

GEOLOGICAL REPORT
MURPHY CORPORATION PERMIT HOLDINGS
SOUTH TATILINA LAKE AREA, N.W.T.

Prepared for
Murphy Corporation
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INTRODUCTION

The present report contains the results of a study of geology and terrain in the Hay River-South Tathlina Lake area, Northwest Territories, conducted by J. C. Sproule & Associates at the request of Murphy Corporation. The principal objective of this study was to indicate and evaluate conditions favorable for the accumulation of petroleum and natural gas within the lands held under P. & N.G. Permit by Murphy Corporation. The Permits, numbered 1397, 1398, 1399, 1400, 1401, 1402 and 1403, are situated between Longitudes $116^{\circ} 30'$ and $117^{\circ} 15'$, Latitudes $60^{\circ} 20'$ and $60^{\circ} 30'$. They cover an area of approximately 700 square miles, or 452,000 acres. The southern limit of the Permit area coincides with the boundary between the Province of Alberta and the Northwest Territories.

The geological evaluation of the area was carried out using several techniques. A field investigation of outcrops and terrain in the Permit area and its vicinity preceded a regional subsurface study, which entailed examination of core, sample and electric log data from pertinent wells. Much use was made of aerial photographs for photogeological analysis. Data on test holes drilled in the vicinity of the Permits were obtained by Murphy Corporation, and this information was taken into account in the structural analysis of the area.

The field work was carried out in the second half of August, 1957. The area was extensively flown by helicopter in a search for outcrops and in order to become acquainted with the physiography of the area. Fair exposures may be found on the banks of the Hay River, particularly from Grumbler Rapids north approximately to "Mile 18" on the Mackenzie Highway. Most of these outcrops were accessible from the highway and were reached by truck and on foot. Only a small number of outcrops was encountered at some distance from the Hay River. In all outcrops special attention was given to porosity and traces of hydrocarbons.

The project was conducted under the supervision of R. deWitt, who was assisted in the field by student-geologist W. R. Turner. The helicopter used was a Bell Model G-2, rented from General Helicopter, Santa Barbara, California. The pilot was D. L. Sides.

PHYSIOGRAPHY AND CULTURE

The topography of the project area shows marked relief, two main levels being present. The lower level forms a low, flat land surrounding Hay River, with elevations from 930 feet to 1,000 feet above sea level. Most of the Permit area is located in this low land. To the west, a steep slope rises to the elevated Cameron Hills plateau which reaches a height of more than 2,800 feet.

Hay River - The Hay River crosses part of the subject area, flowing in a north-east direction to empty into Great Slave Lake. In most places the river is some 250 feet wide. The water flows with moderate speed except near the rapids and falls, such as Grumbler Rapids, located within the Permit area, and Alexandra and Louise Falls farther downstream. The water level fluctuates approximately six feet, depending on the season of the year. During the summer of 1957 the river was abnormally high, due to excessive rainfall. The Grumbler Rapids were hardly perceptible for this reason, and part of the outcrops along the river was under water.

Cameron Hills - The Cameron Hills constitute a relatively flat plateau area which slopes to the southwest. The northeast corner of the hills is the highest part and forms a conspicuous buttress rising up from the surrounding lowland. The plateau is 2,500 feet to 2,800 feet high within the Permit area, and is only sparsely covered by shrubs and trees. Glacial grooves and boulders are abundant on the top of the plateau, where they are preserved on a thick layer of ground moraine deposits. These grooves are particularly obvious on aerial photographs.

In contrast with the plateau, the steep slopes to the north and east are covered with spruce trees. Numerous small streams cut deeply and run almost straight down the soft slope. Most of the hills appear to be composed of shales, which break in parallel slices along the slopes and cause numerous small slump terraces. Towards the foot of the hills the decomposed shale forms a broad fan of outwash. Good outcrops are scarce on the Cretaceous hills; a few were found near the edge of the plateau in the upper reaches of small streams, where slumping was relatively fresh.

Permits Nos. 1398 and 1401 are situated entirely on the Cameron Hills and their sloping eastern edge.

Lowlands - Most of the remaining Permit land held by Murphy Corporation lies in a relatively flat, poorly drained area, which is covered by lakes and muskeg. Elevations vary from approximately 930 feet to 1,000 feet. Dry spots are covered with spruce, pine and poplar bush. The wet terrain is virtually inaccessible in summer and, therefore, exploratory operations should be carried out during the winter.

Access Roads - The area may be easily reached from Edmonton by highway. The Mackenzie Highway is a well maintained gravel road, which is suitable for heavy traffic all the year round. It closely follows the left bank of Hay River for a distance of 30 miles through the Permit area. The shortest connection to

Edmonton by road is via Lesser Slave Lake, a distance of 647 miles from the Alberta border. The distance from the northeast Permit boundary to the settlement of Hay River is 52 miles.

An old winter tractor trail runs partly parallel with the Mackenzie Highway. It was the only overland route connecting Hay River Town with the Peace River district prior to the completion of the highway in 1950. Another trail is discernible on photo-mosaic Sheet No. 1. It runs from the river in an easterly direction and lies close to the south border of the Permit area. The present condition of the trail is not known.

Habitation - The Permit area is not inhabited. The nearest small Indian settlement, called Indian Cabins, is 9 miles south of the Alberta border. The only facility that is offered at Indian Cabins is a small restaurant which also carries gasoline. A similar restaurant is situated at "Mile 28" on the Mackenzie Highway, at the junction with the Hills Lake Highway, 24 miles north of the Permit area.

Hay River Town lies at the mouth of the Hay River where it enters Great Slave Lake. This settlement has a partly white population and it offers modest accommodation for visitors. Other facilities include an Army Signals station which provides fair radio communication with Alberta and many places in the Northwest Territories, a post office, a garage, several general stores, including the Hudson's Bay Company, and a well provided Imperial Oil Limited depot. There is no bank in town. Hay River possesses an air strip where Canadian Pacific Airlines planes land twice a week. A Norseman aircraft which is mounted on floats in summer time and on skis in the winter, can be chartered locally.

GENERAL GEOLOGY AND STRATIGRAPHY

The Murphy Corporation Permits lie in the extreme northeastern portion of the Alberta basin. The regional dip in this area is to the west and southwest. The sedimentary area ends along the edge of the Canadian Shield, some 150 miles northeast of the subject lands.

Pre-Devonian beds of undetermined age are generally thin in this portion of the Alberta basin. However, north of Mackenzie River dolomites, sandstones and shales of Ordovician age are encountered. In the Imperial Windy Point deep test, located at $61^{\circ} 18' N$, $115^{\circ} 51' W$., more than 500 feet of red beds, containing dolomite and anhydrite have been logged. This sequence may also belong in part to the Ordovician. The area with more pre-Devonian beds is separated from the northern Alberta basin, where they are thin or absent, by a boundary line which probably runs west, approximately along the south shore of Great Slave Lake to Hills Lake. This may be the boundary between the Alberta basin and the Mackenzie basin, which lies north of it.

The border zone between the two major basins seems to have been an area of intensive reef development in the Middle Devonian. Reef dolomites are found in outcrop in the Pine Point area, south of Great Slave Lake, and

northwest across the lake near Windy Point. These reefs belong to the Presqu'ile dolomite. To the south, near the Murphy area, the reef dolomite occurs lower in the Middle Devonian sequence, while the upper portion is strongly anhydritic.

Possibly connected indirectly with the interbasinal zone is an optimum development of clastic limestone and silt in the Grumbler formation of Upper Devonian age (see Figures I, V and VI) in the vicinity of the Hay River and as far southwest as the Sun and Imperial Russet Creek wells.

Interest in the general area is stimulated by major structural trends which are almost at right angles with the general southeast orientation of the monoclinial Alberta basin. These trends form the continuation of a complex system of major faults that have been mapped on the Precambrian Shield near Great Slave Lake. Within the sedimentary area the same basement disturbance has caused block faulting and regional arching, which in turn influenced such conditions as reef development and dolomitization. Thus a variety of stratigraphic and structural traps for oil and gas may be expected in this region.

Descriptions of the formation which are present in the Murphy Corporation Permit area are summarized in the following table:

Table of Formations

<u>System</u>	<u>Formation</u>	<u>Lithology</u>	<u>Thickness Feet</u>
PLEISTOCENE		Boulder clay, gravel, sand.	0-500
CRETACEOUS	Undifferentiated	Shale, dark grey, marine.	0-1000+
		Unconformity	
UPPER DEVONIAN	Wabesan	Limestone, fragmental.	eroded
	Trout River	Limestone, silty, cream, granular.	0-150
	Grumbler	Reef limestone and dolomite; detrital limestone, silty limestone, silty shale and shale, partly reddish stained.	400-700
	Alexandra	Limestone, cream, dense; biostromal limestone and dolomite.	100

Table of Formations - Continued

<u>Series</u>	<u>Formation</u>	<u>Lithology</u>	<u>Thickness Feet</u>
	Hay River	Shale, greenish gray; with silty limestone, biostromal limestone and minor sandstone near the top.	1250
		Unconformity	
MIDDLE DEVONIAN	Slave Point	Limestone, finely elastic, brown with petroliferous odor.	200
	Watt Mountain	Breccia of limestone or dolomite; green (residual?) clay-shale.	0-50
		Unconformity	
Elk Point Group	Presqu'île	Dolomite, brown, crystalline, in part reefal; abundant anhydrite in upper half.	700
	Pine Point	Limestone, brown, argillaceous.	absent?
	Chinichaga	Anhydrite and dolomite.	200
		Unconformity?	
UNIDENTIFIED	Red Beds	Dolomite, sandy shale, anhydrite.	100±
	"Granite Wash"	Sandstone.	40±
PRECAMBRIAN		Igneous and metamorphic rocks.	

Description of Formations

Precambrian

Igneous and metamorphic rocks of Precambrian age lie at the surface of the Canadian Shield. The boundary between the Paleozoic sediments and the Precambrian rocks of the Shield follows a southeast direction, crossing Great Slave Lake. The subject area is approximately 150 miles west-southwest of the edge of the Shield. Igneous rocks are exposed on the south shore of Great Slave Lake, about 10 miles east of the mouth of Slave River, where they occur at lake elevation of 513 feet above sea level. From this location the Precambrian surface dips in southwesterly direction. It lies at a depth of 2,150 feet to 2,900 feet below sea level in the area of the Murphy Corporation Permits, or at 3,100 feet to 3,500 feet below the surface in the five eastern Permit blocks (Figure II).

"Granite Wash"

The Precambrian is generally overlain by sandy beds of varying age, thickness and composition. The sandstones may be accompanied by carbonates, evaporites, shale and breccia, which together make up the so-called "Granite Wash." Sandstones, equivalent to those encountered in Imperial Yates River No. 1, are probably present in the Murphy Permit acreage with a thickness of approximately 50 feet. A core taken in this interval in the Yates River well showed tight quartzose sandstone, pink in colour, with poorly sorted grains.

Red Beds

In most of the Alberta basin the "Granite Wash" is overlain by Red Beds. These consist of sandy and silty shales with anhydrite, and are characterized by bright, brick red colours. Their age has not been established, but probably they preceded the Devonian. The thickness varies; it rarely exceeds 100 feet. In the subject area some 50 or 70 feet may be encountered.

Chinchaga Formation

The Chinchaga formation of Middle Devonian age forms a dolomite and evaporite unit at the base of the Devonian sequence. Sandstone is found in some places at the base of the formation, but in other localities poorly sorted quartzose sandstone occurs at the top. It is expected that approximately 200 feet of Chinchaga will be encountered within the Murphy lands.

Pine Point Formation

The Pine Point limestone is found in outcrop near Resolution and at Dawson Landing on the south shore of Great Slave Lake. It has been penetrated by bore holes in the Pine Point Concession of Consolidated Mining and Smelting Co. and in Imperial Windy Point No. 1, located at $61^{\circ} 18' N.$, $115^{\circ} 51' W.$ At Windy Point the thickness of the interval is 375 feet according to Cameron (1922).

The formation consists of brown to dark brown, fossiliferous limestone, which is possibly bituminous. The top of the Pine Point formation is chosen at the base of the overlying dolomites, but this lithological change may not be confined to one constant stratigraphic level, since the limestone and dolomite seem to be, at least in part, time equivalents.

The Pine Point limestone was not found in Imperial Yates River No. 1, in Lsd. 16-18-126-14 W. 5th, four miles southeast of the subject area. It is not expected that the formation will be encountered in the Murphy lands.

Fresquille Formation

In the subject area the Fresquille consists largely of crystalline, detrital and reef dolomites, partly associated with anhydrite. Commonly colonial corals can be recognized despite intensive recrystallization. Vuggy porosity is partly connected with obliterated fossils such as corals and stromatopora, and may be observed in most cores and outcrops of the formation. Oil-staining is common in the Fresquille and oil seepages of dark brown oil, dripping from the vugs and fissures of the rock, can be observed at many places near Windy Point, on the southwest of Great Slave Lake, and also at the south shore of the lake.

The top of the formation is characterized by bright green clay which occurs in the form of vug-fillings and thin irregular layers within the upper 10 or 20 feet of the dolomite. This clay suggests leaching of the Fresquille surface prior to deposition of the disconformably overlying beds.

The upper one-third to two-thirds of the Fresquille formation contains considerable anhydrite in most wells in the northeastern portion of the Alberta basin.

The Fresquille, which was named on Great Slave Lake, is equated to the Muskeg and the Keg River formations in the subsurface of northern Alberta. The Muskeg formation is equivalent to the upper anhydrite and dolomite sequence, while the underlying Keg River equivalent consists more uniformly of brown dolomite, and in places of limestone.

In the Murphy Permit area a thickness of 700 feet of Fresquille dolomite and anhydrite may be expected in the subsurface.

Watt Mountain Formation

The Watt Mountain formation is widely recognized in northern Alberta and forms the top unit of the Elk Point group. It consists of siltstone, green shale, dolomite, and partly of breccia. The unit is relatively thin, 10 to 150 feet, and it probably represents widespread uplift or withdrawal of the sea towards the end of Elk Point time.

Near Hay River the Watt Mountain is indistinct. Efforts to trace the formation in outcrops or cores in this area have been unsuccessful thus far, but it can be recognized in cuttings, as green shale, and also on electric logs.

In the subject area the Watt Mountain is approximately 40 feet thick. The "Amco shale," a thin argillaceous dolomite zone found in the Pine Point concession, which occurs in the basal Slave Point, has been regarded by some authors as a Watt Mountain equivalent, but this correlation is questionable.

Slave Point Formation

In the present report the Slave Point formation is tentatively placed in the Middle Devonian, but several authors consider it to be the basal part of the Upper Devonian on the basis of faunal interpretation. The formation has a remarkably uniform lithology in northern Alberta and in the southern Territories. It consists of brown, finely elastic limestones. Almost invariably the limestone emits a strong petroliferous odor when it is struck with a hammer. Oil-staining can be noticed in most cores that have been recovered from this unit, but porosity is generally very poor. The Slave Point carries a fauna of algal(?) balls, *Archimedes* and poorly preserved brachiopods. However, the nature of the rock suggests that locally the elastic limestones could be associated with reefs, and under favorable circumstances these might offer better porosity and suitable conditions for the formation of oil or gas reservoirs.

The Slave Point varies slightly in thickness, possibly due to erosion which may have caused a disconformity at the top of the formation. Within the subject area a thickness of 180 feet is expected.

Hay River Formation

The Hay River formation, or "Hay River shale," is generally considered as representing the lower portion of the Upper Devonian. It consists mainly of greenish grey shale with a few thin limestone bands. Siltstones, silty limestone and biostromal beds are found near the top (Figure II) and may be grouped in the Louise Falls member. The Hay River shale is relatively poor in fossils. It is well exposed on Hay River, where most beds can be traced for some distance. Near Alexandra Falls and north of Louise Falls two siltstone units were found in the Louise Falls member. The upper one, forming the top of the Hay River formation, is 10 to 15 feet thick; it remains remarkably uniform and may be recognized in the subsurface as far south of the Falls as the Murphy Permit acreage. The lower siltstone unit is more than 20 feet thick near the junction of the Mackenzie and the Hills Lake Highways at "Mile 28," but five miles to the south it has wedged out entirely.

Several coralliferous biostromal beds were found in the Louise Falls member, ranging in composition from pure limestone to dolomite. Slight porosity in these biostromes is not uncommon, particularly in the more dolomitized types. Their lateral extent seems to vary considerably; some can be traced many miles, but others are small and have more the character of mounds. It is not believed that the biostromes of the Louise Falls member are present in the Murphy lands. Maximum thickness of organic beds observed on Hay River is 15 feet.

Alexandra Formation

The Alexandra formation is approximately 100 feet thick and consists of light colored cryptocrystalline limestone on Hay River. It causes Alexandra Falls and a canyon with precipitous walls for some distance downstream. This

In the subject area the Watt Mountain is approximately 40 feet thick. The "blue shale," a thin argillaceous dolomite zone found in the Pine Point concession, which occurs in the basal Slave Point, has been regarded by some authors as a Watt Mountain equivalent, but this correlation is questionable.

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Alexandra Formation

The Alexandra formation is approximately 100 feet thick and consists of light colored cryptocrystalline limestone on Hay River. It causes Alexandra Falls and a canyon with precipitous walls for some distance downstream. This

is the type locality of the hard and tight Alexandra limestone. Superficially the limestone appears rather homogeneous, but closer examination reveals that it consists largely of elastic pelletal limestone, tightly cemented by calcite. Numerous beds, up to a few feet thick, contain an abundance of the small algal or stromatoporoidal organisms *Amphigora*. This type of deposit is thought to have originated under marine shallow water conditions, similar to those existing at present on the Bahama Banks. South of the Falls the Alexandra formation appears to grade into "normal" marine, finely crystalline limestone. Limestone studies by Illing (1954) and Beales (1957) indicate that porosity reaches a maximum on the fringes of the shoals. It will, therefore, be advisable to examine closely the Alexandra formation in the subject area wherever it is penetrated by drilling, since an up-dip porosity trap is possible.

At the type locality the Alexandra formation incorporates a biostromal zone near the base. The upper and lower boundaries are arbitrarily placed in a succession with gradational vertical changes. The lower contact is at the top of a cross-bedded, finely sandy siltstone band, and the upper limit is chosen at the base of a fine-grained limestone zone of distinctive mottled appearance.

The Alexandra formation correlates with part of the "Shale Unit" of northern Alberta. Within the Murphy Permit area the top of the limestone is expected at a depth of 800 to 500 feet.

Crumbler Formation

The Crumbler formation is partially exposed on Hay River. It underlies the surficial sands and gravels in most of the lowland in the Murphy Permits.

The formation consists of elastic limestone, similar to that of the Alexandra, reefs, and a considerable proportion of silty and shaly beds, which all show lateral transitions. Many of the outcrops on the Hay River are stained with maroon coloring.

The most interesting of the smaller sub-units are the reefs, some of which are of the biohermal type (Harding, 1957); other reefs are vaguely bedded and partially elastic. It was noticed that the bioherms are almost invariably overlain by bedded encrinites, or crinoidal limestones. Possibly the encrinite beds exposed along the Hay River (Plate V-A) are associated with reef. Reef units are most numerous in the lower part of the Crumbler from the Hay River northwestward to the vicinity of Kakisa Lake. Farther west reefs are more prominent in the upper Crumbler, in which they reach a thickness of 60 to 80 feet. Near the Hay River thin reefal zones are found as far south as Crumbler Rapids. Reef limestone can be seen in a flat-lying outcrop near the northeast corner of Tathlina Lake, and porous reef (?) dolomite occurs in a small exposure on Yates River. The latter is the only Crumbler outcrop observed east of the Hay River. In the subject area reef zones not exceeding approximately 15 feet in thickness are probably present. It is thought that the chance of finding thick reef is small.

Most of the shales and silty limestones of the Crumbler formation are richly fossiliferous and contain abundant brachiopods, bryozoa, solitary and

colonial corals. The majority of Grubler beds are tight. Good porosity is found only in dolomitized reef beds. Grubler outcrops on Hay River are described in Appendix I.

In westerly and southerly directions the lower half of the Grubler changes progressively into green shale which forms the upper part of the "Shale Unit" of northern Alberta (Figures I, V and VI). The upper part of the formation is continuous with part of the "Silty Limestone Unit" of northern Alberta, which correlates in turn with the major part of the Winterburn group (Wabamun and part of the Calmar).

The thickness of the Grubler formation in the Murphy area is estimated at 700 to 500 feet.

Trout River Formation

The Trout River formation consists of cross-colored, silty limestone and calcareous sandstone. In places the beds appear to be finely porous and patches of black pyrobitumen are common.

The contact of the Trout River with the underlying Grubler formation is marked by a major change in fauna, which can be noticed in the field without much difficulty. Corals and the brachiopod *Atrypa* are absent in all Devonian beds that occur stratigraphically higher than the Grubler (Trout River and Wabamun). The same faunal change takes place within the silty Calmar formation of central Alberta. Probably the Trout River can be correlated with the upper portion of the Calmar and with most of the Grainsia formation in the Edmonton area.

Outcrops are not plentiful. On Kaldia River, less than a mile from the north side of Tathlina Lake, a small exposure of Trout River limestone was found. Most probably the erosional east limit of the formation lies within the western part of the Murphy Corporation lands (Figure IV), but it has not been observed in this area.

It is difficult to trace the Trout River southward in the subsurface, due to the fact that fossils are scarce, and also because the lithology is less distinctive than in the north and east. The cross sections (Figure V to VIII) show an attempt to correlate the Trout River interval in various wells. The lower limit of the formation is probably accurate, but the top could be placed some 50 feet higher in the section in all wells.

The Trout River is almost 200 feet thick. However, it is unlikely that the formation reaches this thickness in the subject area due to erosion.

Wabamun Formation

The Wabamun formation consists of limestone and reaches a thickness of 700 feet farther west. In the Permit area the Wabamun has been removed completely by pre-Cretaceous erosion.

Cretaceous

Dark grey shales of Cretaceous age, containing fish scales, underlie most of the Cameron Hills, where they may reach a thickness of more than 1,000 feet. Foraminifera, collected at one locality (D.L. Campbell, 1956), form an assemblage similar to that of the Shaftesbury in the Peace River District. It is probable that most of the shale series in the Cameron Hills belongs to the Lower Cretaceous.

It is difficult to find good exposures, as the shales have a tendency to slump down the sides of the Cameron Hills. Small exposures were found near the upper edge of the plateau at the northeast corner of the Hills.

STRUCTURE

General Information

The northwest-trending structural monocline of the Alberta Basin terminates within the southern Northwest Territories. The area occupied by the Basin is bounded to the north by the Mackenzie River above its confluence with Liard River. The enclosed structure maps, drawn on the Precambrian basement (Figure II), the Slave Point formation (Figure III), and the Grubler formation (Figure IV), illustrate the structural pattern of the Hay River area in relation to adjacent portions of the sedimentary basin.

The contour map of the Precambrian surface (Figure II) shows a north-south strike within the Permit area with an average dip to the west of 28 feet per mile. This marked deviation from the regional northwest strike in the Alberta Basin is the result of pronounced, broad structural nosing from Great Slave Lake to the southwest, with the axis of the nose approximately parallel with Hay River. Subsidiary undulations along the same trend are also evident on this map. Several of these undulations may be interpreted as a system of horsts and grabens separated by faults. Indirect evidence of complicated vertical movements is found on the cross sections (Figure V and VI), between Imperial Nat Lake No. 1 and Imperial Dizzy Creek No. 1. Between these wells, movement in opposite directions may have taken place along the same faults in pre-Devonian, Devonian and post-Devonian time. There is no doubt that the fault trends which are mapped in the Precambrian east of Great Slave Lake can be projected to the west and southwest, and into the sedimentary area.

It appears likely that strong northeast-southwest tectonic trends were in evidence in Precambrian time. Rejuvenations of these lines of weakness in later geological periods have controlled the position of oil-forming facies, as well as of oil reservoirs such as reefs and clastic bodies. It should also be noted that the basin has been tilted to the south and west, probably in late Paleozoic and Mesozoic time. Any structural and/or paleotopographic irregularities along these trends, whether they be fault scarps or complicated fault and joint systems affected by erosion, were tilted along with the basin floor and this influenced further concentration of oil and gas in traps.

The Slave Point structure map (Figure III) shows the same general trends as Figure II. The position of some northeast faults have been inferred near the Hay River, south of the Northwest Territories border. Undoubtedly more such faults occur both north and south of the border in the Hay River area.

Figure IV is a structure map contoured on the base of the Trout River formation or on top of the Grumbler where it has not been subjected to erosion. The top of the Grumbler is one of the markers, high in the stratigraphic column, which can be carried over a considerable area. As shown on this map, the Grumbler is not eroded in the western part of the Murphy Corporation Permit area. Contouring indicates an anticline with a southwest-trending axis on which Shell Kakisa River No. 1 and Shell Thurston Lake No. 1 are located. Parallel to this anticlinal feature is a syncline, which is occupied in part by the Cameron Hills.

Only a few structural phenomena were observed on outcrop in the field. Direct evidence of faulting was noticed on Reef Creek, some four miles south of Heart Lake near the Mills Lake Highway. At this locality biostromal dolomites and limestones are cut by three or four small northwest-striking faults with maximum displacement of 30 or 40 feet. The presence of this fault trend, at right angles to the dip, is encouraging. In the subsurface, faulting of this type should create structural traps.

A slight reversal in dip near "Mile 38," Mackenzie Highway, on the banks of Hay River is due to draping of beds overlying the bichorus (Plate IV-A).

Minor structural undulations were noticed in the lithographic limestone beds that are exposed on Hay River (Plate V-B), little more than a mile south of the Union test hole No. 2. These undulations are several hundred feet long and closure is rarely more than a few feet. They may have been caused by deep seated structure, by draping over bichorus, by salt tectonics or by salt removal. Minor domes of this type are common and seem particularly noticeable on continuous outcrops in the areas where the sedimentary column above the basement is thin. They have no known significance with regard to oil exploration at the present time, unless they should happen to represent topographically high irregularities reflected from the Precambrian basement.

Information Obtained from Structure Maps

Murphy Corporation arranged to obtain access to confidential information regarding the results of structure test drilling that was carried out by Union Oil Company of California in 1955, and by Merrill Petroleum Ltd. in 1957. The areas explored lie to the north and northeast of the Murphy Permit.

The locations of the Union test holes, numbered 1 to 6, are marked on Figure II. An electric log marker, referred to as the "U" marker, was selected for contouring structure in the area (Figure II). The structural trend is dominated by synclinal and anticlinal ridges running in a southeast direction. A syncline appears to point to Heart Lake and an anticline (or a horst) occurs in the vicinity of the Hay River near test holes numbers 2 and 4. To

the southeast the anticlinal feature is separated by a fault from another syncline or graben. No evidence of faulting was seen on Hay River. The position of the fault on Figure IX coincides with a 12 mile stretch on Hay River where outcrops are absent.

The Merrill test holes have been plotted on Figure I; they are numbered 1 to 17. Contours on the "B" marker within the Grubler formation reveal the presence of a small anticline with a southwest-trending axis. The general curvature of the contour lines conforms with that of the regional structure.

The essence of the structure test information has been plotted on Figure IV, to compare the magnitude of local features with the regional picture.

GAS AND OIL POSSIBILITIES

The main potential reservoirs in the subject area are briefly reviewed below. The Cretaceous shale series and the Trout River formation may be written off entirely as prospective for oil and gas. A map of shows in the region is included in this report (Figure I).

Grubler Formation

Most of the Grubler consists of tight limestone, silty limestone and shale. Porosity may be encountered in an equivalent of the lithographic limestone and in isolated reefs. Accumulations of hydrocarbons in small traps may be found, but the chance of making a discovery of commercial significance in these shallow beds is extremely small.

Alexandra Formation

The remarks regarding the Grubler formation apply equally to the Alexandra formation.

Slave Point Formation

Most cores taken from the Slave Point formation in northern Alberta have a strong petroliferous odour and many are stained with oil. However, the limestone is generally tight and visible porosity is rare. Some encouraging tests have been reported from wells that are not too far removed from the Murphy acreage. At Imperial Yates River No. 1, located in Sec. 16-18-126-14 W. 5, four miles southeast of Permit No. 1403, water and an unknown quantity of oil were recovered from the Slave Point. Some 20 miles west of the Murphy block the formation yielded one foot of oil with gravity of 31.6° A.P.I., together with water. Local topographically high remnants on top of the eroded surface of the formation, fractured or dolomitized zones, and local reefs within the Slave Point may have caused oil and gas accumulation. Other oil and gas shows, encountered farther south, are marked on Figure I.

Few core analyses are available to provide factual data regarding porosity and permeability in the Slave Point. Porosity figures vary from 3 percent to as high as 13 percent. Permeability is generally less than 1 millidarcy. More permeable thin zones are encountered that are probably reflected by intervals of intensive oil-staining on cores. It would seem possible that techniques of formation fracturing might be successfully applied in the Slave Point, provided enough oil section lies above the water.

Elk Point Group

The Elk Point dolomites of Middle Devonian age (Presqu'ile formation) form the most promising reservoir in the area. In many places these dolomites exhibit excellent vuggy porosity. Figure I shows that gas, oil and water have been recovered from the Elk Point over a wide region. Tests on wells in the vicinity of the Murphy lands yielded less water than those farther south and north, probably due to decrease in porosity near the subject area. This tightening of the formation may act locally as a permeability barrier causing porosity traps. Structural anomalies, which are probably plentiful, will provide potential oil traps. Oil-stained cores have been recovered from a large number of wells and oil seepages are found on the shores of Great Slave Lake near Pine Point and Windy Point. The most prominent discovery made in the general area to date is that near Rabbit Lake. The discovery well has been reported publicly to yield gas at a rate of 17 Mscf. per day from the Elk Point.

"Granite Wash"

The search for reservoirs in the basal sands or "Granite Wash" has been successful to the south and southwest, in the Red Earth area and near the Peace River Arch. In far northern Alberta and in the Northwest Territories no encouragement was found in the tight basal beds. However, basal sands found in outcrop at Old Fort Island, on Great Slave Lake (just north of the map area, Figure I), are extremely porous.

"Granite Wash" possibilities are difficult to assess because of the scarcity of subsurface data. Due to the fact that sand development may be connected in various unpredictable ways with the basement topography it is difficult to explore specifically for "Granite Wash" reservoirs.

Despite the lack of success in the past, the "Granite Wash" is still worth probing in any deep well that is drilled in the Northern Alberta Basin.

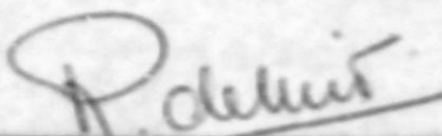
SUMMARY AND RECOMMENDATIONS

Our study indicates that a thickness of 3,200 feet to 5,500 feet of sedimentary rocks is present in the Murphy Corporation P. & H. G. Permits in the South Tatlinia area. These strata include several formations that are prospective for oil and gas. Relatively few wells have been drilled in the Territories south of Mackenzie River and Great Slave Lake, and in the adjacent portion of northern Alberta, but the incidence of oil and gas shows is high in these wells. The occurrence of gas and oil seeps in the Great Slave Lake area is further evidence of the potentiality of the area.

Primary objectives in exploration of the subject lands are the Slave Point limestone and the porous reef dolomites in the Frenguile formation (Elk Point group). Secondary targets are the limestones and the dolomitic reef beds in the Grumbler and Alexandra formations, and the "Granite Wash" near the base of the sedimentary section.

The Permit area lies on the northwest flank of a broad basement arch or ridge which protrudes in a southwesterly direction into northern Alberta. Several southwest-trending anticlines and synclines (or horsts and grabens) are superimposed on this ridge.

In the exploration of the selected area it is recommended that the next step towards evaluation should be to locate larger fault blocks, folds or domes. This may be achieved by drilling a number of structure test holes. Contingent upon the outcome of the structure test drilling, a further program may be designed for the detailing on specific prospects.


H. de Wit.


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February 20, 1958.

EARNSCcliffe

LINEN BOND

MAG. CONTENT-CANADA

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APPENDIX I

STRATIGRAPHIC SECTION IN UPPER DEVONIAN STRATA

HAY RIVER, NORTHWEST TERRITORIES

—RAC-CONTENT-CANADA—

The following is a description of Upper Devonian beds that are exposed on Hay River. Scattered outcrops on the banks of the river have been arranged in stratigraphic order. The description begins in the upper part of the Grubler formation and continues down into the Alexandra and Hay River formation (See also Stratigraphic Section No. 1).

The most southerly Grubler outcrops on Hay River are found near the mouth of a creek that flows southeast from the Goose Egg Lakes. From here to the mouth of Swede Creek, near "Mile 56" on Mackenzie Highway, scarce outcrops represent an interval from 0 to 226 feet in the section. Over a distance of more than 10 miles northeast of "Mile 56" no outcrops were found on Hay River. It was estimated that the covered interval represented some 300 feet of covered section (interval 226'-606'), but probably the amount of missing section is far less than the original estimate, due to faulting. Near "Mile 46" the Grubler formation is again exposed on the Hay River and numerous outcrops can be found from this position to Alexandra Falls.

The entire Alexandra formation is exposed on sheer cliffs near the Falls, at the foot of which the upper sandstone bed of the Hay River formation can be found. Good outcrops of Alexandra and of the calcareous Louise Falls member (upper part of the Hay River formation) are present at Louise Falls and Twin Falls. The green shales of the Hay River formation appear intermittently on the steep banks of Hay River down stream until approximately as far as "Mile 12" on the Mackenzie Highway.

<u>Interval</u>	<u>Thickness Feet</u>	<u>Description</u>
<u>Grubler Formation</u>		
0-1.5	1.5	Limestone - mottled light brown and brown, finely crystalline, finely silty and argillaceous, beds platy to flat, nodular, weathering buff, scattered fossils (<u>Atrypa piliipes</u> , <u>Pugnoides subacuminata</u> , <u>Hervostrophia</u> , <u>Devonoproductus</u>).
1.5-30	28.5	Covered.
30-54	24	Limestone - light brown, irregularly mottled with finely calcarenitic nodules embedded in light brownish buff, finely crystalline silty limestone, scattered brachiopods (<u>Atrypa</u> , <u>Devonoproductus</u>), thin to medium nodular bedding; buff weathering.

Interval	Thickness Feet	Description
54-100	46	Covered.
100-111	11	Limestone - light grey, crystalline, biostromal, slightly dolomitized, minor silt, abundant fossils; corals, <i>Phylloporina</i> most plentiful, scattered <i>Halysites</i> and <i>Strophomena</i>, a few bulbous stromatopora, horn corals, (<i>Tabulophylus</i> sp.) brachiopods (<i>Orthis</i> sp., <i>Atrypa</i> sp., <i>Schizophoria</i>), abundant crinoid fragments, and some layers contain abundant bryozoa (<i>Madarella</i> sp.), scattered fish bones; beds 2 to 4 inches thick, slightly nodular, near pin-point porosity. Weathers buff-grey. On the north side of the outcrop the beds show lateral and vertical transition into greenish grey, red in part, finely crystalline, crinoidal dolomite.
111-114	3	Covered.
114-119	5	Limestone - silty, light brown, finely crystalline with irregular patches of brown calcarenitic limestone, scattered brachiopods, detrital, some layers with isolated disphyllus-type corallites and <i>Cladopora</i> (?), thin-bedded, somewhat nodular. Weathers brown.
119-169	50	Covered.
169-174	5	Limestone - light brown with red mottling, finely conchoidal with abundant brachiopods, thin-bedded, slightly nodular.
174-224	50	Covered.
224-225	1	Limestone - cream, finely crystalline to lithographic, scattered brachiopods, calcarenitic, with small isolated vugs, stylolitic.
225-605	380	Covered.
605-613	8	Limestone - cream, lithographic, dolomitized in part, calcarenitic in part, detrital in part, scattered large stromatopora and <i>Halysites</i>, gastropod zone 5 feet from top, lower 3 feet are vuggy with numerous small vugs some of which are filled with secondary clear calcite, massive.

<u>Interval</u>	<u>Thickness Feet</u>	<u>Description</u>
613-621	8	<u>Limestone</u> - as above, facies resembles that of the Alexandra formation; scattered bulbous stromatoporoidea, rare corallites. Beds show low structural rolling.
621-633	12	Covered.
633-635	2	<u>Limestone</u> - biostromal, mainly platy stromatoporoidea and <u>Thamnopora</u> .
635-674	39	Covered.
674-677	3	<u>Limestone</u> - mottled greenish grey and maroon, fine-grained, argillaceous, dolomitic, finely silty, massive. Weathers light brown.
677-684	7	<u>Shale</u> - greenish grey, maroon mottling, calcareous and dolomitic, abundant layers of small limestone nodules up to 1.5 inches thick. In the lower portion silty bands, with arenaceous content increasing downward, possible plant imprints at base.
684-704	20	Covered.
704-707	3	<u>Siltstone</u> - mottled greenish and maroon, fine-grained, calcareous, slightly micaceous, with numerous worm or plant (?) imprints, vaguely thin-bedded, beds some 3 inches thick, slightly more resistant than underlying beds. Weathers buff-grey.
707-709	2	<u>Limestone</u> - mottled maroon with some greenish colours, argillaceous, in part silty (?), calcareous shale, very fossiliferous, mainly brachiopods, <u>Atrypa</u> , <u>Schizophoria</u> , <u>Gynidula</u> (?).
709-710	1	<u>Limestone</u> - maroon with greenish mottling, crystalline, very crinoidal, hard, scattered <u>Alveolites</u> and bulbous stromatoporoidea, in places algal balls up to .5 inches (<u>Girvanella</u> -type).
710-715	5	<u>Limestone</u> - reddish and greenish mottled, silty and argillaceous, a few scattered brachiopods, thin-bedded; reddish weathering.
715-759	44	Covered.
759-760	1	<u>Limestone</u> - light greenish grey to buff, crystalline, very crinoidal, thin-bedded.
760-765	5	<u>Limestone</u> - maroon, argillaceous, abundant brachiopods, nodular, thin-bedded.

Interval	Thickness Feet	Description
		<u>Limestone</u> - buff with light greenish grey and pink mottling, very crinoidal, thin-bedded, scattered small vugs.
765-769	4	<u>Limestone</u> - buff, biotronal layers of <u>Thamnostrophia</u> transitional into a biohermal assemblage of <u>Phylloporites</u> , <u>Alveolites</u> , stromatoporoidea, fair porosity in corals.
769-773	4	<u>Limestone</u> - buff, slightly dolomitized, platy. Weathers light yellowish brown.
773-777	4	<u>Limestone</u> - light buff with red mottling, finely crystalline, dolomitized mottling in the shape of large worm trails or plant imprints, crinoidal, massive.
777-782	5	<u>Shale</u> - maroon, calcareous, with abundant small limestone nodules, a few thin platy hard limestone beds, almost unfossiliferous.
782-790	8	<u>Limestone</u> - maroon to brown-grey, dolomitized, argillaceous, and slightly silty, abundant scattered crinoid fragments and brachiopods, <u>Atrypa</u> several species, <u>Schizophoria</u> , <u>Crinoid</u> (?), <u>Strophomena</u> , <u>Spirifer</u> , beds a few inches thick.
790-792	2	<u>Limestone</u> - grey to greenish grey, silty, crinoidal coquina with abundant brachiopods, ground mass greenish grey, finely crystalline, dolomitized and very silty. Beds seem to show lateral transition into bioherm.
792-807	15	<u>Limestone</u> - bioherm, packed with corals, <u>Phylloporites</u> , <u>Stromatoporoidea</u> , <u>Thamnostrophia</u> , <u>Alveolites</u> , stromatoporoidea, scattered brachiopods and crinoid fragments.
807-808.5	1.5	<u>Limestone</u> - light grey-brown, lithographic, with light brown finely crystalline dolomite mottling, dense with <u>very small vugs</u> lined with calcite crystals, few scattered brachiopods, slightly nodular, platy, hard beds to two inches.
808.5-813	4.5	<u>Dolomite</u> - light brown, crystalline, calcareous, finely detrital, <u>very intercrystalline</u> normally, massive, hard. Weathers rusty.
813-816	3	Covered.

Interval	Thickness Feet	Description
		limestone - buff with light greenish grey and pink mottling, very crinoidal, thin-bedded, scattered small vugs.
613-619	6	limestone - buff, bihercinal layers of <i>Thamnostrophia</i> transitional into a bihercinal assemblage of <i>Phillipsopora</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , fair amount in corals.
619-673	4	limestone - buff, slightly dolomitized, platy. Weathers light yellowish brown.
673-677	4	limestone - light buff with red mottling, finely crystalline, dolomitized mottling in the shape of large wave trails or plant imprints, crinoidal, massive.
677-682	5	Sand - brown, calcareous, with abundant small limestone nodules, a few thin platy hard limestone beds, almost unfossiliferous.
682-690	8	limestone - brown to brown-grey, dolomitized, argillaceous, and slightly silty, abundant scattered crinoid fragments and brachiopods, <i>Strophomena</i> several species, <i>Strophomena</i> , <i>Strophomena</i> (?), <i>Strophomena</i> , <i>Strophomena</i> , beds a few inches thick.
690-692	2	limestone - grey to greenish grey, silty, crinoidal corals with abundant brachiopods, ground mass greenish grey, finely crystalline, dolomitized and very silty. Beds seem to show lateral transition into bihercinal.
692-697	15	limestone - bihercinal, packed with corals, <i>Phillipsopora</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , <i>Strophomena</i> , scattered brachiopods and crinoid fragments.
697-698.5	1.5	limestone - light grey-brown, lithographic, with light brown finely crystalline dolomite mottling, dense with rare small vugs lined with calcite crystals, few scattered brachiopods, slightly nodular, platy, hard beds to two inches.
698.5-699	4.5	Dolomite - light brown, crystalline, calcareous, finely detrital, rare intercrystalline porosity, massive, hard. Weathers rusty.
699-699	3	Covered.

<u>Interval</u>	<u>Thickness Feet</u>	<u>Description</u>
816-820	4	<u>Limestone</u> - buff, coarsely crystalline, dolomitic, bioclastic, mainly crinoids, scattered brachiopods, <u>scattered small vugs</u> up to 1/16 inch, massive, hard.
820-822.5	2.5	<u>Limestone</u> - maroon, shaly nodular, limestone nodules finely coquinoïdal, layers interbedded with thin shale. Weathers maroon.
822.5-832.5	10	<u>Limestone</u> - light buff to cream, in part maroon stained, argillaceous, nodular.
832.5-833	.5	<u>Limestone</u> - buff with reddish mottling, coquina, abundant crinoid fragments, scattered large brachiopods; in part conglomeratic with small limestone pebbles.
833-834	1	<u>Shale</u> - pale buff-grey, calcareous with small limestone nodules, soft.
834-844	10	<u>Limestone</u> - light buff to cream, pink mottling at top, finely crystalline, slightly argillaceous, finely coquinoïdal at top, nodular, fairly soft. Weathers light brown.
844-850.5	6.5	<u>Limestone</u> - buff to light brown, coarsely crystalline, crinoid coquina, coarsely granular, cross-bedded, some thin lenses of brachiopod coquina; <u>scattered fine vuggy porosity</u> , massive, numerous stylolites.
850.5-866.5	16	<u>Limestone</u> - "mottled limestone unit" at the top of Alexandra Falls. Limestone, buff, dense, with irregular dolomitic mottling.
<u>Alexandra Formation</u>		
866.5-876.5	10	<u>Limestone</u> - pale buff to cream, lithographic, calcarenite, finely striated on weathered surface, massive.
876.5-881	4.5	<u>Limestone</u> - slightly argillaceous, pale buff to cream, crystalline to lithographic, in part finely bioclastic; on weathered surface slightly nodular, due to green argillaceous material or to large worm burrowings (?).
881-882	1	<u>Limestone</u> - cream to pale grey-buff, calcarenite, tight.
882-885	3	<u>Limestone</u> - argillaceous, light buff, thin platy.
885-890	5	<u>Limestone</u> - light buff, lithographic, calcarenitic, 6 inch <u>Ambinora</u> bed 3 feet above base.

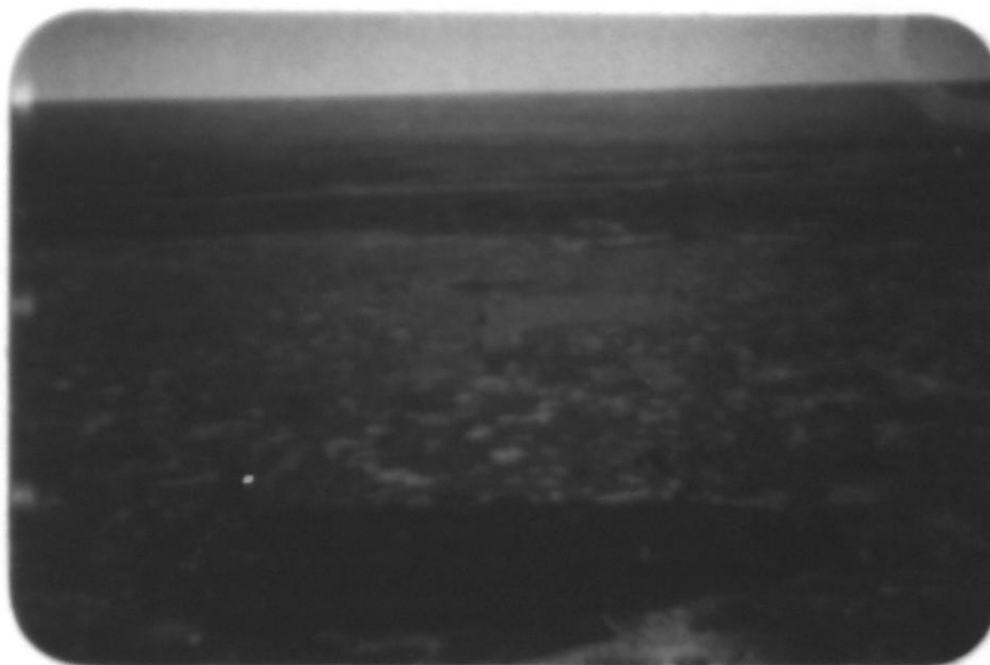
Interval	Thickness feet	Description
870-871	1	Limestone - pink, finely crystalline, abundant <i>Ambinora</i> , probably rudite.
871-875.5	4.5	Limestone - light brown to buff, finely crystalline to lithographic, abundant <i>Ambinora</i> , occasional small stromatoporeids.
875.5-878	2.5	Limestone - pale buff, fine calcarenite, mixed with some light green argillaceous material, somewhat easier weathering.
878-913	35	Limestone - buff, lithographic, scattered <i>Ambinora</i> , numerous stylolites, scattered <i>Ambinora</i> , vaguely thick-bedded, buff weathering.
913-916.5	3.5	Limestone - buff, abundant <i>Ambinora</i> , irregular thickness 2 to 3 inches; overlying limestone, light buff, lithographic, scattered <i>Ambinora</i> , thickness 1 foot 3 inches.
916.5-919.5	3	Limestone - light buff, lithographic, with scattered <i>Ambinora</i> .
919.5-923.5	4	Limestone - buff, lithographic, with abundant <i>Ambinora</i> .
923.5-926.5	3	Limestone - as above, calcarenite, finely striated on weathered surface.
926.5-928.5	2	Limestone - buff to pink, crystalline, hard, with abundant <i>Ambinora</i> , massive.
928.5-932	3.5	Limestone - light grey to light maroon, coarsely crystalline, abundant <i>Ambinora</i> , secondary white calcite. Minor disconformity.
932-941	9	Limestone - biostromal, abundant <i>Thamnostroma</i> , and flat and bulbous types of stromatoporeids.
941-959	18	Limestone - becoming silty near base of interval, light brown to brown-grey, slightly nodular.
959-964	5	Limestone - silty, grey, with brachiopods and crinoid stems, partings of greenish grey micaceous shale with numerous worm trails. Silty limestone forms lenticular layers up to 1/2 foot thick.

Interval	Thickness Feet	Description
<u>May River Formation, Louisa Falls Member</u>		
964-968	4	<u>Siltstone</u> - quartzose, calcareous and dolomitic, interbedded with fine shaly layers, finely micaceous, greenish gray, with numerous worm trails.
968-972	4	<u>Siltstone</u> - dolomitic, quartzose, fair sorting, grains subangular to subrounded, cross-bedded, massive, forming lenticular beds.
972-974	2	<u>Siltstone</u> - as above, medium-bedded, with shaly partings, greenish gray, finely micaceous, numerous worm trails.
974-996	22	Covered. (Shale interval)
996-1000	4	<u>Limestone</u> - slightly dolomitic and finely silty, light brown, finely crystalline, calcarenitic to finely bioclastic, scattered crinoid fragments and small brachiopods, <u>Atrypa</u> , <u>Spirifer</u> , <u>Subocoelia</u> ; tight, cliff-forming, beds 3 to 5 inches thick, buff weathering.
1000-1012	12	<u>Limestone</u> - shaly, nodular, buff-gray, thinly bedded, scattered <u>Spirifer</u> ; interbedded with shale, calcareous, soft, buff-weathering. Nodules calcarenitic to coquinoideal.
1012-1013.5	1.5	<u>Limestone</u> - dolomitic and finely silty, light gray, finely crystalline, very fossiliferous, biostromal, coarsely nodular, with vague medium bedding, few stromatoporoids, abundant <u>Alveolites</u> , large heads of <u>Disphyllum</u> , <u>Phillipsastraea</u> , numerous solitary corals, coarse-ribbed <u>Atrypa</u> , <u>Strophodontes</u> , large nautiloid (max. diameter 4 1/2 inches); brown-gray weathering.
1013.5-1031.5	18	<u>Limestone</u> - buff to buff-gray, finely crystalline, tight, bedded, beds 5 to 6 inches thick; interbedded light gray argillaceous limestone beds up to 4 inches thick, scattered crinoid fragments, <u>Productella</u> , solitary corals, in part finely coquinoideal, few small vugs in recrystallized fossils, scattered worm trails.
1031.5-1046.5	15	<u>Limestone</u> - finely silty and argillaceous, light buff-gray, fine-grained, with scattered brachiopods, vaguely nodular, thin to medium bedding, relatively soft.
1046.5-1050	3.5	Covered.

EARN'S CREEK

- 8 -

Interval	Thickness Feet	Description
1050-1060.5	10.5	<u>Siltstone</u> - dolomitic, quartzose, finely laminated, thickness increases northward to 20 feet near "Hills 28."
1060.5-1099.5	39	Covered.
1099.5-1107.5	8	<u>Limestone</u> - dolomitic, biostromal, more detrital than underlying organic zone, abundant fossils, brachiopods, bryozoa, scattered <u>Alveolites</u> and <u>Phylloporina</u> .
1107.5-1112	4.5	<u>Limestone</u> - biostromal, abundant corals, massive.
1112-1697	585	<u>Shale</u> - greenish gray, partly maroon-coloured in upper part, occasional thin argillaceous and silty limestone intervals, intermittently exposed.
1697-2217	520	Covered interval to top of Slave Point formation.



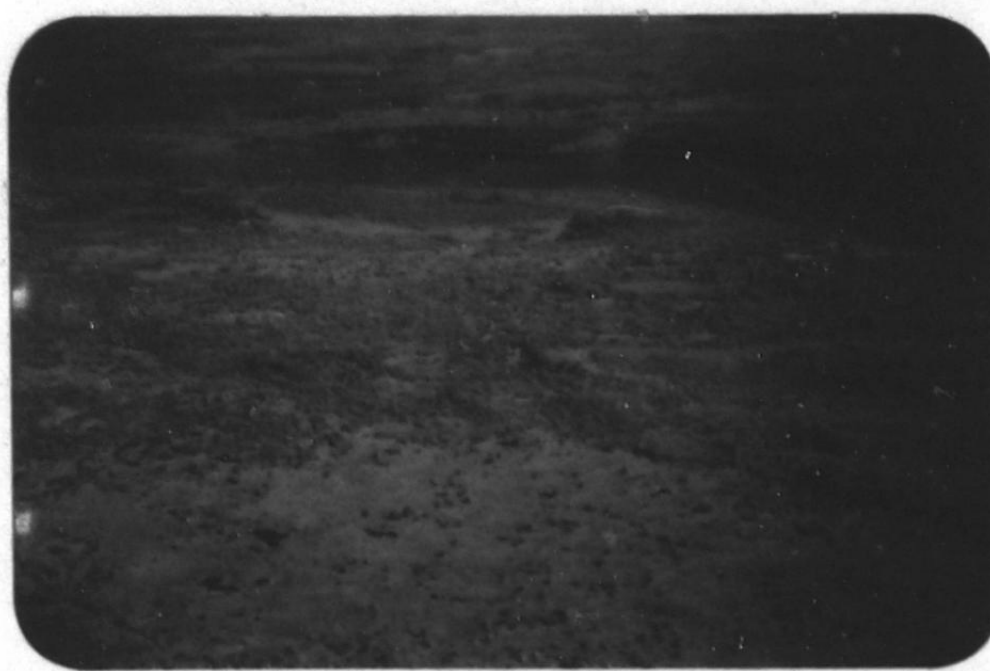
A. Hay River lowland. View across muskeg and lakes to the west. The Cameron Hills are visible in the background beyond Hay River.



B. Hay River lowland. View to the northwest showing muskeg and bush east of Hay River. The northeast edge of the Cameron Hills can be seen in the upper left hand corner.



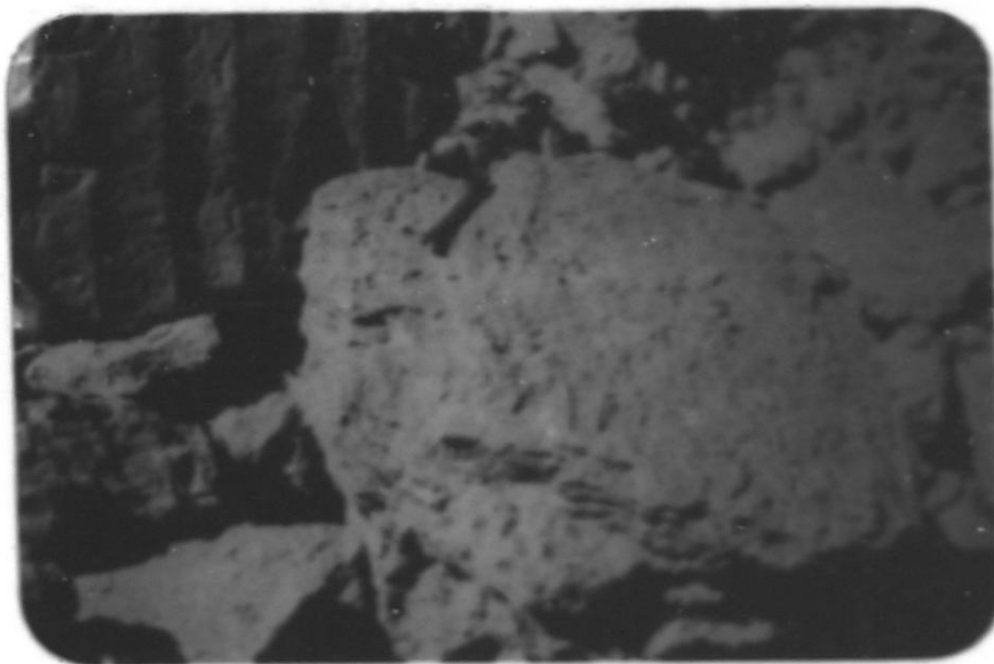
A. West bank of Hay River. Lowland with muskeg and spruce growth in foreground.



B. Hay River in P. & N. G. Permit No. 1400.



A. Louise Falls, Hay River. In foreground the "Louise Falls Member," consisting of silty and shaly limestone, near the top of the Hay River formation. A green shale band, 30 feet thick, is seen across the river below the limestone cliffs of the Alexandra formation.



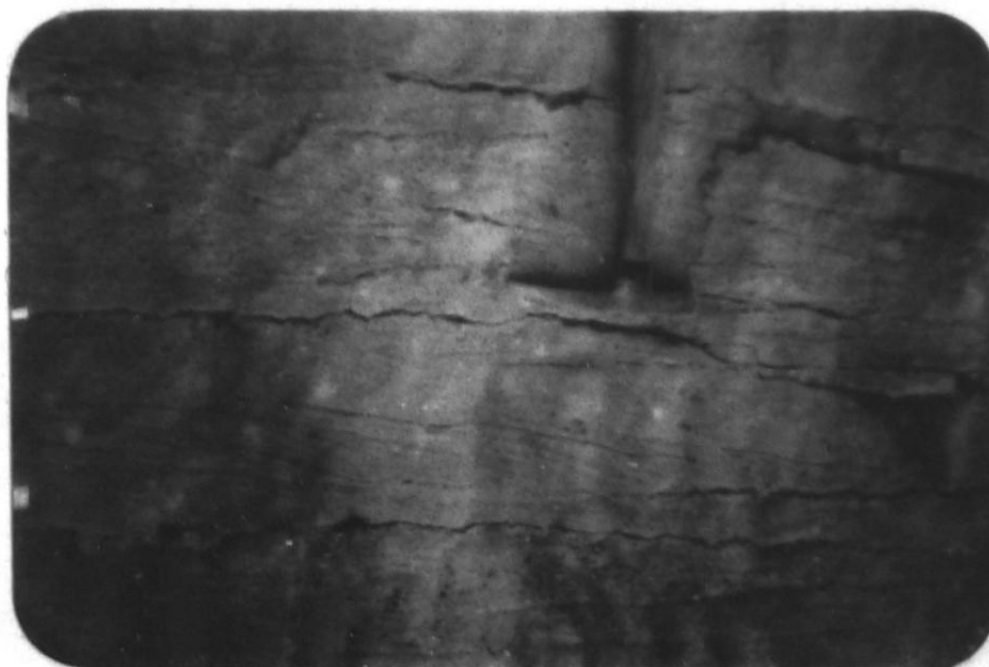
B. Alexandra formation. Blocks at the foot of the cliff near Alexandra Falls, Hay River. Lithographic limestone with oscillation ripple marks and "worm" tubes may be seen in the background.



A. East bank of Hay River near Mile 38 showing beds covering bioherm. These strata consist of reddish coloured shaly limestone, containing abundant brachiopods, crinoid fragments and corals. Layers are inclined to the north due to draping over the bioherm. Photograph taken 50 feet northwest of bioherm shown below.



B. Bioherm near Mile 38, east bank of Hay River. Core of bioherm is structureless mass of corals. The upper one-third of the photograph shows vaguely bedded *Thamnopora*-bearing limestone which underlies the red shaly beds of picture A.



A. Encrinite. Cross-bedded limestone in the Grumbler formation entirely composed of crinoid fragments; exposure is a few miles upstream from Alexandra Falls.

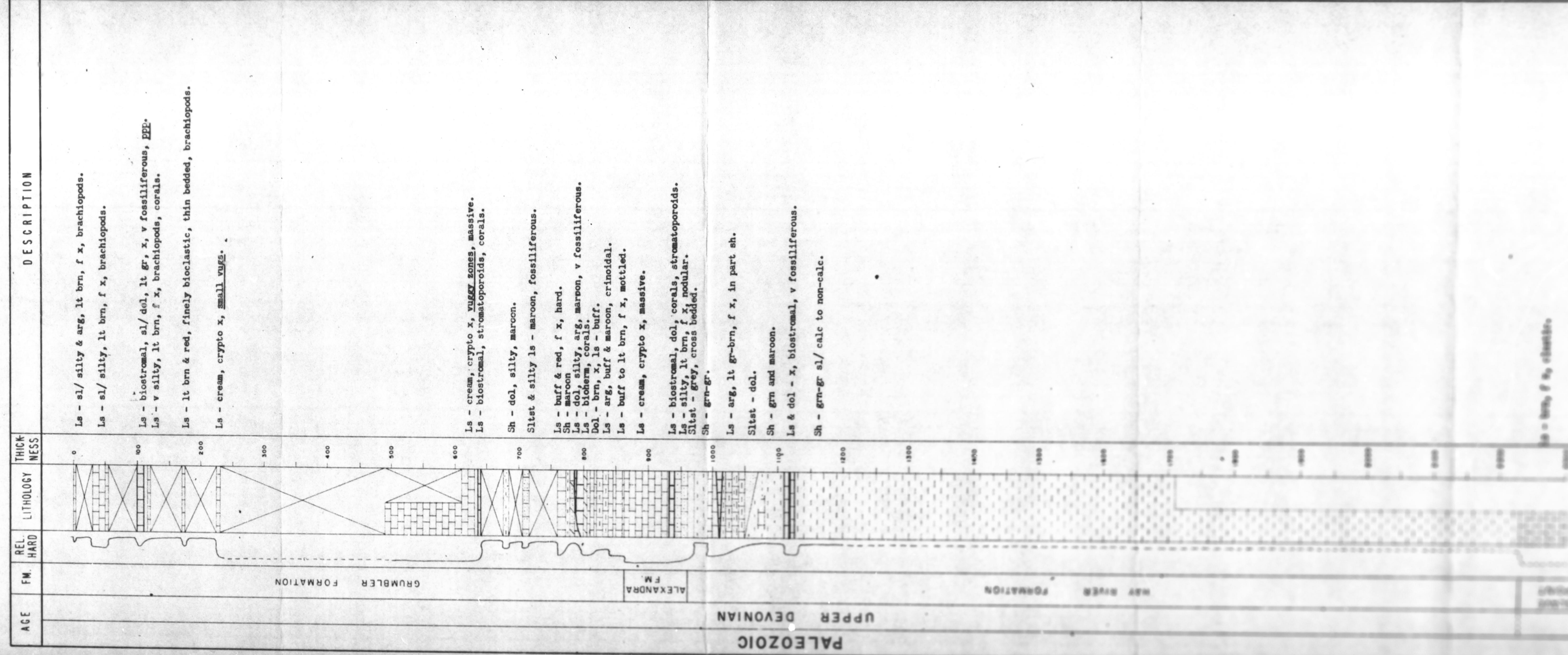


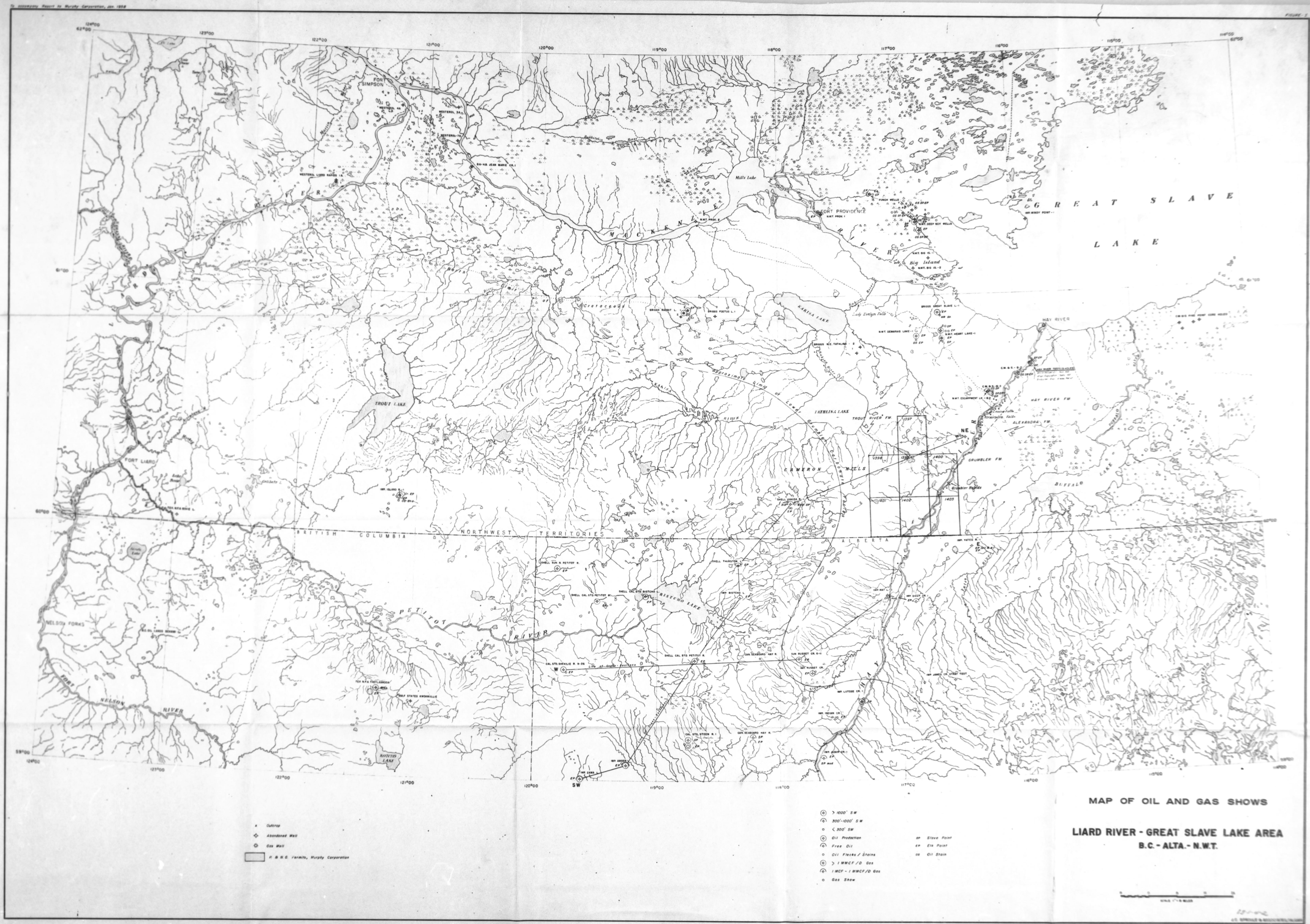
B. Grumbler formation on Hay River. Lithographic limestone layer, forming small, low structural dome.

STRATIGRAPHIC SECTION NO. 1

HAY RIVER

NORTHWEST TERRITORIES





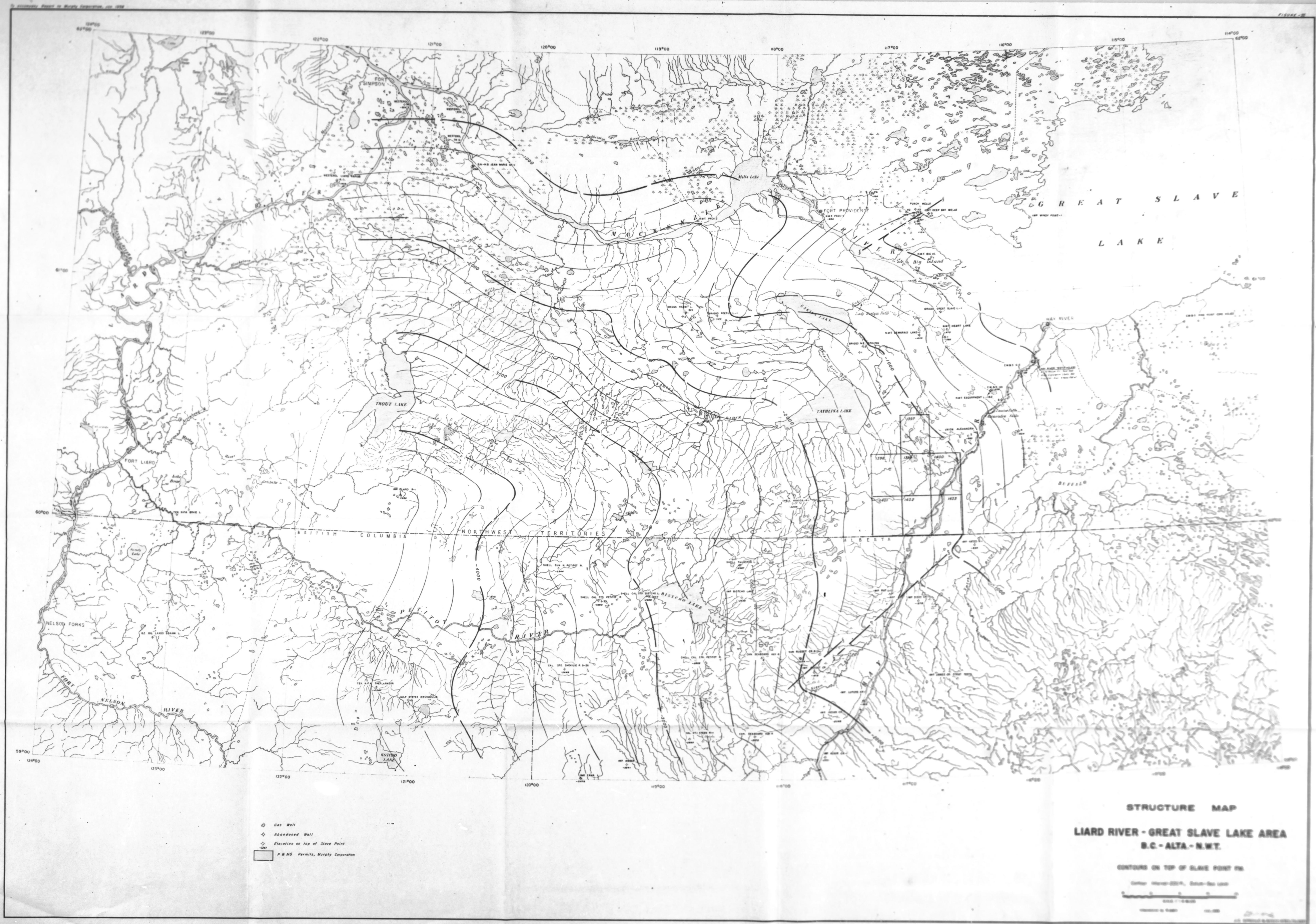
MAP OF OIL AND GAS SHOWS
 LIARD RIVER - GREAT SLAVE LAKE AREA
 B.C. - ALTA. - N.W.T.

Scale 1:50,000



30x





☆ Gas Well
◇ Abandoned Well
+ Elevation on top of Slave Point
P.B.M. Permits, Murphy Corporation

STRUCTURE MAP
LIARD RIVER - GREAT SLAVE LAKE AREA
B.C. - ALTA. - N.W.T.

CONTOURS ON TOP OF SLAVE POINT RM.

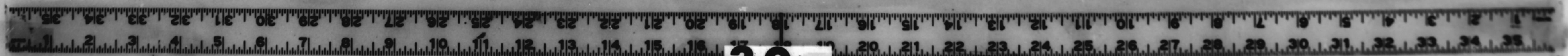
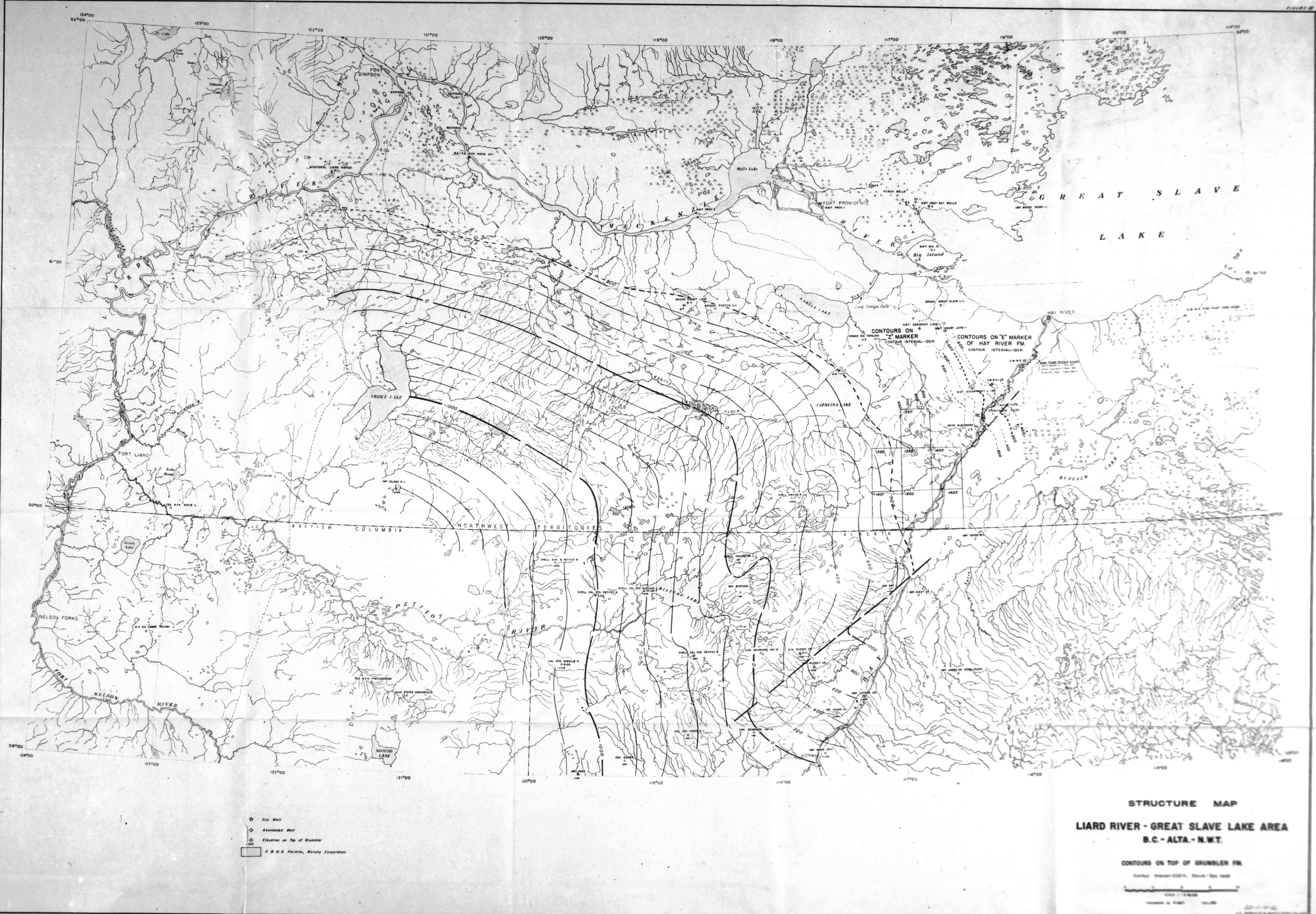
Contour Interval - 200 ft., Datum - Sea Level

Scale 1:50,000

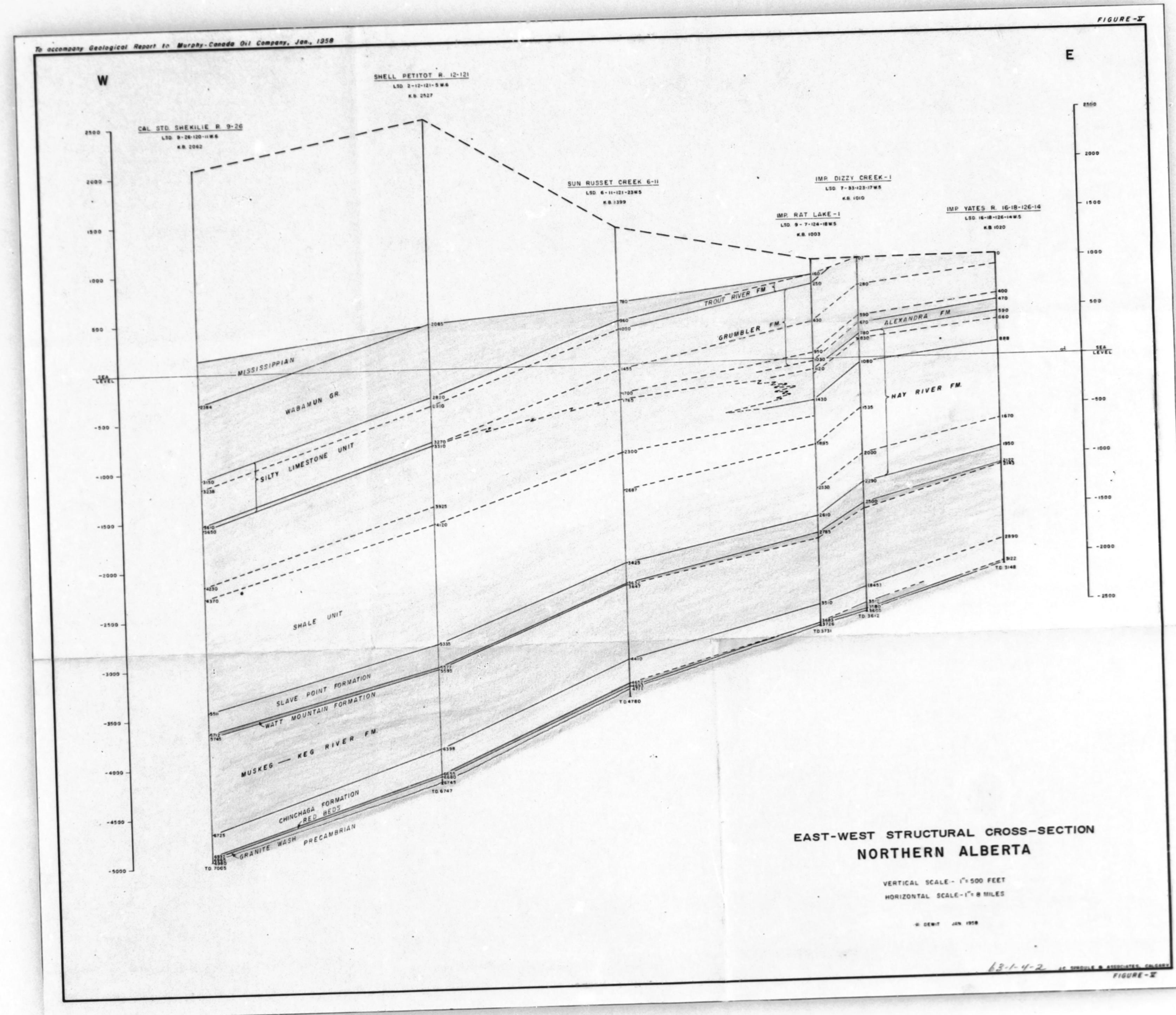
Projection - UTM

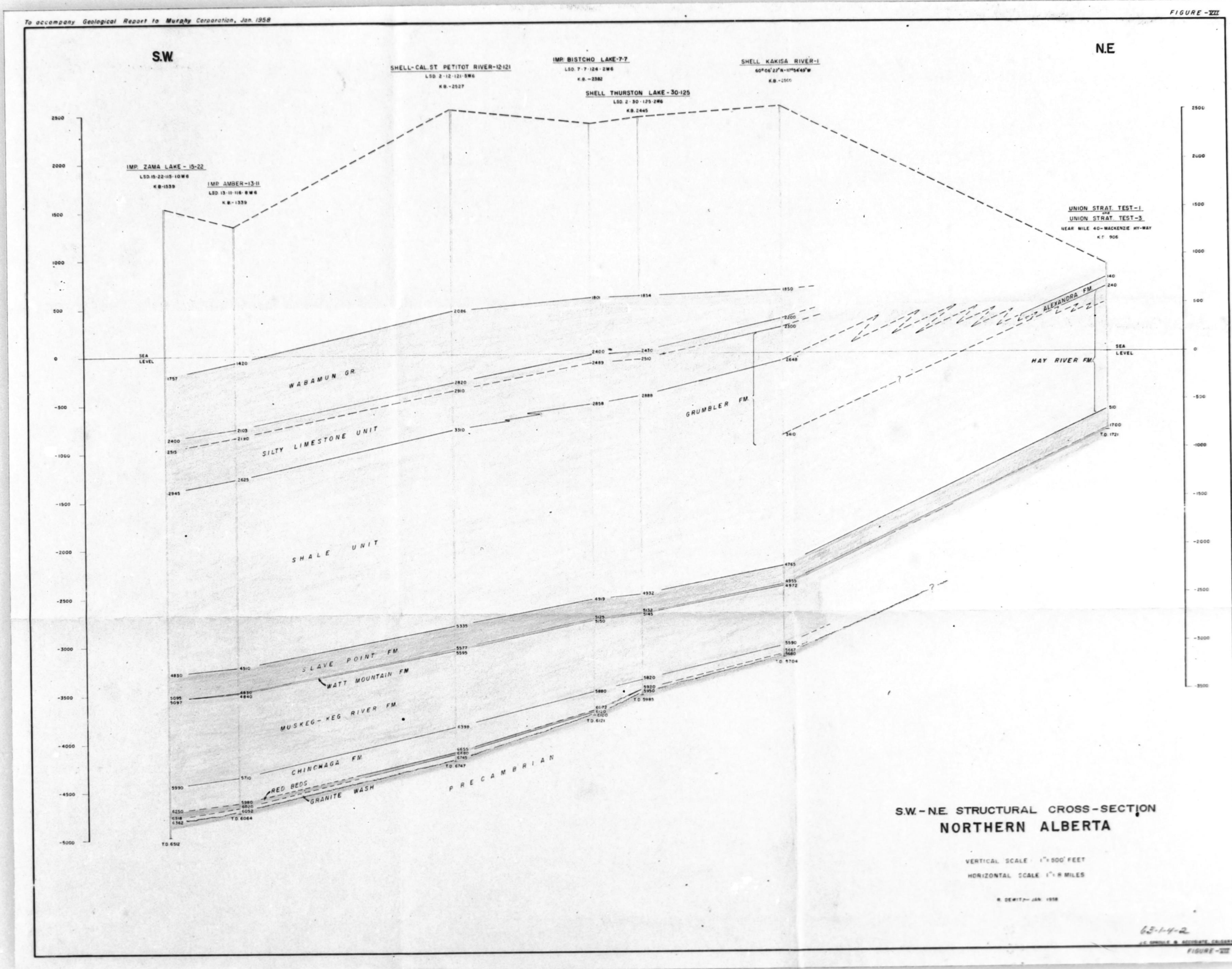


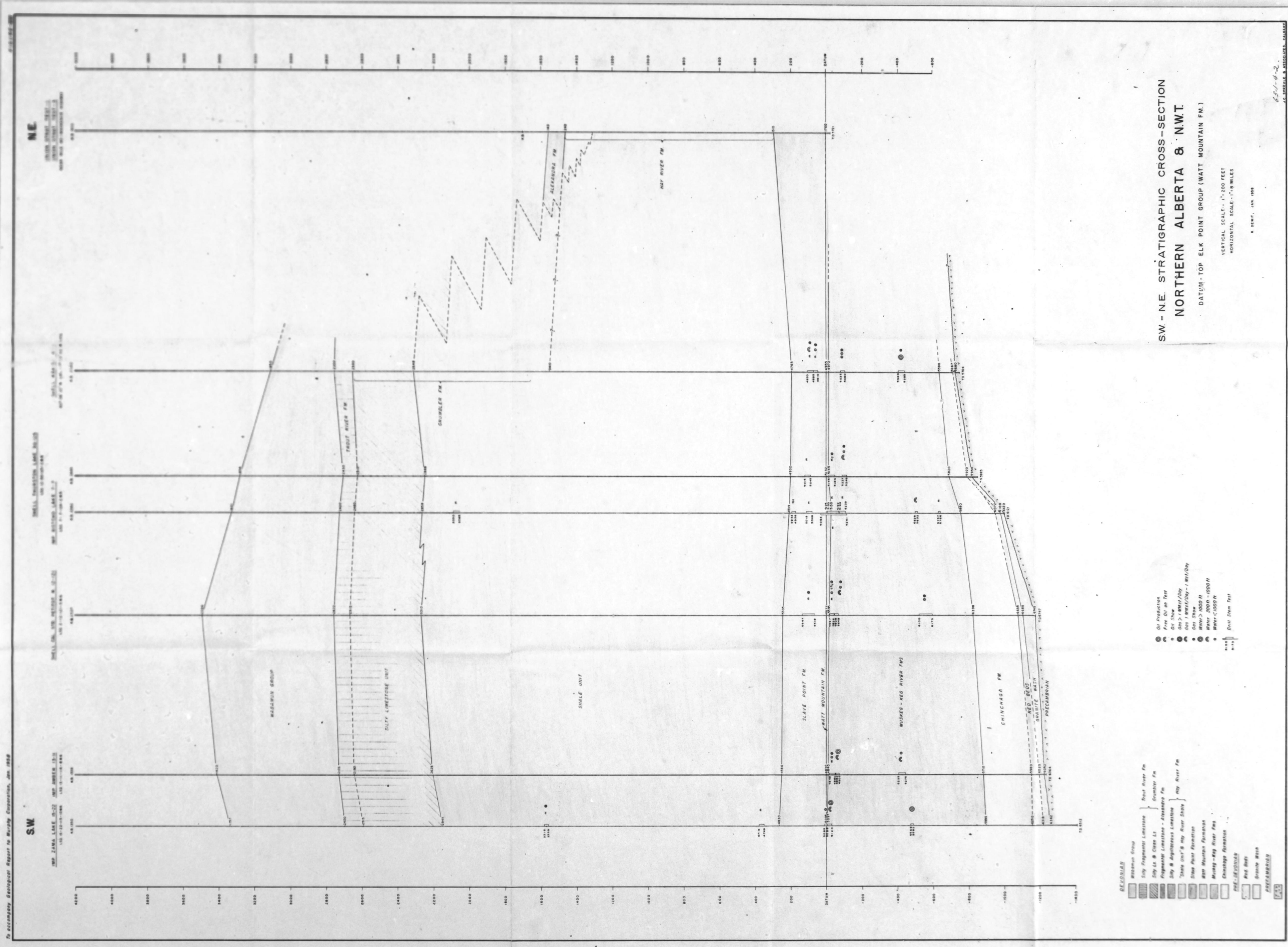
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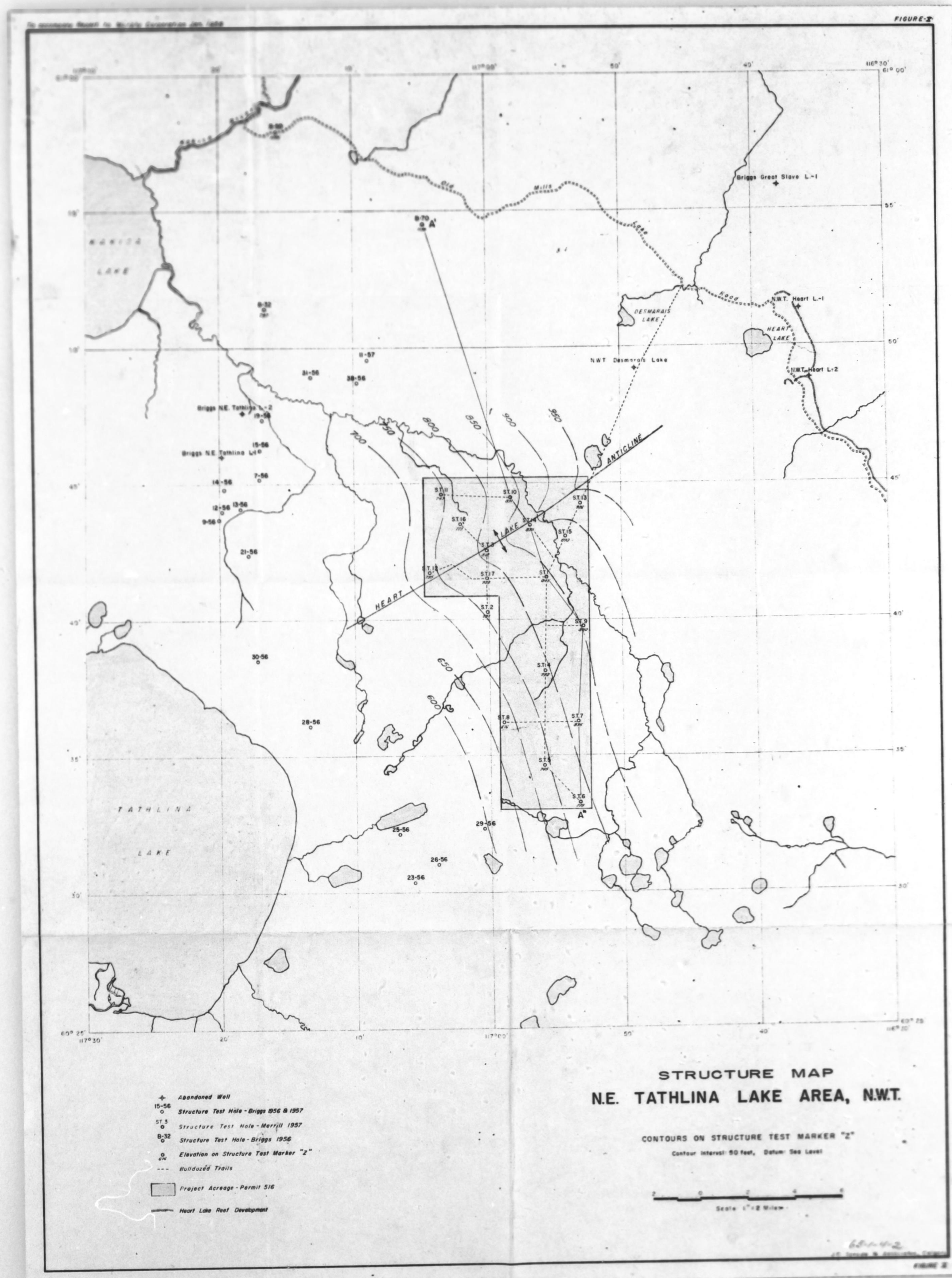


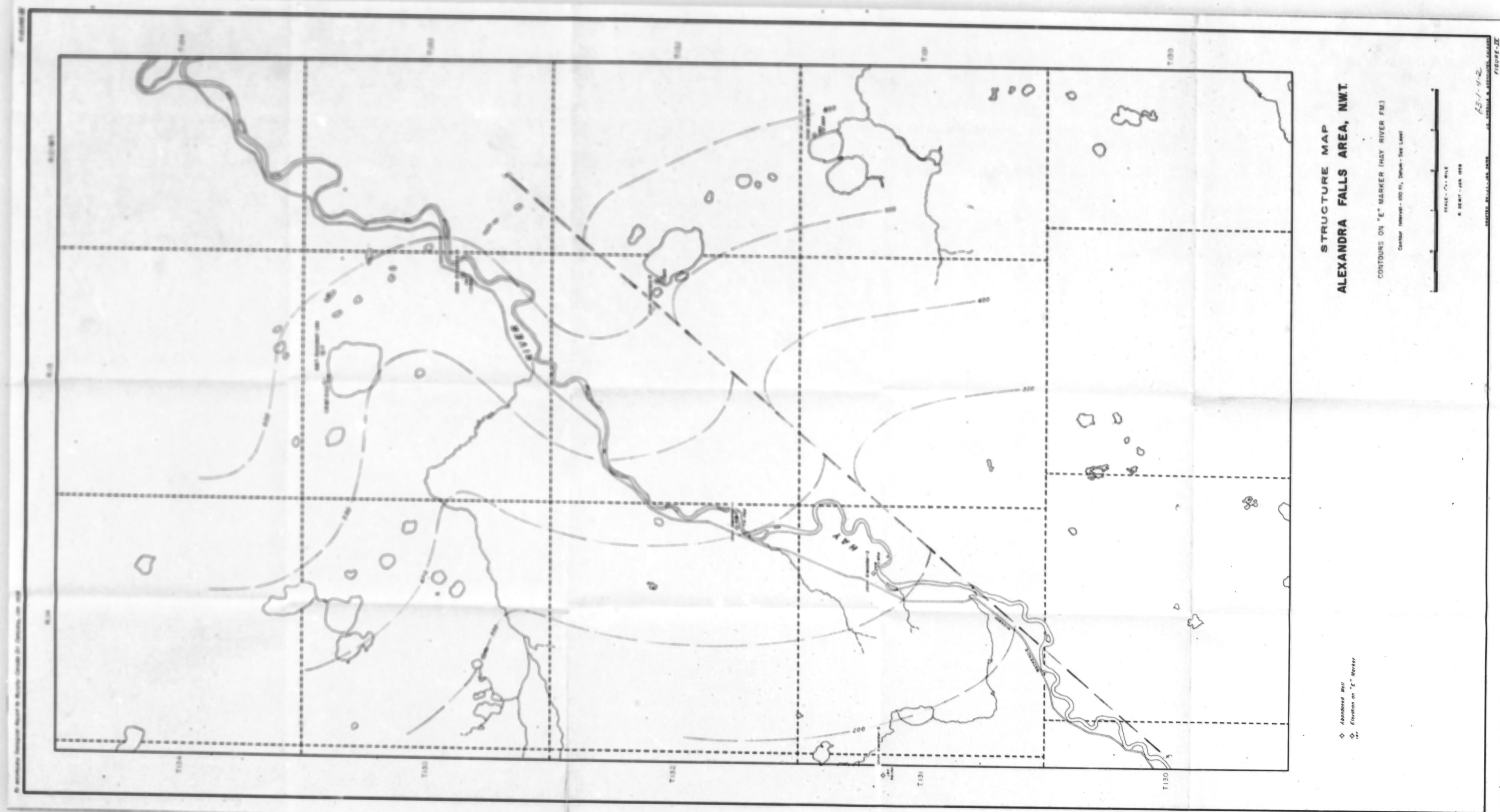
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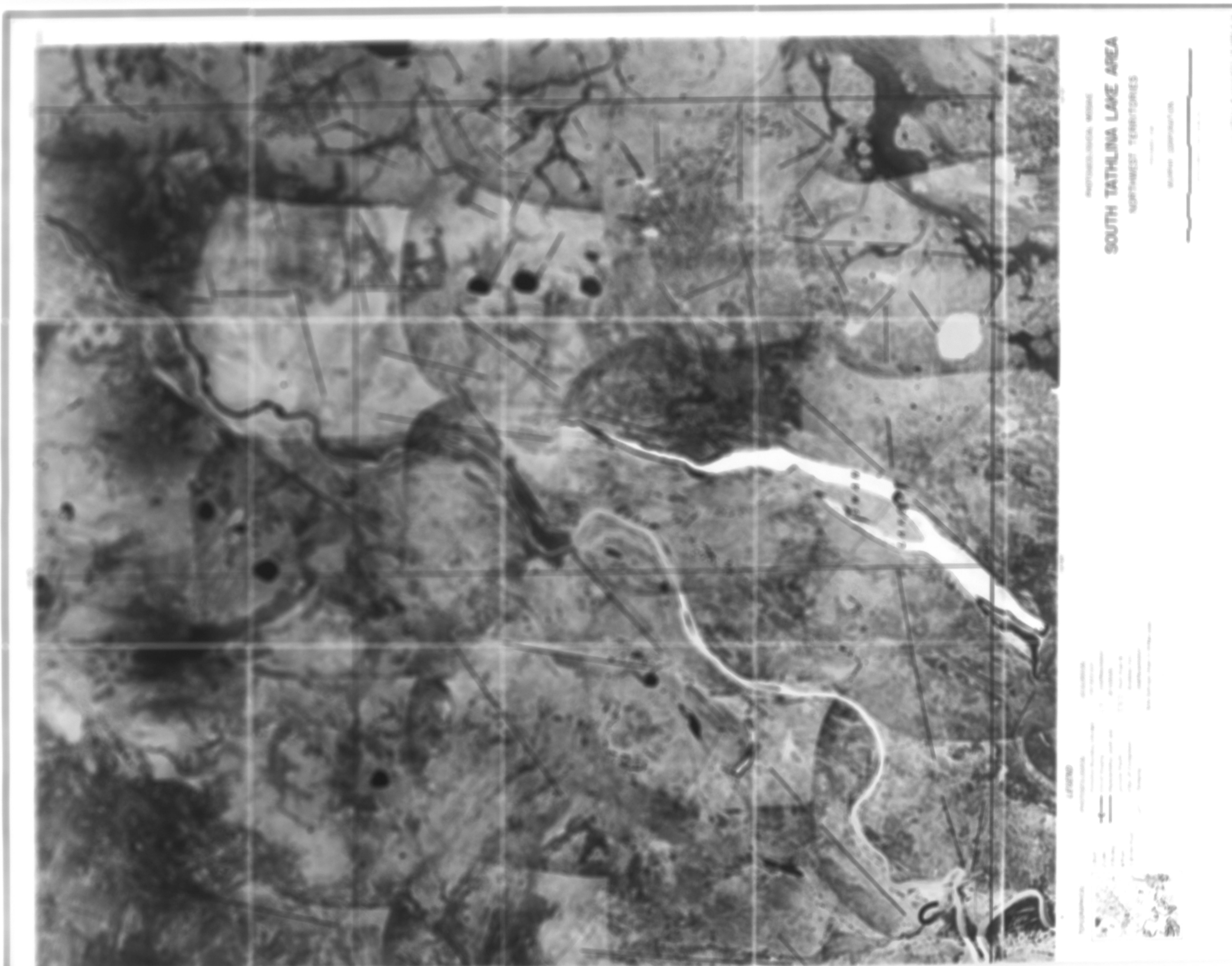


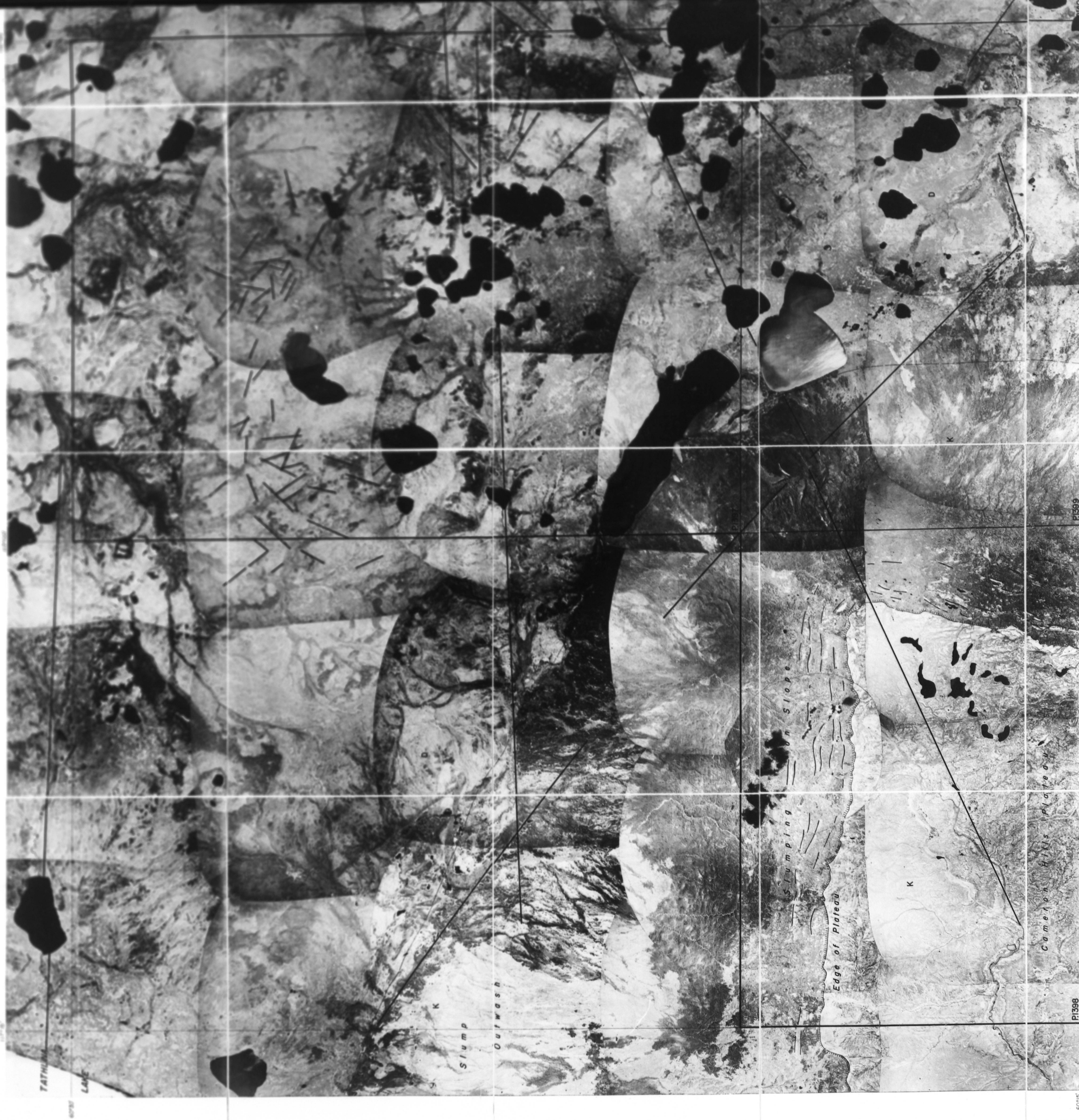












TOPOGRAPHICAL

1. Bath
2. Lake
3. Building
4. River
5. Winter Road

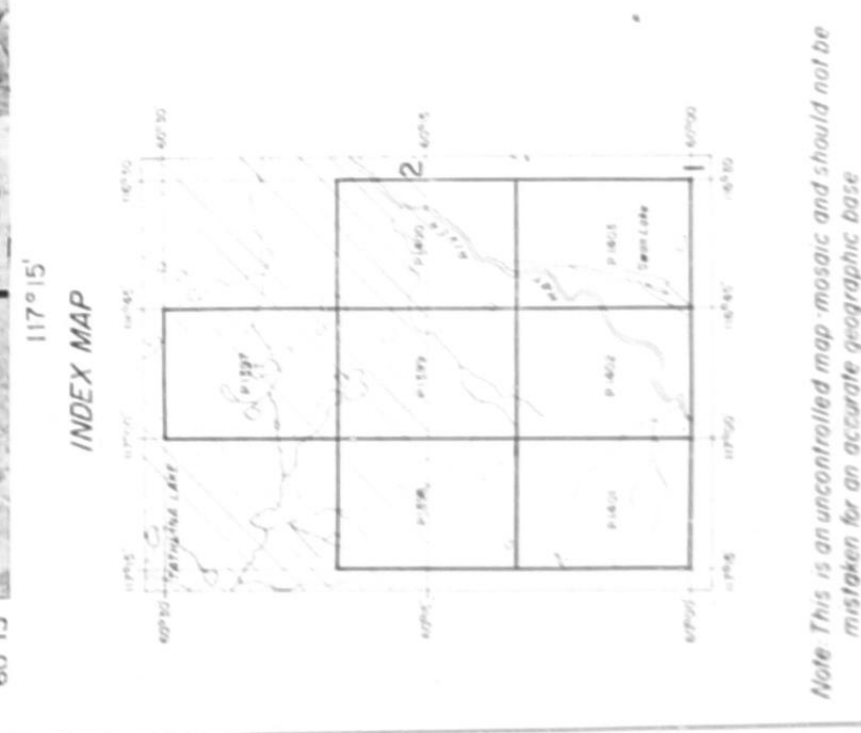
PHOTOLOGICAL

Formation boundary inferred
Cliff or Gully
Representative Joints and possible Faults
Edge of Escarpment
Slumping

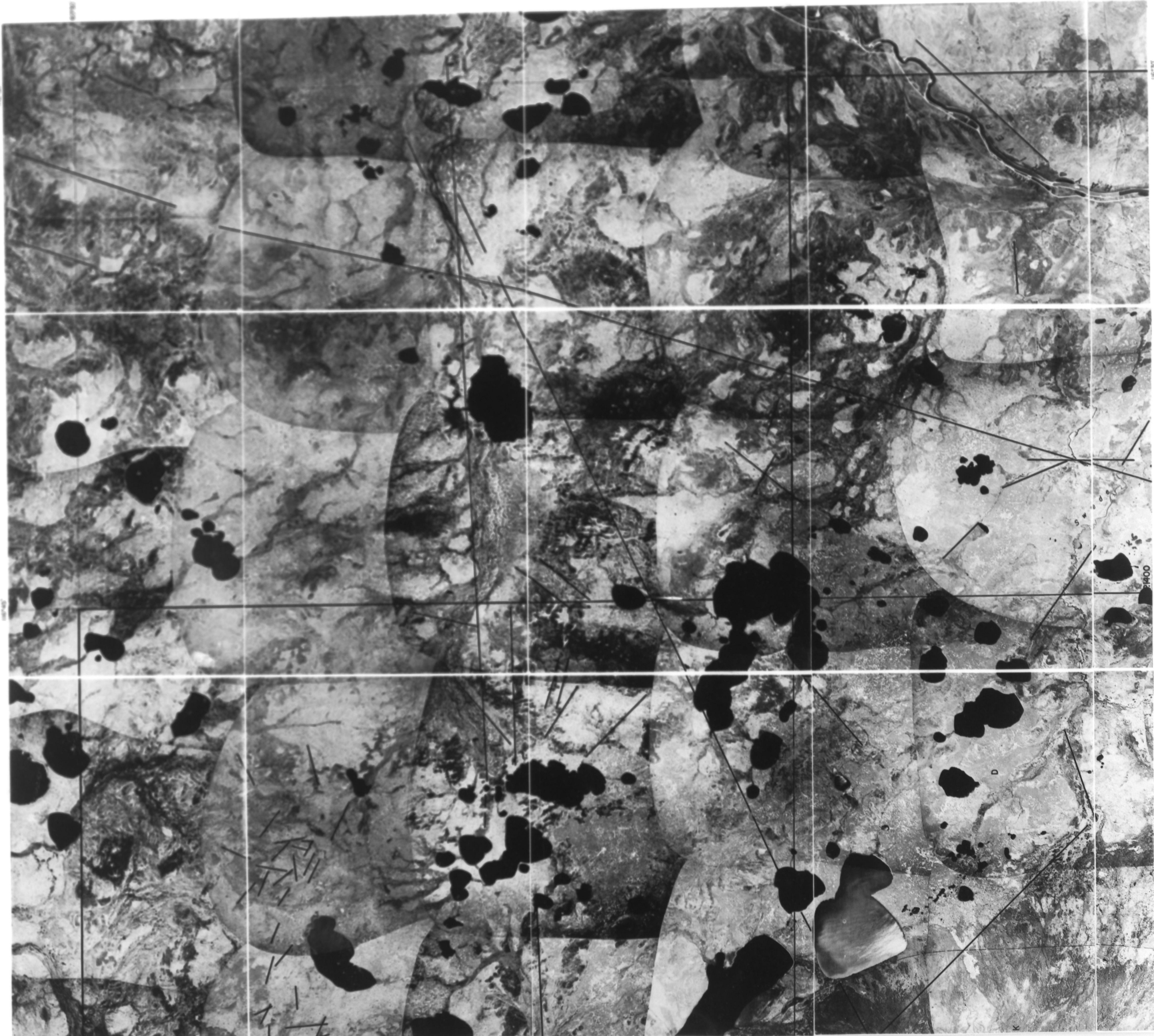
GEOLOGICAL

CHETACIOUS
Undifferentiated
DEVONIAN
Trent River
Undifferentiated

Note: Outcrops shown in darker color



30x



PHOTOGEOLOGICAL MOSAIC
SOUTH TATHLINA LAKE AREA
NORTHWEST TERRITORIES
PREPARED FOR
MURPHY CORPORATION
SHEET 52

TOPOGRAPHICAL

1 Bush
2 Low
3 Medium
4 River
5 Water Road

PHOTOGEOLOGICAL

Formation boundary inferred
C Gravel (loosing)
Representative beds and possible faults
Edges of Escarpment
Slumping

GEOLOGICAL

CHL LACEDUS
Undifferentiated
DEVONIAN
Trent River
Gumbler fm's
Undifferentiated

Note: Outcrops shown in darker color