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REGIONAL GEOLOGICAL STUDY
SULPHUR PROSPECTING PERMITS NOS. 33, 34, 145, 146, 150, 151 AND 152
FORT VERMILION AREA, NORTH-CENTRAL ALBERTA

Prepared For
19690051 Mr. J. Superstein
January, 1969
By
J. C. Sproule and Associates Ltd.

THIS REPORT HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF:

Mr. J. Superstein

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FORT VERMILION AREA, NORTH-CENTRAL ALBERTA

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January, 1969

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FORT VERMILION AREA, NORTH-CENTRAL ALBERTA

INTRODUCTION

This report has been prepared at the request of Mr. Jake Superstein. The request made was for a regional geological study of the general Fort Vermilion area of north-central Alberta and a report that would relate this regional geological study to the sulphur prospects of the following Sulphur Prospecting Permits.

Permit No.	Acres	Permit Holder
33	19,840	Alexandra Petroleum Ltd.
34	77,440	Alexandra Petroleum Ltd.
145	39,680	Jake Superstein
146	19,840	Alexandra Petroleum Ltd.
150	19,840	Ruth Superstein
151	19,840	Ruth Superstein
152	19,840	Ruth Superstein

Due to the regional nature of the study, no detailed photogeological evaluations have been undertaken. Aerial photographs and mosaics have been used, however, to assist us in forming opinions on the general nature of the terrain and the possibility of sulphur occurrences on the individual permits involved.

Although parties of J. C. Sproule and Associates Ltd. have conducted field studies of sulphur prospecting permits in the general area of this regional study, no field examination of the subject permits has been undertaken.

A general geological setting of the subject permits and their relationship to other sulphur permits in the area is shown on Figure 1.

REGIONAL GEOLOGY AND SULPHUR OCCURRENCE

The subject permits are located in north-central Alberta in the general area surrounding Fort Vermilion. In summary, within the area of interest, the principal bedrock formations are of Cretaceous age but, to the north and northeast, erosion has stripped off the Cretaceous beds exposing older Devonian rocks. The Devonian,as well as the overlying Cretaceous rocks, is generally inclined gently westward into the Alberta Syncline so that progressively younger rocks of both Paleozoic and Mesozoic ages are present in that direction.

For the purpose of this report, which is principally concerned with sulphur prospects, it is not necessary to describe the details of the stratigraphy of the area. The bedrock, whether of Devonian or Cretaceous age, is overlain by a variable thickness of glacial and related sediments. The thickness of these overlying sediments is generally at a minimum in those areas where river valleys are deeply incised and greatest in the hilly portions of the area.

The surficial geology of the area is of particular interest to the possible occurrences of sulphur.

Sulphur occurrences in the general region of northern Alberta and the Northwest Territories may be broken into three groups, as follows:

(1) In muskeg or other poorly drained lacustrine or "dried lacustrine" areas. The most important known apparent example of this type is the discovery occurrence on Sulphur Prospecting Permit No. 8, northeast of Fort Vermilion.

(2) Deposits of elemental sulphur in connection with active springs with or without associated gas.

(3) Cretaceous shales in the area frequently contain finely disseminated sulphur. Although we know of no reported concentrations of significant size from the Cretaceous, the possibility of such economic occurrences cannot be entirely eliminated.

We are not prepared, at this time, to enter into detailed discussions of theories of the origin of the various sulphur occurrences because of the large number of presently uncertain factors. Theories of origin from Paleozoic connate waters or from bedded Devonian and other gypsum and anhydrite deposits are, however, of principal interest.

It is of general interest to the overall sulphur problem in this region that continuous flowing sulphur springs have been known for many years within a broad area along the Mesozoic-Paleozoic geological contact that extends from western Saskatchewan, through the McMurray oil sands area, across the present region of sulphur permits into the southern part of the Northwest Territories near Pine Point and westward along the Liard River. It is of further

possible significance that there may be a genetic relationship between these sulphur occurrences and the McMurray oil, which has an average four to five percent sulphur content. In addition to this, there is considerable free sulphur associated with the McMurray oil sands, both within and outside of the oil saturated area. As a measure of the amount of sulphur already known to have been deposited, probably from the same type of connate waters that can be expected to have deposited the sulphur under study, we might refer to the "reserve" of sulphur in the McMurray oil sands. Recent estimates indicate that there is over 600 billion barrels of oil in place in the McMurray oil sands. This oil contains four to five percent of sulphur amounting to approximately eight to ten billion long tons.

The above and other evidence available would indicate that what is needed to produce an economic sulphur deposit in this area would be a favourable combination of faults and fractures for sulphate spring exits, sulphur supply in the connate waters and poorly drained lacustrine or other flat basin areas immediately adjacent to the spring exits. All these individual circumstances are known to exist but whether or not a proper combination of circumstances has produced commercial deposits in some location remains to be seen.

LOCAL GEOLOGY

The following is a discussion of individual permits in numerical sequence.

Permit No. 33

This permit, comprising 19,840 acres, is located just south of the Mikkwa River, approximately 90 miles southeast of Fort Vermilion.

An estimated 1,300 to 1,400 feet of Cretaceous shales, siltstones, and sandstones overlie Devonian rocks in this area. This, in turn, is covered with a mantle of glacial drift and lacustrine deposits.

The surface of the permit is inclined gently to the northwest and is drained by tributaries of the Mikkwa and Sputina rivers. Surface elevations vary from 2,100 feet above sea level in the southeast to just under 1,700 feet above sea level in the northwest.

Drainage of the area is fairly efficient, except in the general area of a small lake located near the centre of the permit.

Permit No. 34

This permit comprises 77,440 acres and is located along and to the south of the Peace River, about 65 miles east of the town of Fort Vermilion.

The permit is in the vicinity of the Cretaceous-Devonian boundary and is underlain by Devonian bedrock. In this regard, it is geologically analogous to Sulphur Permit No. 8, the sulphur discovery permit, about 12 miles to the west, which is similarly situated.

The subject permit is characterized by flat to depressional topography and sandy alluvium. The average elevation here is around 800 feet above sea level.

The extreme northern portion of the area is drained by the Peace River but no well developed drainage channels are apparent on the mosaic in the southern portion of the permit. Outlines of what are interpreted as old river channels cut across the central portion of the permit area in an east-west direction. Numerous small bodies of water occur within these channels. In the southern portion of the permit, there are a large number of small topographic highs or mounds. Similar features occurring at other locations within this region have been described as earth mounds, which are made up largely of soil material elevated by frost action.

Outcrops of Devonian bedrock are probably present along the Peace River in the extreme northern part of the area but are not expected to occur in other portions of the permit.

Permit No. 145

This permit, which comprises 39,680 acres, straddles the upper reaches of Harper Creek approximately 70 miles southeast of Fort Vermilion.

The permit occupies an area of generally poor drainage with numerous muskegs. Elevations vary from approximately 1,400 feet above sea level in the southeast corner of the area to around 1,200 feet above sea level in the northwest corner.

The thickness of Cretaceous sediments overlying the Devonian is estimated to be in the neighbourhood of 700 to 800 feet.

No outcrops of bedrock are anticipated within the boundaries of the permit.

Permit No. 146

This permit, comprising 19,840 acres, is located within the Caribou Mountains, some 65 miles northeast of Fort Vermilion.

The surface of the area slopes gently in a general southeasterly direction from approximately 2,200 feet above sea level to 1,800 feet above sea level.

Numerous lakes occur within the permit boundary, indicating a somewhat irregular drainage system.

The Cretaceous-Devonian boundary is projected in a southwest-northeast direction between the Caribou Mountains and the Peace River, approximately three miles southeast of the subject permit but at a considerably lower surface elevation. Thicknesses of Cretaceous and Recent sediments in excess of 700 feet are believed to overlie Devonian rocks in the permit area.

Permit No. 150

This permit comprises 19,840 acres and is located between the Caribou and Ponton rivers some 22 miles due north of Fort Vermilion.

An estimated 700 to 800 feet of Cretaceous sediments overlie Devonian rocks in this area. Discontinuous outcrops of dark grey Cretaceous shales and thin ironstone beds are exposed in the walls of the Caribou and Ponton river valleys on either side of the subject permit but within the permit iself the bedrock is generally masked by glacio-lacustrine sediments.

The area is characterized by gently sloping to slightly depressional topography with surface elevations ranging from around 1,900 feet above sea level in the northern portion to 1,400 feet above sea level in the southern portion. Drainage of the area is to the south but is somewhat imperfect, resulting in scattered closed basinal features containing muskeg.

Permit No. 151

This permit, comprising 19,840 acres, is located in the Buffalo Head Hills, near their eastern edge, and some 55 miles south-southeast of Fort Vermilion.

The area is underlain by Cretaceous rocks covered with a variable thickness of glacial till. The thickness of Cretaceous above the Devonian within the permit area is estimated to be in excess of 1,400 feet.

The Buffalo Head Hills represent a pre-glacial erosional remnant, rising abruptly hundreds of feet above the surrounding lowlands. Surface elevations within the permit area range from a maximum of 2,500 feet above sea level to a minimum of 2,000 feet above sea level.

The area is reasonably well drained and approximately 60 percent of the permit is tree-covered. A few, very small, lakes occur in the higher elevations of the northern and eastern portions of the permit and some poorly drained muskeg areas are present in the extreme south and southwest portions.

Permit No. 152

This permit comprises 19,840 acres and is located on the Ponton River approximately 10 miles northwest of Fort Vermilion. Highway 58, an all-weather road from High Level, passes along the northern boundary of the subject permit.

Approximately 350 feet of Cretaceous rocks are present in the area and are covered by varying thicknesses of glacio-lacustrine deposits.

The surface of the subject permit is relatively level but drainage is apparently good as a large portion of the ground is presently under cultivation. No depressional features or muskeg areas stand out on the mosaic.

SUMMARY AND CONCLUSIONS

Three Sulphur Prospecting Permits held in the name of Alexandra Petroleum Ltd., one held in the name of Jake Superstein, and three held in the name of Ruth Superstein together comprises approximately 218,320 acres. These permits are distributed over an area that extends approximately 100 miles from north to south and 90 miles from east to west.

Devonian strata form the bedrock in Permit No. 34 along the Peace River immediately west of the Fifth Meridian. Cretaceous shales and sands form the bedrock in all the other subject permits.

From our overall sulphur studies in the general area, we conclude that surficial deposits are the most likely locations for sulphur occurrences. We also conclude that deposits of sulphur are most likely to occur in poorly drained areas, such as muskegs, which may be located along or adjacent to fractures and/or faults that permit sulphur-bearing waters from the Devonian to reach the surface. On this basis, the most favourable areas in which to explore for possible sulphur accumulations would be where the relatively plastic Cretaceous beds overlying the Devonian are thin or absent, providing sulphur springs with an easier access to the surface. Of the seven subject permits, only one, Permit No. 34, has this more favourable situation. The other six have moderate to thick sections of Cretaceous rocks overlying the Devonian.

It is recommended that consideration be given to retaining Sulphur Prospecting Permit No. 34 for further study. A recommended exploration program from this permit would include a photogeological study in which the areas most prospective for sulphur accumulation would be selected. This would be followed by a preliminary field examination after the frost is out of the ground in the spring. If analyses of samples from the preliminary field examination should yield encouragement, an additional exploration program would be recommended.

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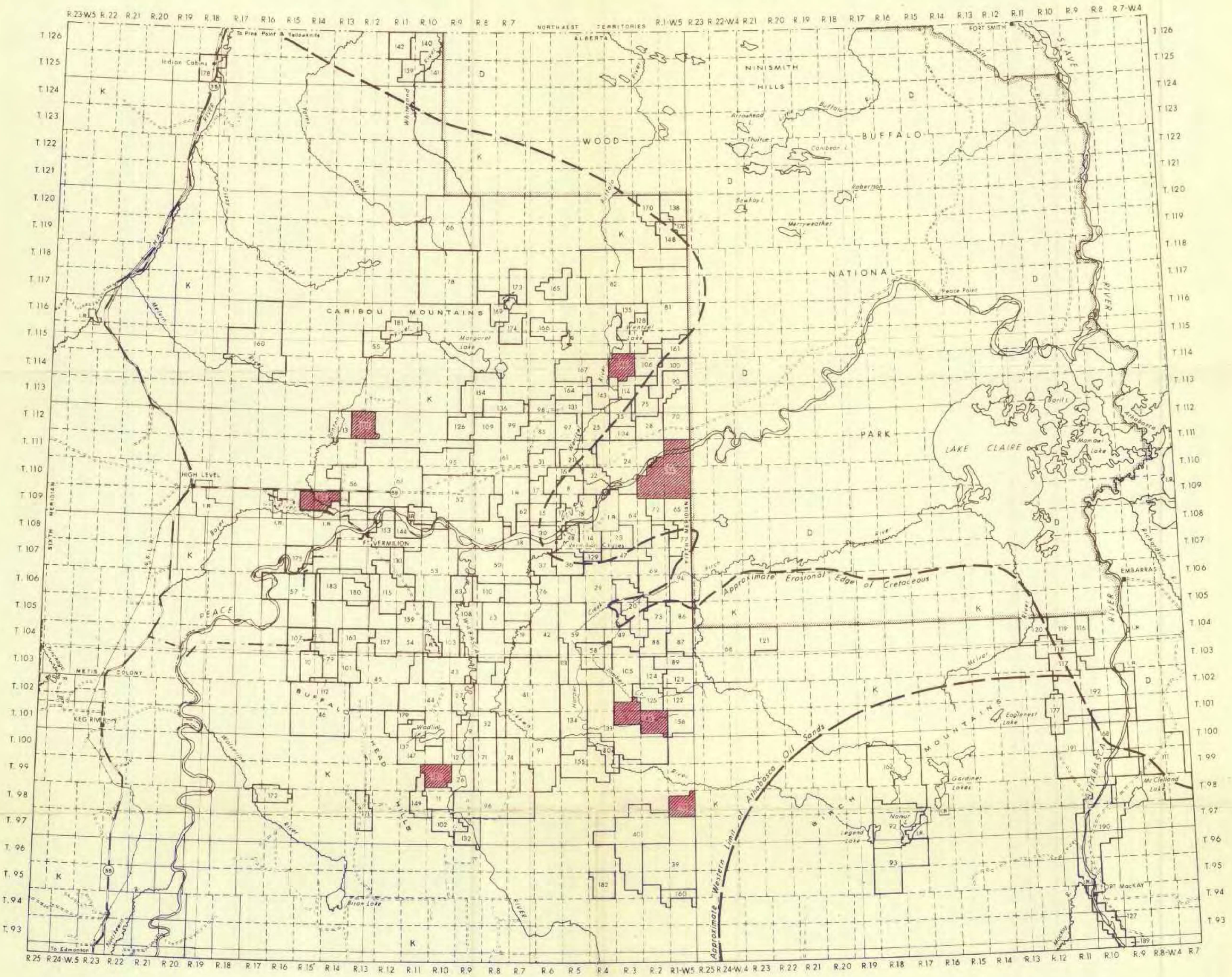
[redacted]

V. A. Farley

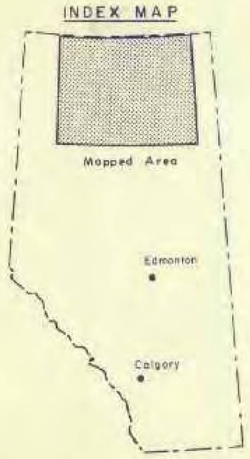
[redacted]

S. R. L. Harding, P. Geol.

1009 Fourth Avenue S. W.,
Calgary, Alberta.
January 13, 1969,
VAF/SRLH/fc



INDEX MAP



LEGEND

- K — Cretaceous Formations
- D — Devonian Formations
- 94 — Sulphur Prospecting Permits
- Subject Permits
- Highway - Gravelled
- All Weather Road - Gravelled
- Dry Weather Road - Dirt - Truck Trail

NORTH - CENTRAL ALBERTA

SHOWING

SULPHUR PROSPECTING PERMITS

J. SUPERSTEIN

16 0 16 32

SCALE: 1" to 16 MILES

NOTE: Permits as Published to: March 29, 1968 (Data on later permits not yet available)

J.C. SPROULE AND ASSOCIATES LTD., CALGARY

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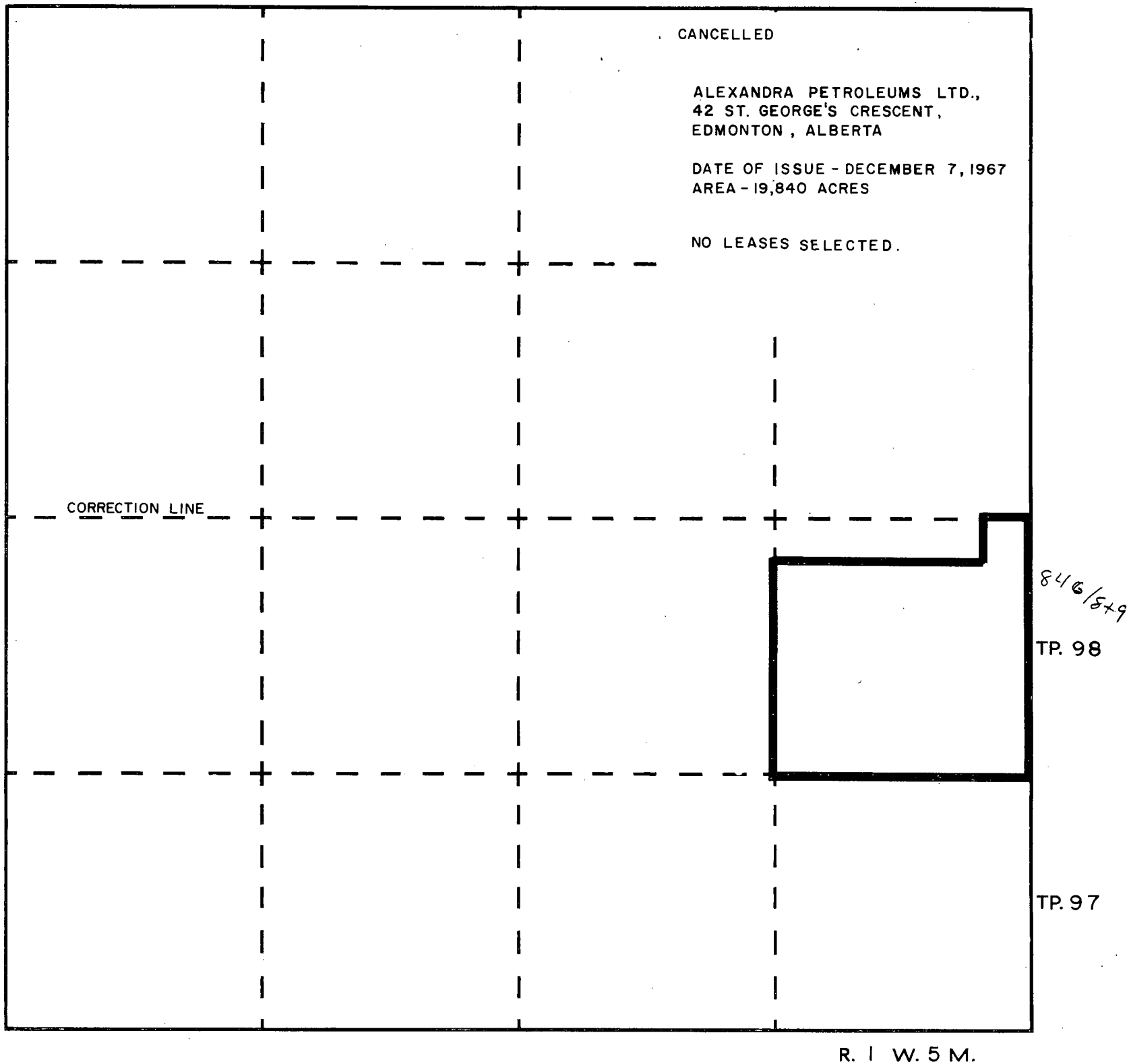
SULPHUR PROSPECTING PERMIT NO. 33



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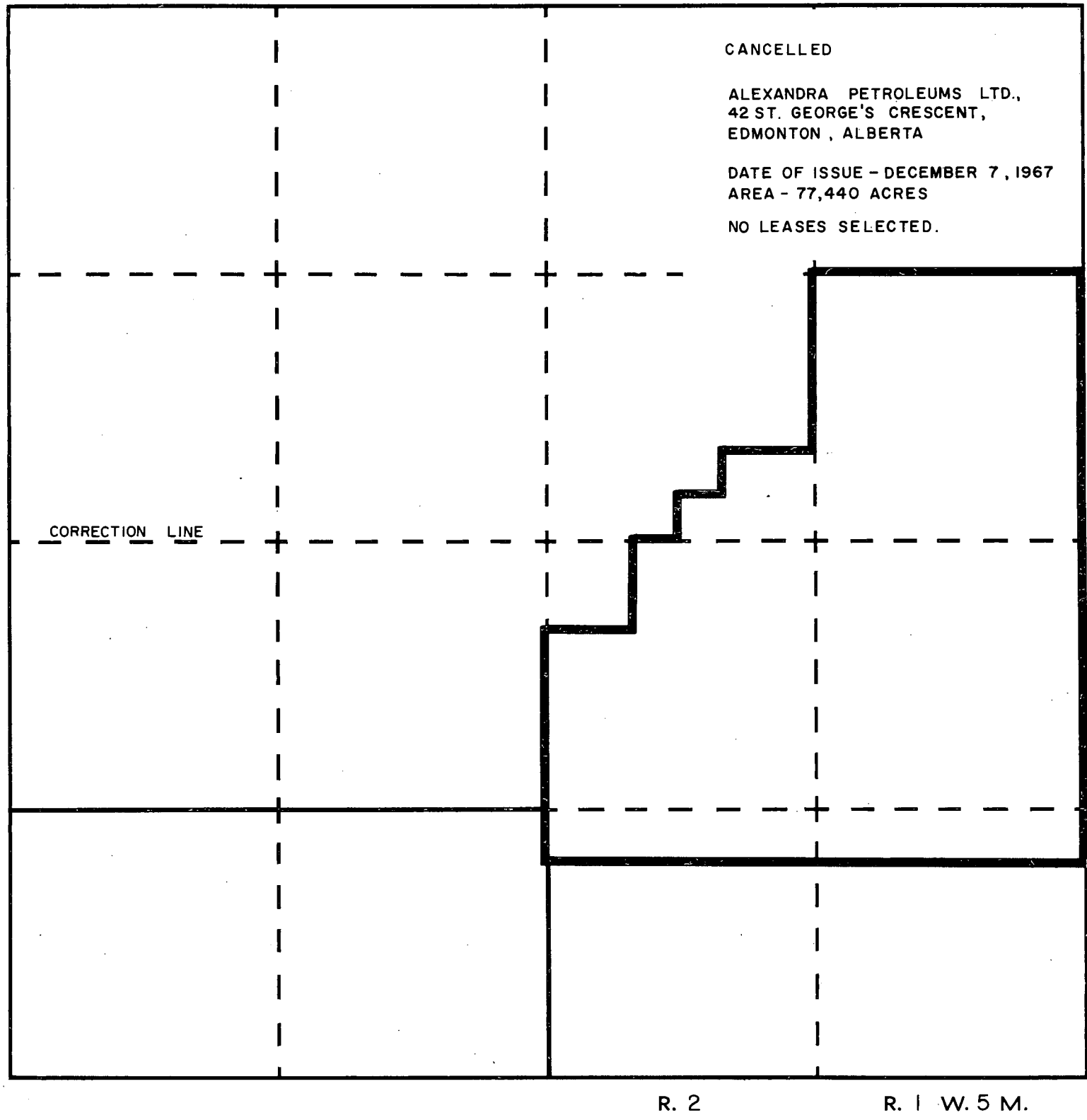

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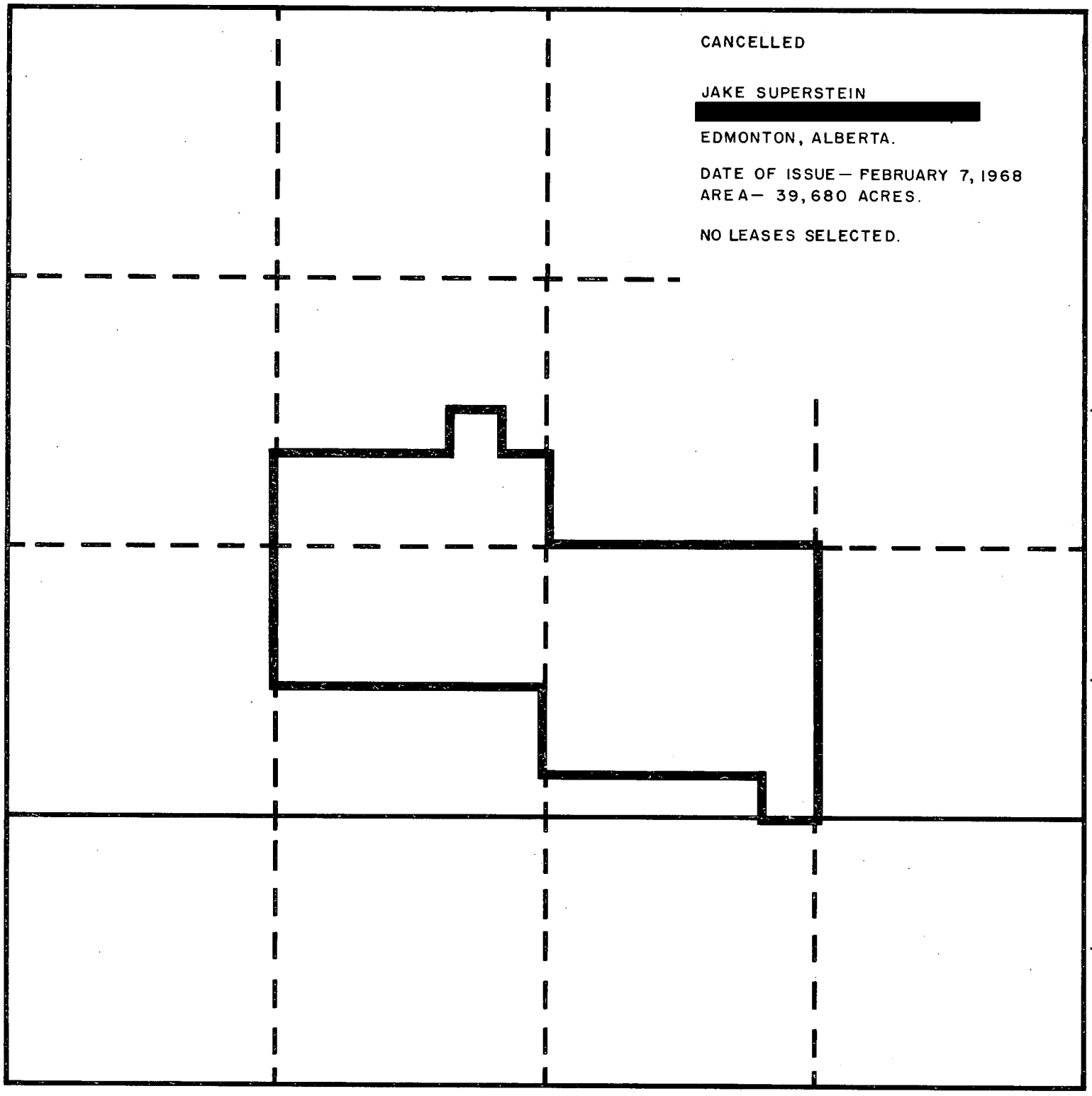
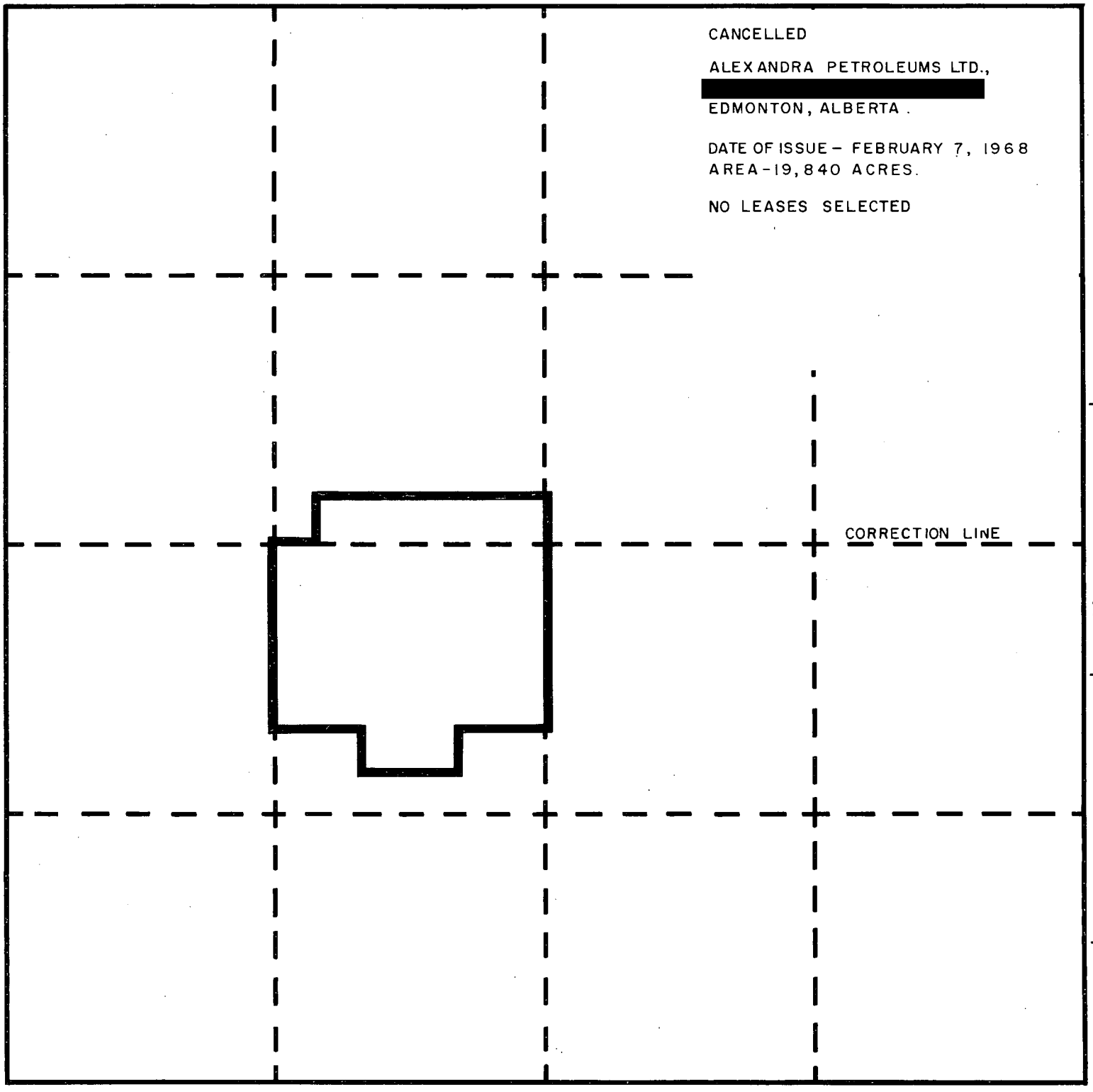


84 G/9 E's
NE

SULPHUR PROSPECTING PERMIT No. 146



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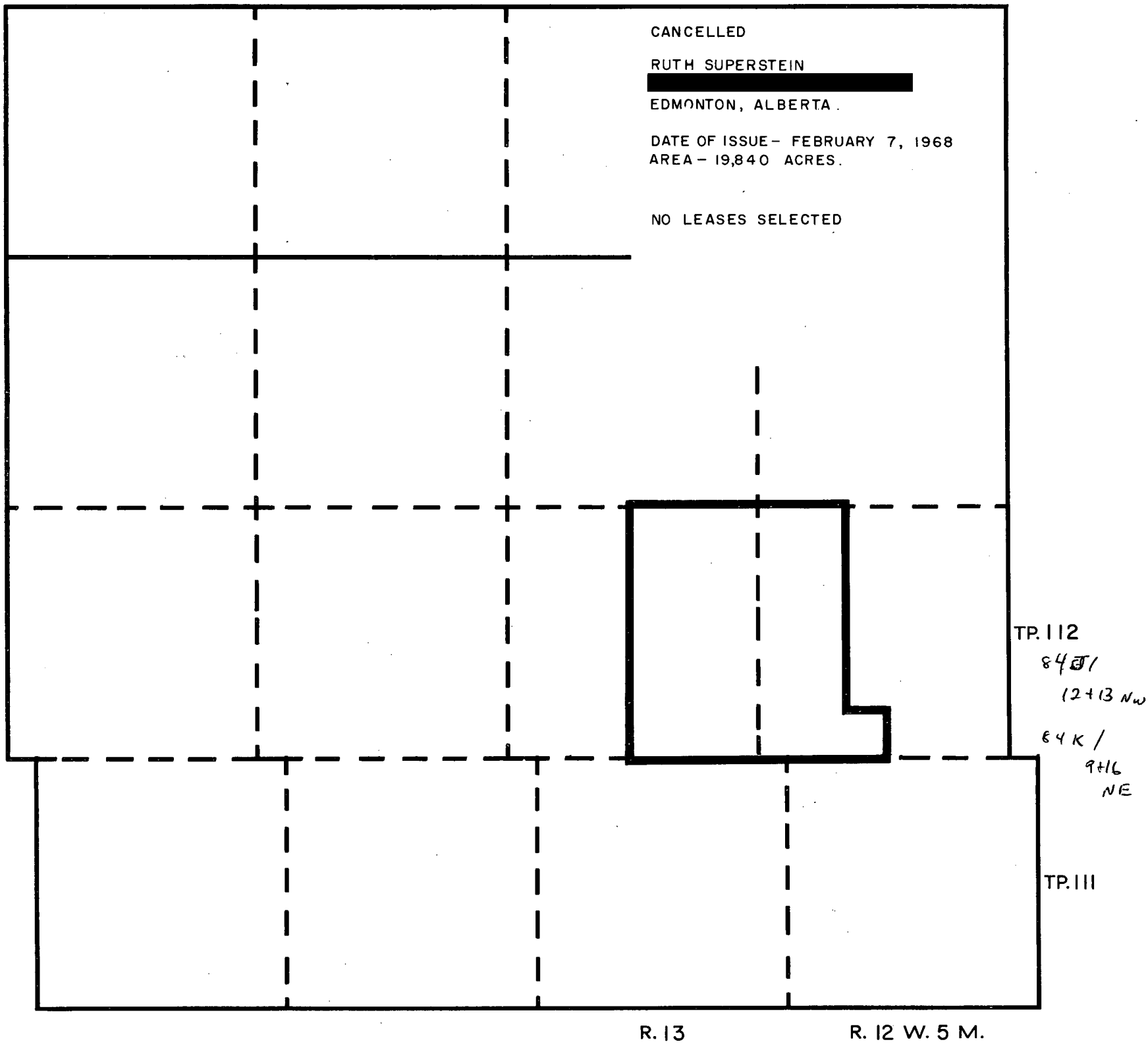

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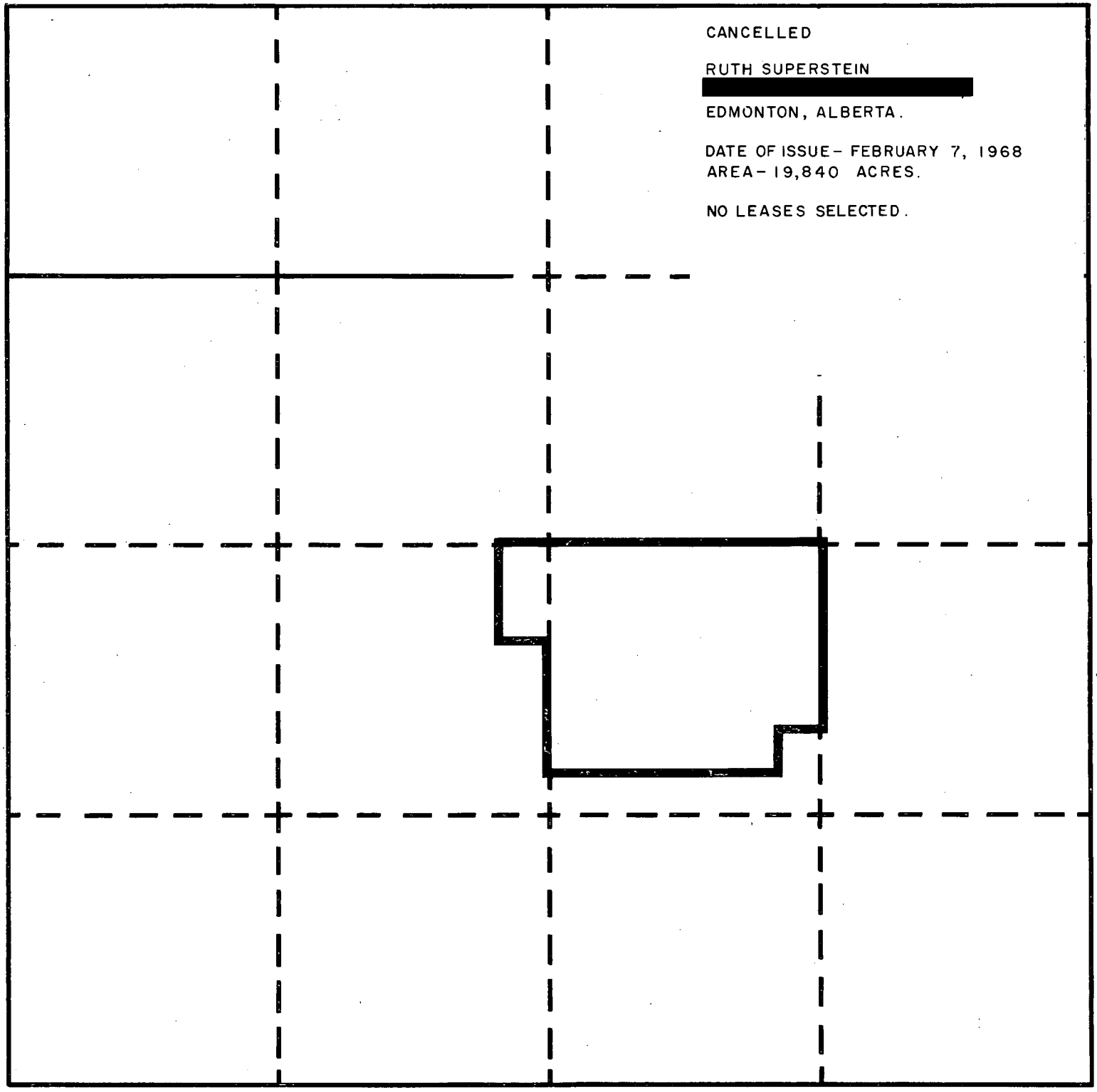

SULPHUR PROSPECTING PERMIT No. 152