D 181	Traces only
D 182	Traces only
D 183	2.12
D 184	1.40
D 185	1.23
D 186	0.33
D 187	2.54
D 188	2.53
D 189	2.27
D 190	1.32
D 191	0.63
D 192	3.49
D 193	0.95
D 194	1.83
D 195	2.35
D 196	2.07
D 197	1.78
D 198	0.89
D 199	1.13
D 200	Traces only
D 201	4.65
D 202	0.44
D 203	3.24
D 204	2.50
D 205	2.51
D 206	2.25
D 207	0.22
D 208	1.31
D 209	0.98
D 210	1.16
D 211	0.69

C.G.L. 64

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

OPERATOR: GEOPHOTO SERVICES LTD. **REPORT NUMBER:** C68-3247-1

KIND OF SAMPLE: Sulphur Soils and Rock Cores

SAMPLE NUMBER	ELEMENTAL SULPHUR %
A 42	0.79
A 43	0.71
A 44	1.40
A 45	2.12
A 46	2.73
A 47	1.60
A 48	2.89
A 49	2.31
A 50	7.07
A 51	1.33
A 52	3.60
A 53	1.27
A 54	5.58
A 55	0.81
A 56	Traces only
A 57	1.68
A 58	1.45
A 59	0.95
A 60	0.19
A 61	9.56
A 62	9.27
A 63	39.42
A 65	6.16
A 66	5.22
A 67	32.29
A 68	5.27
A 69	3.92
A 70	21.36
A 71	4.82
A 72	3.79
A 73	1.04
A 74	3.71
A 75	21.90
A 76	11.37
A 77	32.82
A 78	7.99
A 79	42.78
A 80	9.47
A 81	7.58
A 82	7.39
A 83	3.41
A 84	4.02
A 85	1.49
A 86	2.99
A 87	0.55
A 88	0.47
A 89	3.66
A 90	0.73
A 91	Traces only

C.G.L. 64

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

OPERATOR: GEOPHOTO SERVICES LTD.

REPORT NUMBER: C68-3247-1

KIND OF SAMPLE: Sulphur Soils and Rock Cores

SAMPLE NUMBER	ELEMENTAL SULPHUR %
C 1	0.29
C 2	1.93
C 3	0.07
T 23	3.94

Sulphur Permits 8, 9, 10

SCIENCE SERVICES DIVISION
TEXAS INSTRUMENTS
INCORPORATED

GEOPHOTO SERVICES, LTD.
world-wide natural resources evaluation

February 23, 1968.

Alcon Petroleums Ltd.,
630 - 6th Avenue S.W.,
Calgary, Alberta.

Attention: Mr. L. Bebensee

Dear Sirs:

Re: Report on Evaluation of Three Sulphur Permits in the Fort Vermilion area, northern Alberta.

We noted in this report (p. 32) that the high assay value obtained for sample D 170 in drill hole D - 11 was suspect and therefore this sample had been submitted to Core Laboratories - Canada Ltd. for check assay.

Core Labs reported 2.9% elemental sulphur for D 170. We therefore challenged Chemical and Geological Laboratories Ltd. who now admit an error on their part. They say the true assay is 3.01% elemental sulphur.

Copies of the appropriate assay sheets are enclosed.

Yours very truly,

GEOPHOTO SERVICES, LTD.

[redacted]

E. J. Hooke

EJH/ss
Encls.

CHEMICAL & GEOLOGICAL LABORATORIES LTD.

14240 - 115 AVENUE, EDMONTON, ALBERTA

428 - 35th. Avenue, N. E., Calgary, Alberta.

February 22nd., 1968.

Geophoto Services Limited,
706 - 6th. Street, S. W.,
Calgary, Alberta.

Attention: Mr. J. Raham
Mr. E. Hooke

Dear Sirs:

As per your request of February 20th., 1968 for clarification of the sulfur results for sample D 170, we give you the following:

The correct result for D 170 is 3.01% elemental sulfur.

The discrepancy between the results reported on the preliminary report and the final typed report C 68-3247-1 was due to a typographical error. Our typist must have read a calculating figure on our work sheet instead of the calculated answer of 3.01. Our apologies for the error.

Yours very truly,

[redacted]

W. M. Morrison,
Manager.

WMM/mn

CORE LABORATORIES - CANADA LTD.
Petroleum Reservoir Engineering

201-736 EIGHTH AVENUE S.W.
CALGARY, ALBERTA

7501 STEMMONS FREEWAY
DALLAS, TEXAS

FILE - CBH-2-2666

DATE - February 19/68

Geophoto Services Ltd.
Geophoto Building, 706 Sixth Street S.W.
CALGARY, Alberta

Attention: Mr. G. Raham

One Sample D-170

% Elemental Sulphur - 2.9%

[redacted]

for G. Priest
Assayer

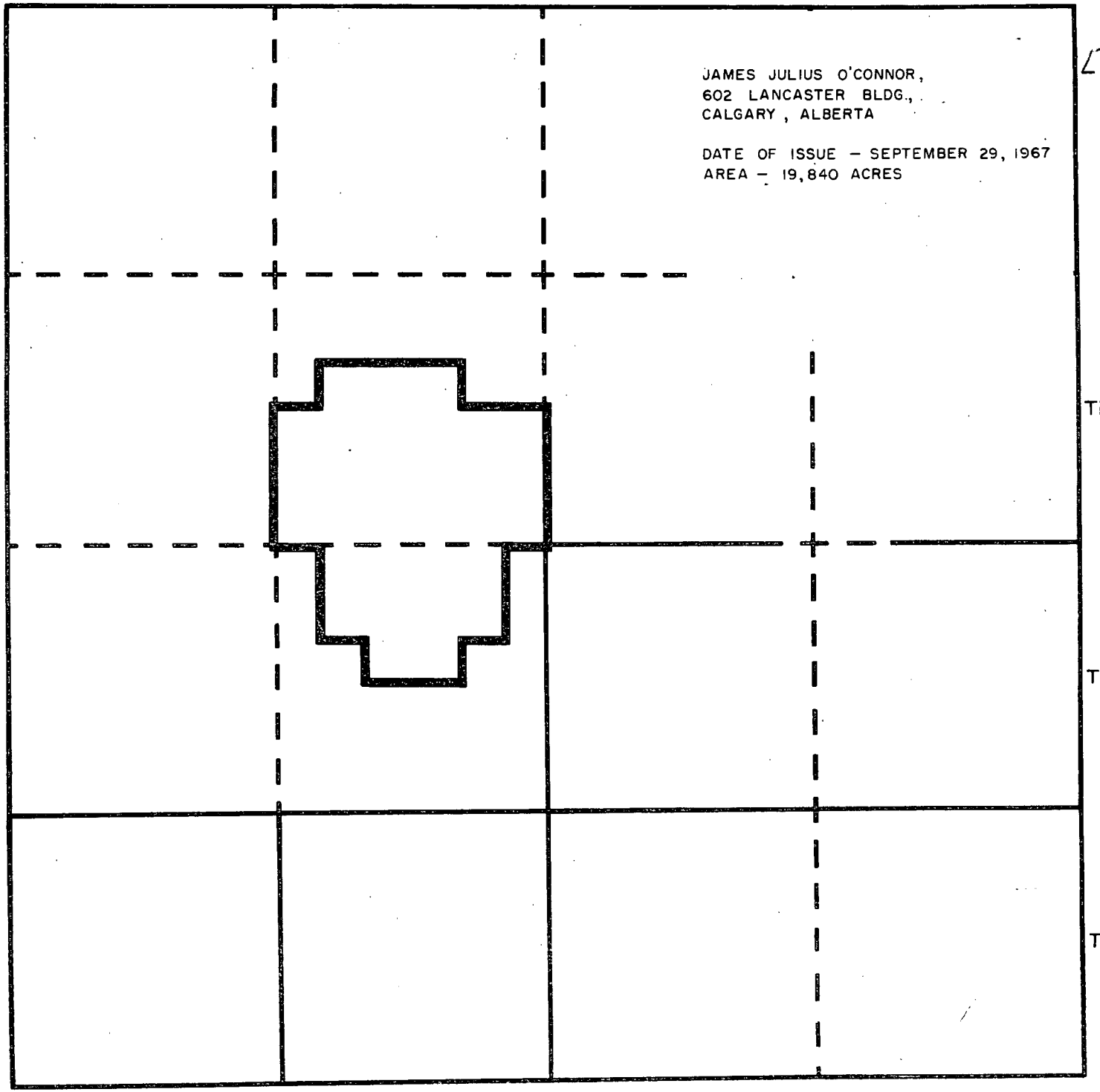
/in

SULPHUR PROSPECTING PERMIT No. 8

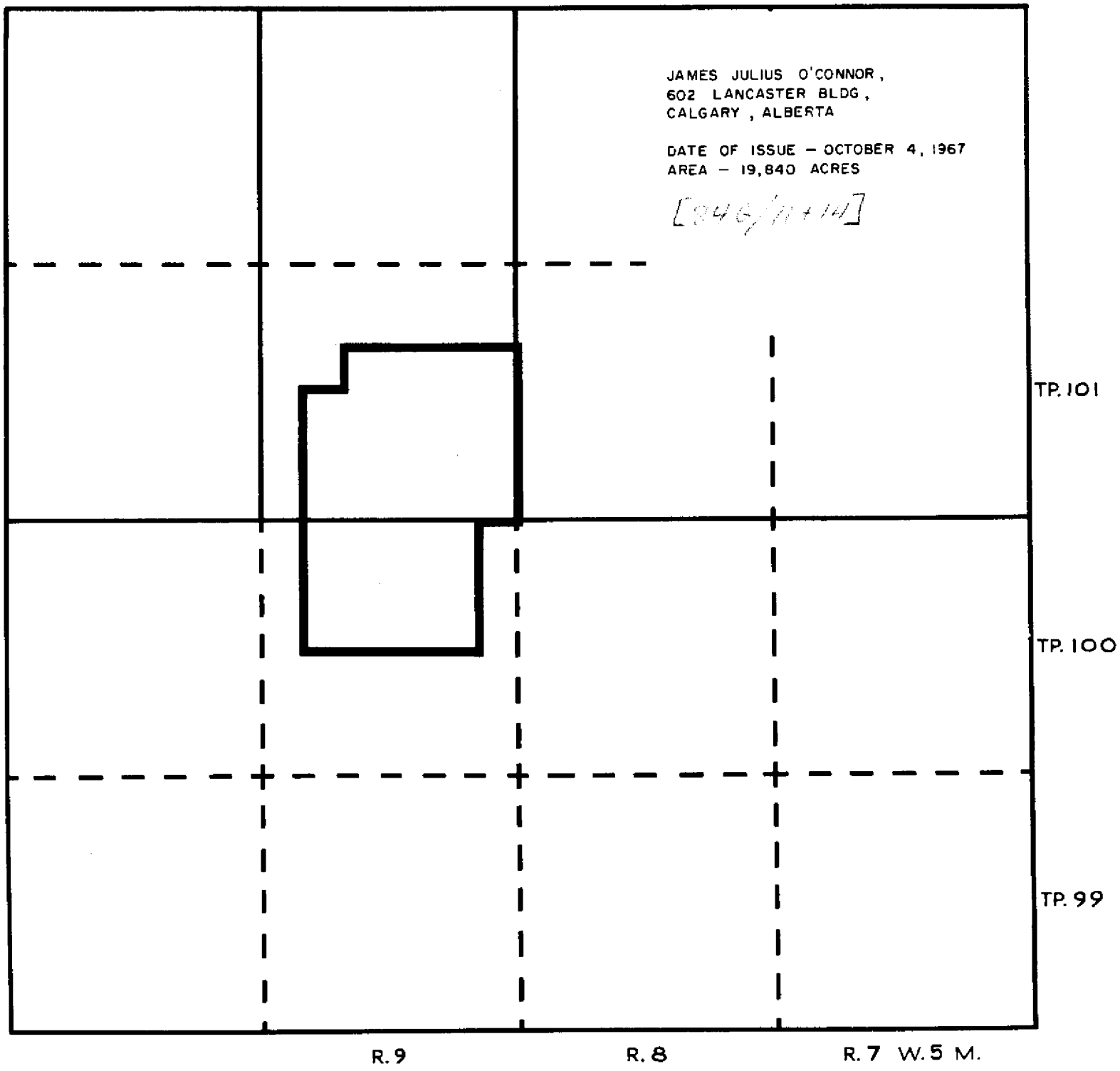
[84J/7+10]

JAMES JULIUS O'CONNOR,
602 LANCASTER BLDG.,
CALGARY, ALBERTA

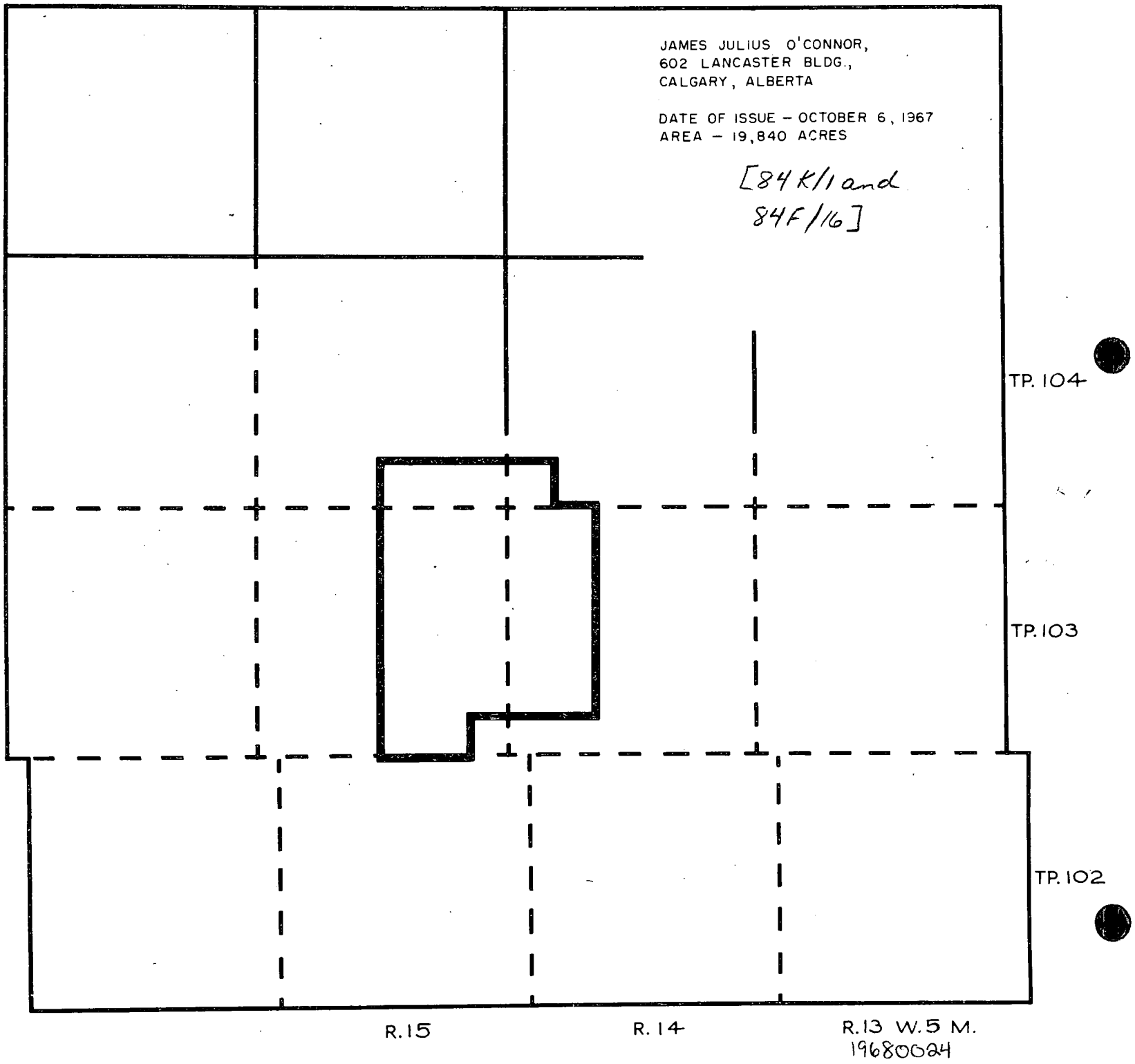
DATE OF ISSUE – SEPTEMBER 29, 1967
AREA – 19,840 ACRES



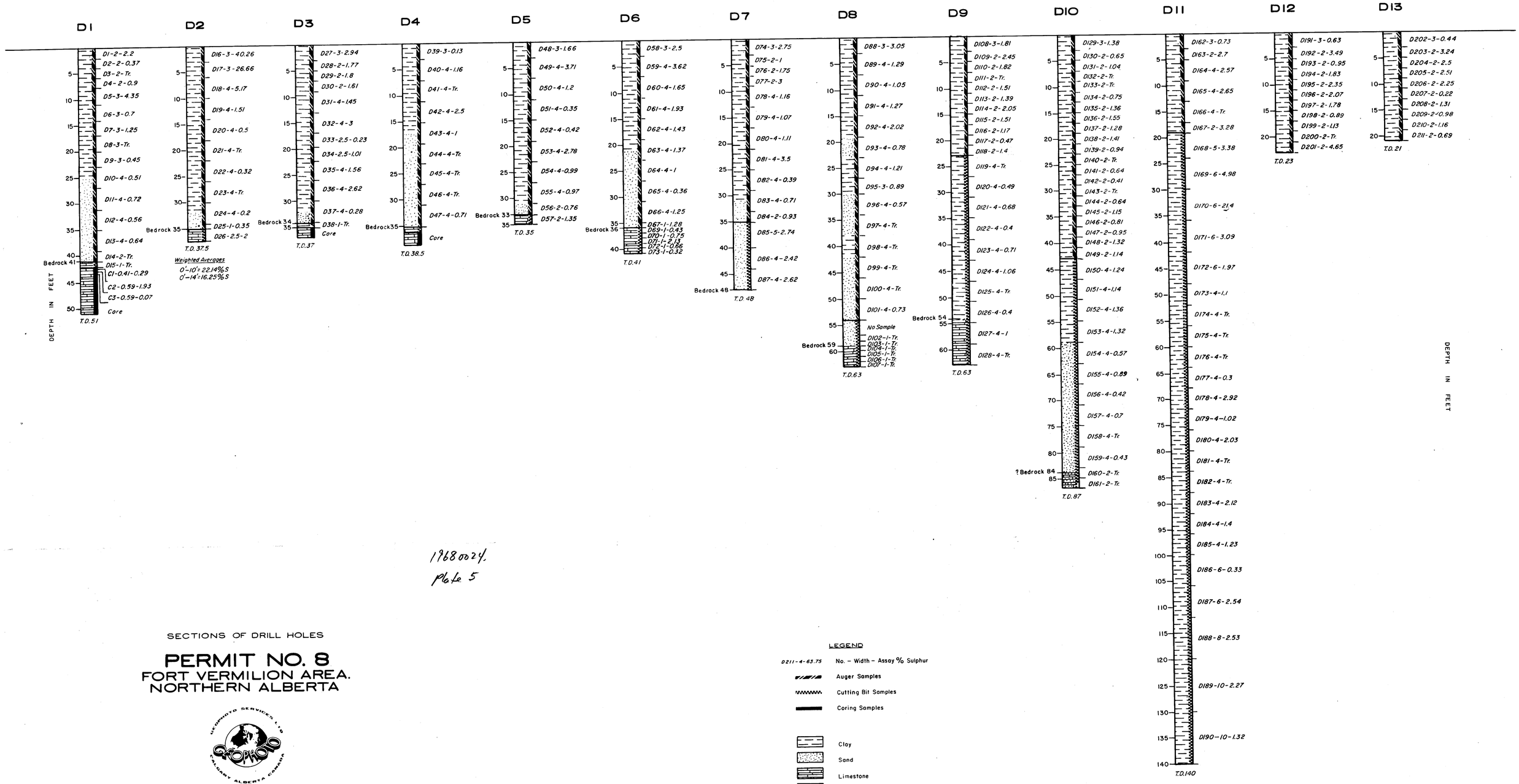
SULPHUR PROSPECTING PERMIT No. 9



SULPHUR PROSPECTING PERMIT No.10



19680024



19680024.
Plate 5

SECTIONS OF DRILL HOLES

PERMIT NO. 8
FORT VERMILION AREA.
NORTHERN ALBERTA

GEOPHOTO SERVICES LTD. CALGARY ALBERTA CANADA

VERTICAL SCALE: 1 INCH = 10 FEET

PREPARED FOR
ALCON PETROLEUMS LTD.
1968

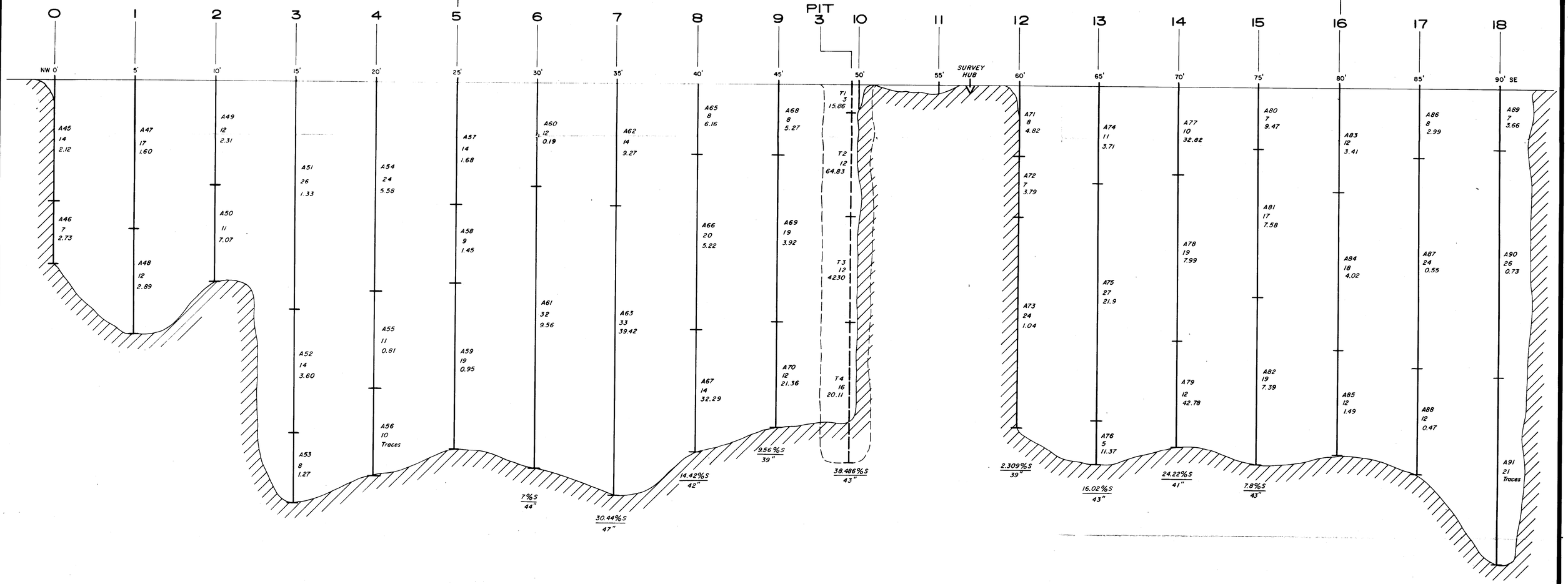
LEGEND

D211-4-63.75 No. – Width – Assay % Sulphur

- Auger Samples
- Cutting Bit Samples
- Coring Samples

- Clay
- Sand
- Limestone
- Sandy-limestone

PLATE 5



LEGEND

7	SECTION NUMBER
A56	SAMPLE NUMBER
10	SAMPLE WIDTH IN INCHES
23.7	ASSAY % SULPHUR

SECTION OF TRENCH
SHOWING ASSAY RESULTS

PERMIT NO. 8
FORT VERMILION AREA. NORTHERN ALBERTA

GEOPHOTO SERVICES LTD. CALGARY ALBERTA CANADA

VERTICAL SCALE: 1 INCH = 6 INCHES
SCALE RATIO – VERTICAL: HORIZONTAL = 6.5:1
PREPARED FOR
ALCON PETROLEUMS LTD.
1968

1968 0024

PLATE 4

1968 0024
Plate 3

PLAN SHOWING LOCATION
OF
PIT AND AUGER SAMPLING

PERMIT NO. 8
FORT VERMILION AREA, NORTHERN ALBERTA

GEOPHOTO SERVICES LTD. CALGARY ALBERTA CANADA

SCALE: 1 INCH = 50 FEET

PREPARED FOR
ALCON PETROLEUMS LTD.
1967

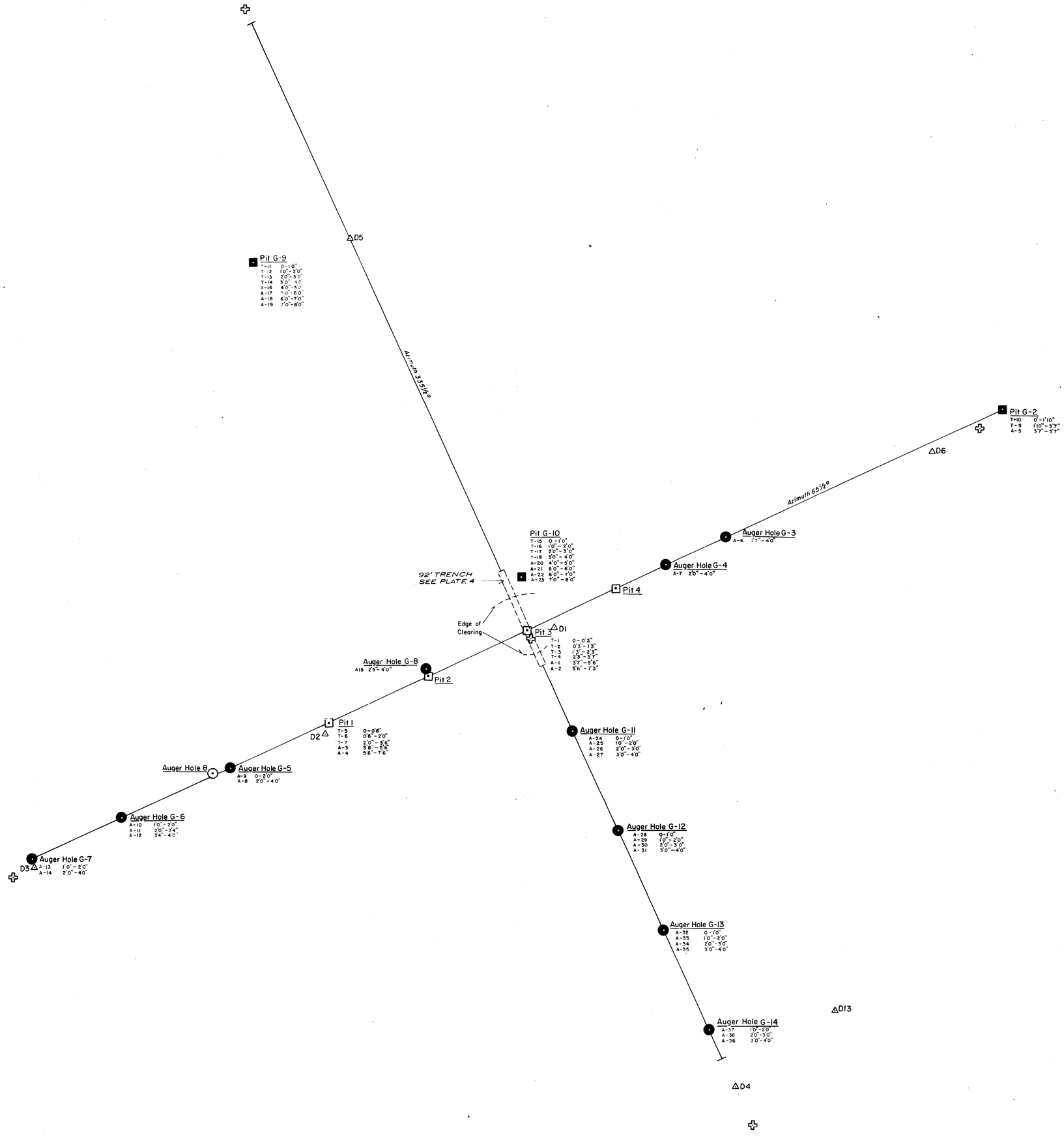


PLATE 3

19680024
Plate 2

PLAN SHOWING LOCATION
OF
PIT AND AUGER SAMPLING

PERMIT NO. 8
FORT VERMILION AREA, NORTHERN ALBERTA

GEOPHOTO SERVICES LTD. CALGARY ALBERTA CANADA

SCALE: 1 INCH = 50 FEET

PREPARED FOR
ALCON PETROLEUMS LTD.
1967

N

LEGEND

- CONTROL LINES CUT BY GEOPHOTO
- PITS DUG BY GEOPHOTO
- AUGER HOLES BY GEOPHOTO
- OLD PITS
- OLD AUGER HOLES
- S SULPHUR PRESENT
- G GAS DETECTED
- W.A. Weighted Average, % sulphur/feet

Azimuth 35½°

Azimuth 65½°

Pit G-9

		%S
T-11	0-1'0"	0.41
T-12	1'0"-2'0"	1.83
T-13	2'0"-3'0"	1.23
T-14	3'0"-4'0"	4.59
A-16	4'0"-5'0"	6.07
A-17	5'0"-6'0"	5.87
A-18	6'0"-7'0"	1.28
A-19	7'0"-8'0"	1.61

W.A. 8' of 3.44 %

Pit G-10

		%S
T-15	0-1'0"	0.72
T-16	1'0"-2'0"	5.93
T-17	2'0"-3'0"	8.24
T-18	3'0"-4'0"	0.66
A-20	4'0"-5'0"	1.26
A-21	5'0"-6'0"	1.47
A-22	6'0"-7'0"	0.93
A-23	7'0"-8'0"	1.20

W.A. 8' of 2.65 %

Pit G-2

		%S
T-10	0'-1'10"	0.13
T-9	1'10"-3'7"	0.41
A-5	3'7"-5'7"	0.21

W.A. 5.5' of 0.25 %

Auger Hole G-3 A-6 17'-40" 1.94 %S

Auger Hole G-4 A-7 2'0"-4'0" 0.27 %S

Pit 4

Pit 3 S.G

		%S
T-1	0-0'3"	15.86
T-2	0'3"-1'3"	64.65
T-3	1'3"-2'3"	42.30
T-4	2'3"-3'7"	20.11
A-1	3'7"-5'6"	5.12
A-2	5'6"-7'3"	6.77

W.A. 7.25' of 22.01 %

Auger Hole G-8 A15 2'5"-4'0" 18.58 %S

Pit 2

Pit 1 S.G

		%S
T-5	0-0'6"	12.35
T-6	0'6"-2'0"	75.35
T-7	2'0"-3'6"	33.03
A-3	3'6"-5'6"	3.89
A-4	5'6"-7'6"	4.13

W.A. 7.5' of 24.64 %

Auger Hole 8 S

Auger Hole G-5

		%S
A-9	0-2'0"	2.39
A-8	2'0"-4'0"	3.64

W.A. 4' of 3.01 %

Auger Hole G-6

		%S
A-10	1'0"-2'0"	0.20
A-11	2'0"-3'4"	0.13
A-12	3'4"-4'0"	0.10

W.A. 3' of 0.15 %

Auger Hole G-7

		%S
A-13	1'0"-2'0"	0.12
A-14	2'0"-4'0"	0.24

W.A. 3' of 0.20 %

Auger Hole G-11

		%S
A-24	0-1'0"	1.33
A-25	1'0"-2'0"	4.82
A-26	2'0"-3'0"	1.58
A-27	3'0"-4'0"	1.26

W.A. 4' of 2.25 %

Auger Hole G-12

		%S
A-28	0-1'0"	0.25
A-29	1'0"-2'0"	0.23
A-30	2'0"-3'0"	0.22
A-31	3'0"-4'0"	1.93

W.A. 4' of 0.66 %

Auger Hole G-13

		%S
A-32	0-1'0"	0.54
A-33	1'0"-2'0"	0.25
A-34	2'0"-3'0"	0.32
A-35	3'0"-4'0"	1.71

W.A. 4' of 0.71 %

Auger Hole G-14

		%S
A-37	1'0"-2'0"	21.12
A-38	2'0"-3'0"	15.62
A-36	3'0"-4'0"	10.66

W.A. 3' of 15.8 %

Auger Hole 7 — Pit 7

Auger Hole 6 S

Auger Hole 5 S

Auger Hole 4 S

Auger Hole 3 S.G

Auger Hole 2 G

Auger Hole 1 S — Pit 6

Pit G-1
T8 0-1'6" 8.30 %S

PLATE 2

1968 0024
Plate 1

R.6 R.5 W5M.

TP. 110

PLAN SHOWING DRILL HOLE LOCATIONS

PERMIT NO. 8
FORT VERMILION AREA. NORTHERN ALBERTA

GEOPHOTO SERVICES LTD. CALGARY ALBERTA CANADA

SCALE: 3 INCHES = 1 MILE

PREPARED FOR
ALCON PETROLEUMS LTD.
1968

LEGEND
- ROAD
- SEISMIC LINE
- SURVEYED ACCESS ROUTE
- GEOPHOTO DRILL HOLE
- PERMIT BOUNDARY

D11

POSITION

APPROXIMATE

D10

D9

WENTZEL RIVER

SEE PLATE 3

D7

Surveyed

D8

Line

D12

DUNNAY CREEK

PLATE 1