OFFICE AIRPHOTO SEARCH
FOR
FOUNDATION AND SURFACING MATERIALS
FOR
TROUT LAKE AIRSTRIP
VICINITY
TROUT LAKE, N.W.T.

J D MOLLARD AND ASSOCIATES LIMITED

CONSULTING CIVIL ENGINEERS AND ENGINEERING GEOLOGISTS

Specializing in airphoto interpretation and ground-water studies

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TROUT LAKE AIRSTRIP
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Prepared for:

Government of Northwest Territories
Public Works - Highways Division
Design and Construction Section
Yellowknife, N.W.T.
X1A 2L9

Attention: Mr. Peter Vician, Project Officer

March 8, 1984

Prepared by:

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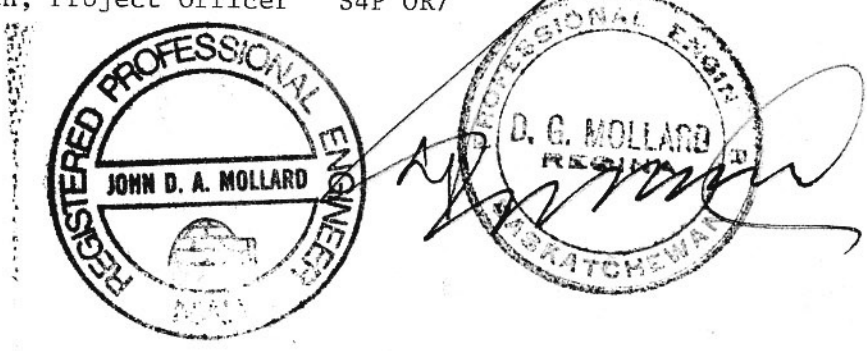

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I -- PURPOSE OF STUDY

Purpose of the study is defined in the terms of reference. These are laid out in a letter received from GNWT dated January 23, 1984. This letter read in part as follows:

1) The objective of this interpretation is to define potential borrow/gravel sources within a limited radius around the community. There are two main requirements:

    a) Large quantities of acceptable borrow materials that can be used in embankment construction.

    b) Relatively well graded gravel that can be used in runway surfacing and road surfacing.

2) Identify all sources within the designated area shown on the enclosed map (1:250,000 scale). Locations should be marked on the airphotos as specifically as possible. Also, if no sources appear within the limits identified on the maps, contact should be made with this office and an additional area will be defined. If potential sources exist close to any accessible seismic lines or winter roads, these should be considered priority sources. Comments regarding method of interpretation and description of source should be attached to the airphotos.

II -- PHOTOGRAPHY

As soon as we were awarded this commission we ordered the 1:56,000 photography from the National Air Photo Library in Ottawa. This coverage was medium to high-level photography flown in 1973. Quality of the airphotos was very good and the scale was about the best for the particular type of mapping that we had to carry out here. It was the most recent photography available in this region, at least in the particular scale range that we required.

III -- GLOSSARY OF TERMS

Several geologic terms have been used at different locations in the report. Though many of these terms are common and most may be known to those using the report there may be a few terms where it would be helpful to have the precise meaning spelled out. Accordingly I have included a short glossary of terms in Appendix 1 at the back of this report. This glossary should probably be read over before the body of the report is studied in detail.

IV -- RATING OF PROSPECTS

When carrying out airphoto mapping of granular prospects we use five prospect rating terms. These terms are: excellent, good, fair, poor and very poor. They are intended to convey our feeling of the chance of success in uncovering a supply of sand and gravel at the location indicated. More precise definitions of the meaning of these terms are as follows:

DEPOSIT	A term used in the report to describe a proven source of sand and gravel. Usually the granular material has been proven with respect to quantity and gradation
PROSPECT	A term used to describe a potential source of sand or gravel that has not been tested or proven; the quantity and gradation of material is therefore inferred. Such prospects may be inferred from airphoto study, field reconnaissance observation, well data, or from a combination of these
POOR PROSPECT	The term indicates that, based mainly on stereoscopic airphoto examination, the chance of finding a source of economically developable gravel appears to be poor
FAIR PROSPECT	The term indicates that, based mainly on stereoscopic airphoto examination, the chance of finding a source of economically developable gravel appears to be fair

GOOD PROSPECT — The term indicates that, based mainly on stereoscopic airphoto examination, the chance of finding a source of economically developable gravel appears to be good

EXCELLENT PROSPECT — The term indicates that, based mainly on stereoscopic airphoto examination, the chance of finding a source of economically developable gravel appears to be excellent.

Note that there are no prospects that I have rated as good or excellent in the Trout Lake area though I have rated two areas as fair-to-good. These two prospects would probably not be rated even that high if we were mapping these same prospects in a gravel-rich area in the south. This is because the five rating terms used are relative, to a degree. That is, all prospects are rated relative to the other prospects in the general area. Thus because the two prospects rated as fair-to-good are perhaps the best in the area, we have elected to give them this high a rating.

V -- COLOR-CODED LEGEND

The following color code helps to highlight the expected quality of the prospects mapped on mosaic sheets 1 to 14 even though these same prospects are already rated in Table 1: (See Figure 1)

Fair-to-good

Fair

Poor to fair or poor to fair locally

Poor or very poor

VI -- TABLE 1

GRANULAR MATERIAL AND BEDROCK PROSPECTS IN THE TROUT LAKE AREA, N.W.T.

Prospect Number	Landform Type	Rating	Comments
1, 2, 3	Crevasse ridges and outwash	Poor	Prospect area 1 probably has a better chance of having granular materials present than does Prospects 2 and 3. One is easily fooled by the tree growth in areas such as this. A small difference in soil dryness makes a large difference in the tree height. Thus often where there appears to be a ridge, under stereo examination, one is in fact simply seeing the effect of better tree growth. Check the small outwash terraces at 2 closely.
4, 5	Eskers	Poor to locally fair	Expect granular materials along these eskers though they may be very small in cross-section once the tree growth is removed. The Prospect 5 eskers lying just off mosaic 2 of 14, to the east, are mapped on mosaic number 4 of 14.
6, 7	Outwash or outwash terrace	Poor	Check all of these areas by chopper. If you can get 2 or 3 holes by heli-drill into each area it would be advisable.
8	Ice-contact prospects	Poor	Check poor-looking ice-contact prospects on the ground. Tree growth falsely enhances the actual height of these small areas.
9	Eskers	Fair	Same area as indicated in Prospect 5. Again, these esker ridges will not be near as high as they appear in the airphotos. In fact, they may be only a metre or two above the general surrounding terrain but the tree growth makes them look 3 or 4 times this high. In any case they are worth checking closely.

Prospect Number	Landform Type	Rating	Comments
10	Mainly esker with some outwash	Poor to locally fair	Check at "X's" as indicated on mosaic. There may be some fair segments along this esker ridge and perhaps on flatter outwash areas along the flanks of the esker.
11	Terraces	Poor	Very small terrace areas along old meltwater channel.
12, 13	Outwash terraces	Poor	Check with 2 or 3 holes at each area to determine whether there is a thin (1-2 metre) layer of depositional sands or fine gravels over the underlying till.
14	Kames	Fair to good	This area looks interesting; may be the best prospect in the Trout Lake area. Try several holes in the large northerly area of Prospect 14.
15	Outwash	Fair to good	A large flat outwash area associated with the hummocky kame area of Prospect 14.
16	Outwash	Poor	Doubtful but may be shallow granular deposits along either side of Muskeg Creek. Put in several holes each side of creek.
17	Ice-contact ridges	Very poor	Low ridges are hardly discernible except trees accentuate these areas; very doubtful that any volume here.
18	Outwash	Poor	May be a little granular material here.
19	Moraine	?	There's a good chance this may be mainly till. Ridge appears to be flat-topped. And, as before, the trees greatly accentuate the ridge height. I suspect ridge is $<$ 2 metres high in highest areas.

Prospect Number	Landform Type	Rating	Comments
20	Moraine	Poor-fair	This large area is perhaps largely till but must be checked thoroughly because some areas may be sand and gravel. Airstrip for landing chopper is right at edge of prospect area and could be used providing it hasn't grown up with trees.
21	Esker	Poor-fair	Small esker may be fair locally; check at same time that Prospect 20 is field-checked.
22,23,24	Near-surface bedrock	Fair	Bedrock should be either very near-surface or, possibly, exposed locally in these areas. Check very thoroughly on the ground along eroded faces of gullies located at tip of arrows on mosaic 7 of 14. Bedrock should be sandstone. Hopefully it would be competent enough to allow use as aggregate if this alternative were selected.
25	Outwash(?)	Poor	Doubtful sand and gravel outwash prospects but worth checking at least by chopper and spade if not by heli-drill.
26	Bedrock or till	Poor	Check headland area at shore to determine if small promontory is bedrock-cored or just till.
27	Bedrock or outwash	Poor	Check these two small areas just east of Trout Lake Settlement.
28	Moraine	Very poor	Expect these are small till knobs that would be OK as fill (subgrade) material for the bottom portion of the runway foundation.
29	Bedrock(?)	Fair (?)	The northernmost nose of this butte-like area may have bedrock near-surface. Check outlined area closely in field for signs of exposed sandstone bedrock. If none exposed try a few holes to see if bedrock is near surface. Haul from a sandstone quarry here would only be 3 or 4 miles to airstrip.

Prospect Number	Landform Type	Rating	Comments
30	Kamey ridge (likely till)	Poor	Expect this is a kame moraine ridge that is composed mainly of till; check for presence of granular pockets within an otherwise till moraine.
31 (also Prospect 19)	Moraine	(?)	Same area as Prospect 19. See comments under 19.
32	Moraine	Poor	I expect that these deposits are all till.
33	Ice-contact	Poor	May be some granular material here. Should put in about 3 holes if possible.
34,37	Beach	Poor-fair	This is a rather nice-looking setting for development when compared with most of the Trout Lake shoreline. It should probably be reserved for a lodge or some other like development. I expect medium to coarse sands to fine gravels here along this almost 2-mile stretch of water-front.
35	Beach?	Poor	May be a segment of old eroded beach.
36	Delta	Poor-fair	Probably OK for siting of airstrip extension but doubtful that any coarser aggregate is to be found here. Sands here are likely coarser adjacent to the water channels but grade to medium sands away from these watercourses.
38	Till	Poor	Till ridges are likely suitable as subgrade fill for airstrip extension foundation.
39	Ice-contact	Poor to fair	May be a small knob of granular material here; gradation unknown but likely fine.
40	Outwash	Poor	Likely sand.

Prospect Number	Landform Type	Rating	Comments
41	Outwash	Fair	May have some gravels here; check thoroughly with at least 3 holes.
42	Erosional islands of till or gravelly ice-contact ridges and knobs	Poor-fair	Worth checking; place at least 1 hole in each area; areas all lie on north side of creek.
43	Outwash	Poor	Area doesn't look very promising at all but may have thin (1-2 metre) outwash along old meltwater channel. Place holes where trees are highest and healthiest as this is likely where granular material is located, if it exists here at all.
44	Outwash	Poor	Check these areas for presence of very thin outwash coarse sands or fine gravels; very doubtful; should be able to check by spade in summer months.
45	Bedrock (?) or till headland	Poor	This is a strange-looking headland area along shore of Trout Lake. Could be bedrock or just highly compacted till that is resistant to erosion.

VII -- PROBABLE MATERIALS AVAILABLE AT PROSPECTS

It appears likely that the materials available for the construction of the subgrade foundation and the surfacing of the proposed airstrip extension at Trout Lake are as follows:

1. Coarse sands: variable in cleanliness ranging from clean to silty

2. Sandy to shaley gravels: generally speaking I would expect the gravels found in this area to be oversanded and shaley

3. Bedrock: near-surface bedrock in the Trout Lake area will be either sandstone or shale

4. Till: expected to be shaley tills for the most part.

Comments that appear on the airphoto mosaic strips at each prospect and, as well, in Table 1 in this report, usually describe the texture and the materials that we expect to be found at each prospect. Though these comments will not be accurate in all cases they will help guide you to the prospects where there is the best chance of your requirements being met.

VIII -- HAUL DISTANCES AND ROUTES

We mentioned in our proposal that we would select preliminary preferred haul routes from some of the better-looking prospects to the proposed airstrip site. After examining the airphotos in a 20-mile-radius around the airstrip only the following comments need to be made at this

time regarding the haul aspect:

1) I see no major topographic impediments to haul (i.e. hills, valleys, gullies, etc.) from any of the mapped prospects to the vicinity of the proposed airstrip site. Certainly the existence of a sparse tree cover and a very wet thin organic peat surface layer will be the two main problems with all proposed haul routes. Thus it would seem to me that winter haul would make the most sense in order to avoid the wetness and peat problems. In some areas existing old seismic trails could probably be used providing they line up to advantage along general haul corridors.

2) I would think Trout Lake would make an excellent winter haul route for any prospects that lie to the south, southwest, west or northwest of the airstrip wherever a major stretch of the ice could be used as a haul road.

As noted in telephone discussions with your office, once several prospect alternatives have been isolated for possible use and after field testing we could then locate the best winter and summer routings on the mosaics from these selected sites to the airstrip area.

A comparison of haul distances from competing prospects can be made directly from Figure 1 where 10-, 15-, and 20-mile radii are shown. Given the terrain existing in the Trout Lake area I would think one could pretty well use a straight line from the prospect site to airstrip when comparing hauls, at least for comparing winter haul alternatives.

IX -- FIELD TESTING OF PROSPECTS

As in most northern areas transport for field-testing equipment is a bit of a problem. Our experience suggests that, as a starter, the heli-drill is probably the best way to explore. But where one cannot get close to the site with the chopper it may be necessary to explore using hand methods -- i.e. by spade. Once you have an idea of the prospects that you feel you want to explore in detail then it would be advisable to get backhoe-type equipment onto the site. But you are likely more familiar with the testing aspect and attendant problems than we are.

X -- QUARRY SITES VS UNCONSOLIDATED DEPOSITS

One decision you will have to make is whether it is more practical to crush quarry rock than it is to use the available unconsolidated sand and gravel deposits. This decision will be based on several parameters that come to my mind. These are:

1) The competency of the available bedrock at quarry sites -- i.e., are the shales or sandstones hard and durable or are they soft and friable?

2) The depth of overburden at, and haul distance to, quarry sites vs haul for competing sand/gravel sites.

3) The availability of and cost of bringing in a primary crusher for first-stage breakdown of quarry rock after blasting.

4) The availability of a secondary crusher for crushing at gravel pits.

5) The comparative importation costs on 3) and 4) above.

6) The specific requirements for runway materials (foundation and surfacing) at the airstrip site.

I would not expect permafrost to be a problem at either quarry or gravel pit sites at the latitude that exists at Trout Lake.

XI -- OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

Following are a few general thoughts on the overall Trout Lake study:

1) Local foundation conditions may be better for airstrip construction at the prospects 34-37 area than at the present airstrip site (36). But this is just a guess and you may have no problem at site 36. For example, I wonder if the sands at 36 are silty thus requiring more imported fill than you would need at site 34-37 where the sands may be cleaner and have better bearing values.

2) The general prospect site 14-15 area looks most interesting as far as the possibility of finding gravel is concerned. But you may find other areas that we have mapped that are also interesting to you. Thus you will need a good field program upon which you are prepared to spend considerable money; this in order to maximize savings on construction costs in the long run.

3) I would seriously consider a winter haul over Trout Lake if you end up using sites 14 and/or 15 as an aggregate source.

4) You may be able to make good use of a few better-than-average (drier) till deposits for subgrade purposes. For this reason I have mapped many morainal (till) ridges that have little chance of yielding any granular material but that will likely be excellent sources of till borrow. You may cut down on your total granular requirements by making prudent use of some of these close-in till deposits.

5) Do not let the fact that nearly all prospects are rated as poor deter you from doing a thorough investigation of these prospects as you work your way out from the shorter-haul prospects to the farther-out prospects. We have found many times over the last 30 years of mapping sand and gravel prospects that there is often a so-called "sleeper" among the lower-rated prospects. This happens because we can only rate a prospect as fair or good if we can actually stereoscopically see airphoto indicators that we know signify the presence of sand and gravel. But in some cases these indicators have been masked out by erosion or by other causes making the prospect look very second rate. Accordingly, we must rate them well down the scale.

6) One final word of warning. It is important that your field staff carrying out the testing and exploration program understand that not all mapped prospect areas are going to be granular. Many will be mainly till. That is, you should expect a fairly high failure rate; this because of the type of

terrain existing in this study area. In fact, I would be most pleased if say 1 in 5 of the prospects I have mapped turn out to have a significant amount of useable material in them. And of course if this many do turn out you should be able to develop one or two of the best-looking prospects.

APPENDIX 1

GLOSSARY OF GEOLOGICAL TERMS

GLOSSARY OF GEOLOGICAL TERMS

ALLUVIAL CONE An alluvial deposit shaped like a half cone, formed at the base of a steep slope or cliff

ALLUVIAL FAN A fan shaped deposit of alluvium laid down by a stream where it emerges from a valley or ravine and spreads out onto more gently sloping terrain

BEDROCK Solid rock that underlies the surficial cover of fragmented earth materials

BUTTE A steep sided more or less conical hill formed by the erosion of a layer of flat lying resistant rock overlying softer material

CREVASSE FILLING A relatively straight ridge, or one with angular bends, composed of glacial drift deposited in a crevasse in stagnant glacier ice that later melted

DEBRIS FLOW The sudden rapid downhill flow of a saturated mixture of fine and coarse rock debris

DEBRIS SLIDE The rapid downhill sliding of fine and coarse rock debris without backward rotation, forming a hummocky deposit at the bottom of the failed slope

DOLOMITE A mineral composed of calcium magnesium carbonate, $CaMg(CO_3)$, or a sedimentary rock composed chiefly of the mineral dolomite; also called dolostone

ESKER A long narrow often sinuous ridge of sand, gravel and boulders deposited between ice walls by a stream flowing on, within, or beneath a stagnant glacier; often includes segments of till

FAN DELTA A deposit formed where an alluvial fan is built into a lake or the sea

FLOODPLAIN The nearly level land along side a stream that is subject to flooding

GLACIAL OUTWASH Predominantly gravelly or sandy stratified sediments deposited by streams issuing from melting glacier ice

GLACIOFLUVIAL Produced by meltwater streams flowing from glaciers, including meltwater erosion and deposits

GROUND ICE Ice in pores, cracks and other openings in soil and rock materials, usually referring to permafrost-affected terrain

HUMMOCKY MORAINE A high relief moraine characterized by a haphazard distribution of ridges, knobs and kettles of different sizes and shapes; also called disintegration, dead ice, stagnation, collapse, and knob and kettle moraine

ICE CONTACT DEPOSIT Stratified drift deposited in contact with melting of glacier ice, usually when the glacier is stagnant

KAME A usually conspicuous mound of complexly stratified sand and gravel deposited against stagnant glacier ice by meltwater

KAME MORAINE A hummocky moraine that consists predominantly of kames

KAME TERRACE A terrace-like body of ice contact stratified drift deposited between a mass of stagnant glacier ice and the side of a valley

KETTLE (GLACIAL) A closed hollow in glacial drift, created by the melting of underlying ice; also called kettlehole

KETTLED OUTWASH An outwash deposit whose surface is marked by many kettles

LACUSTRINE Pertaining to lakes

LANDFORM Any topographic feature of the earth's surface produced by natural processes, either erosional or depositional, having a characteristic shape

LIMESTONE A sedimentary rock composed predominantly of calcium carbonate

OUTWASH FAN A fan shaped body of glacial outwash

OUTWASH DELTA A body of glacial outwash deposited in a pond, lake or the ocean, usually one having a flat top and a steep frontal margin

PEATLAND Any terrain covered by a layer of any kind of peat, such as sedge, moss, or forest peat, or by a combination of them

PERMAFROST A freezing condition in any mineral soil, organic material or bedrock that persists over at least two consecutive winters

ROTATIONAL SLIDE A slide in which shearing takes place on one or more concave upward surfaces, producing a backward rotation of the displaced block or blocks; also called slump

SHALE A laminated fine grained sedimentary rock containing a high content of clay minerals

SLUMP See rotational slide

TALUS An apron of coarse broken rock fragments shed from a cliff face and lying at its base at angles less than 40°, the term referring either to the sloping landform produced or to the rock fragments

TERRAIN A comprehensive term to describe an area of the earth's land surface with respect to one or more of its natural or cultural features

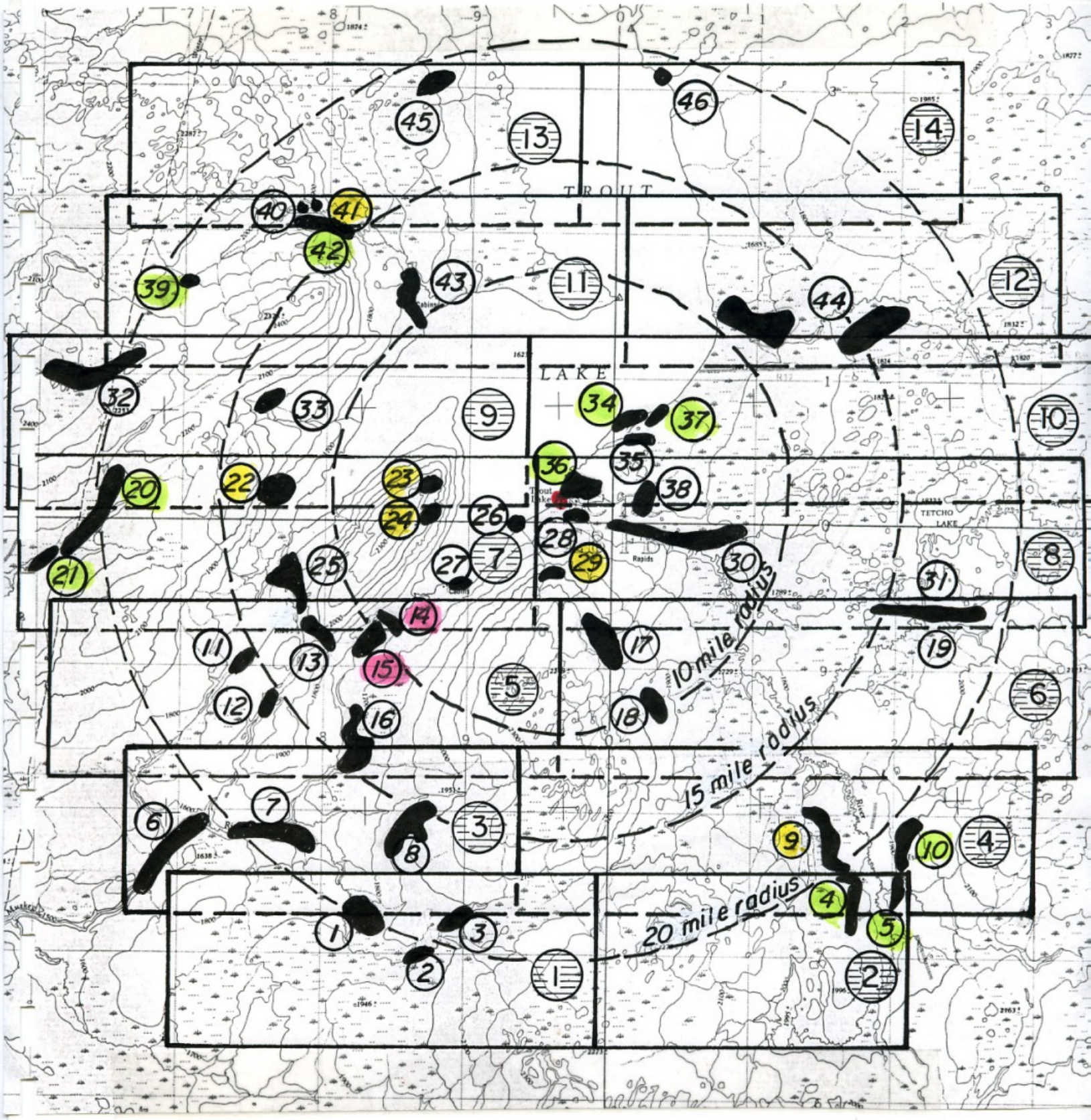
TERRAIN ANALYSIS For a given purpose, the process of identifying, classifying, mapping and interpreting the significance of terrain features, typically performed from maps, airphotos or nonphotographic imagery

TILL An unsorted and unstratified heterogeneous mixture of clay, silt, sand, gravel and boulders deposited directly by glacier ice

VALLEY GLACIER A glacier occupying or flowing down a mountain valley

VALLEY TRAIN A long narrow body of glacial outwash that partly fills a valley

WATER TABLE The upper surface of the zone of saturation below ground level; also called the free water surface or phreatic surface



KEY MAP SHOWING

LOCATION OF MOSAIC SHEETS 1 to 14 AND RELATIVE HAUL DISTANCES AND LOCATIONS OF SAND, GRAVEL AND TILL PROSPECTS IN VICINITY OF TROUT LAKE AIRSTRIP, NWT

0 5 10 15 20 MILES

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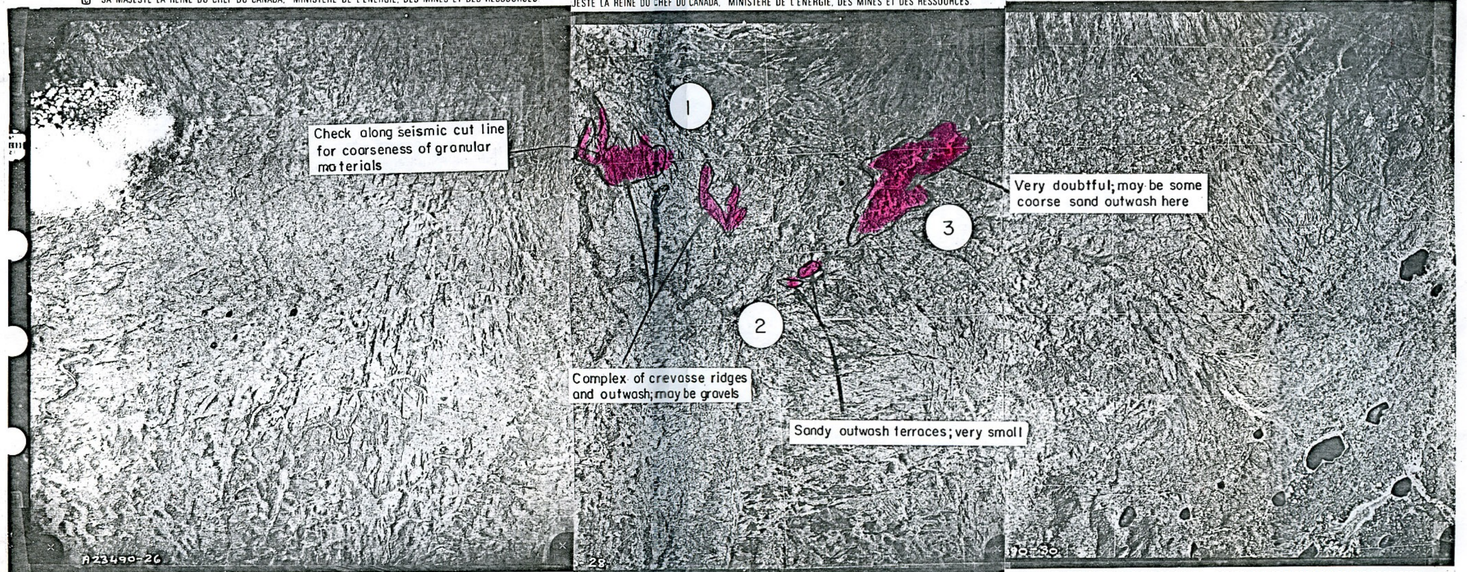
FIGURE 1



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SAND AND GRAVEL PROSPECTS

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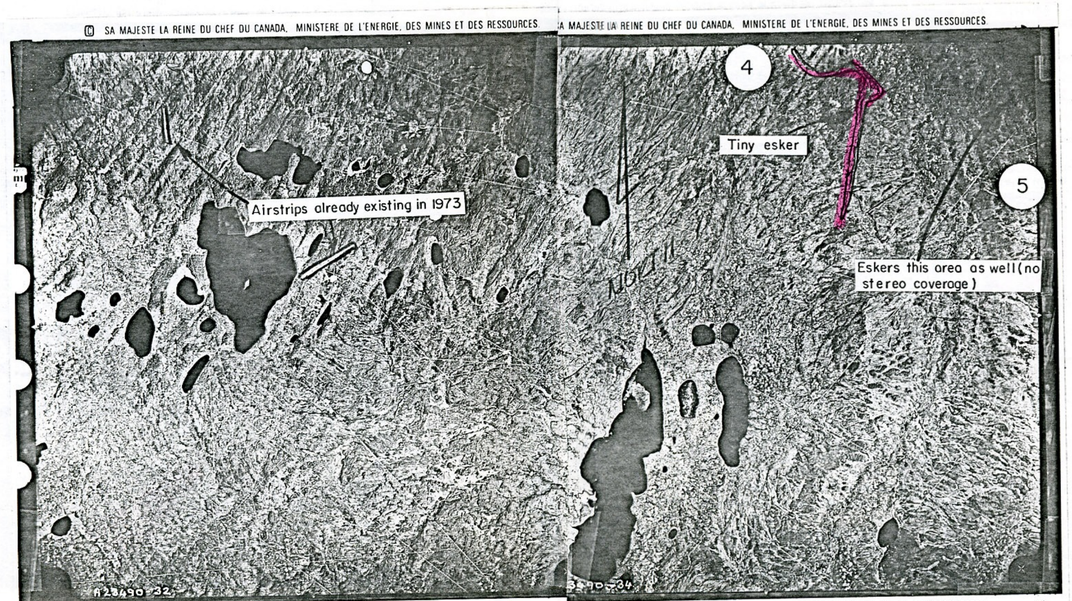

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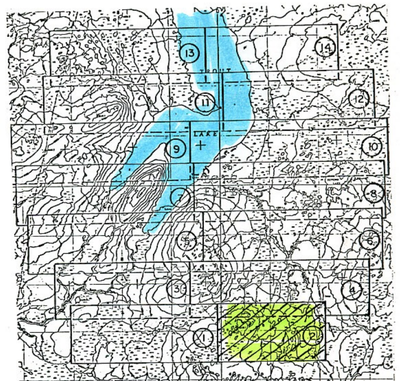

SAND AND GRAVEL PROSPECTS

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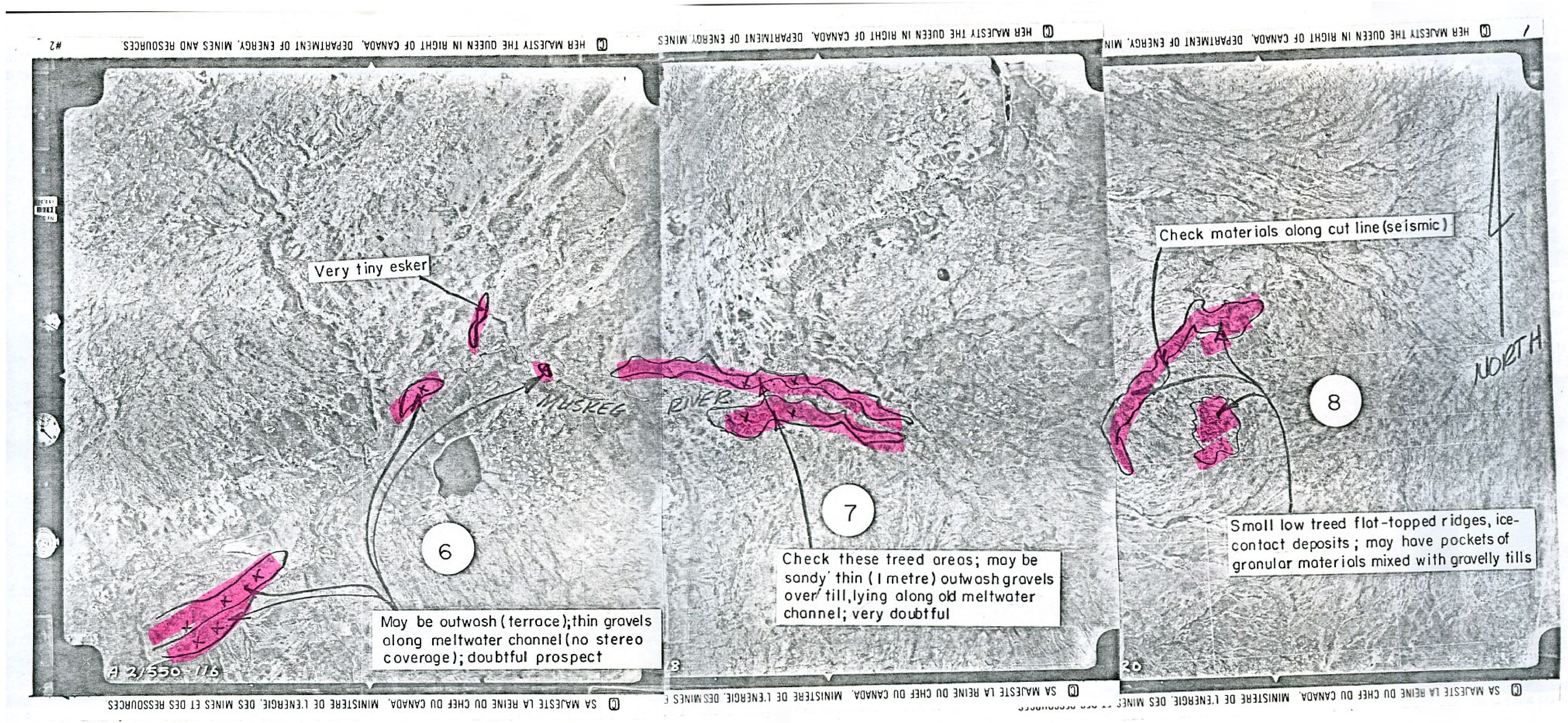
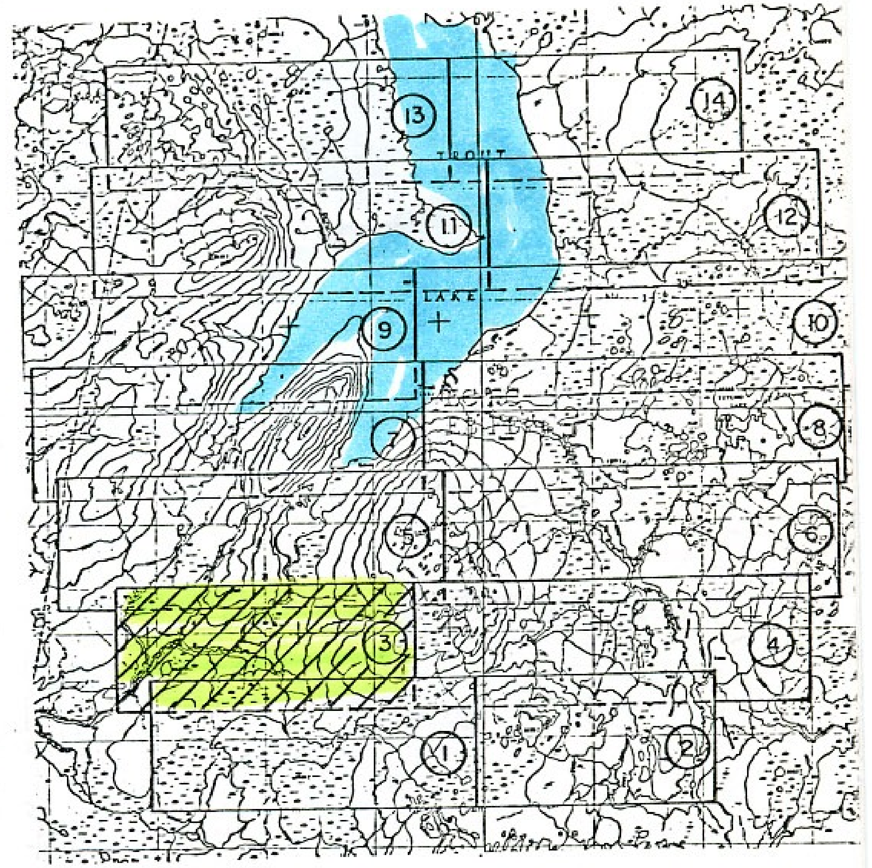
SHEET 2 of 14





SAND AND GRAVEL PROSPECTS

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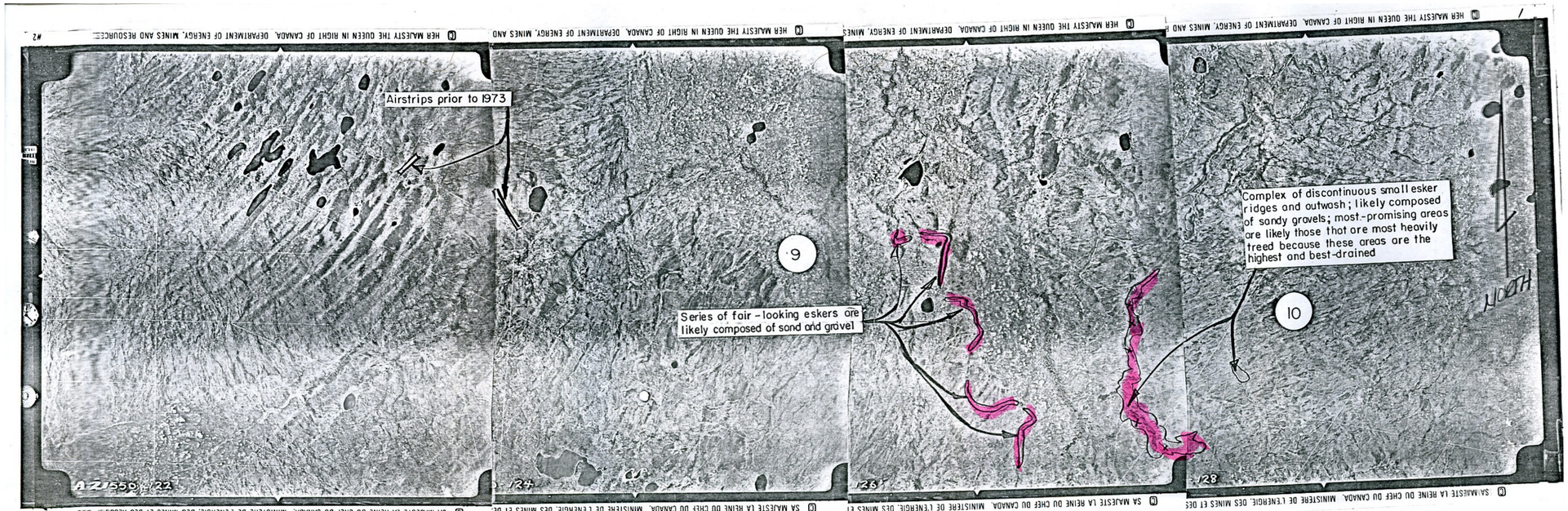
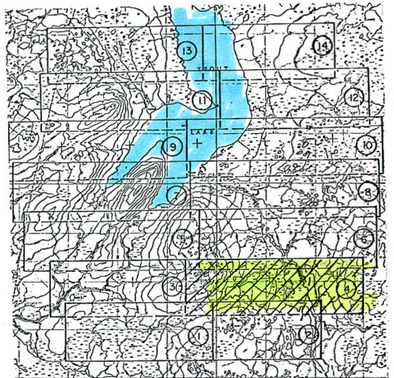
SHEET 3 of 14





SAND AND GRAVEL PROSPECTS

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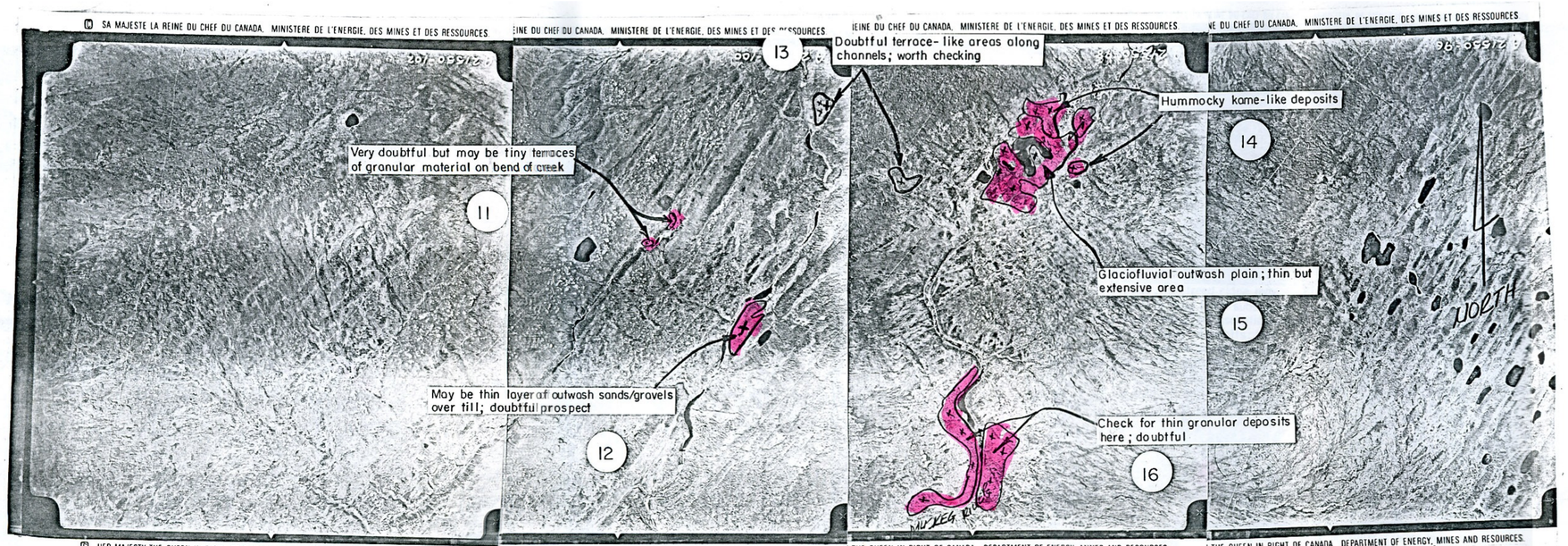
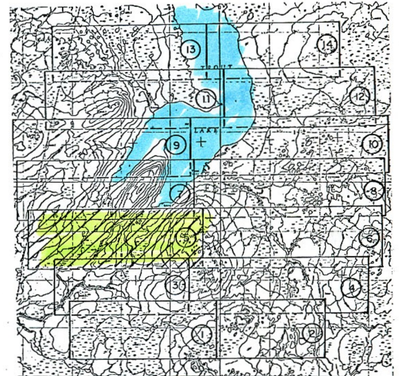
SHEET 4 of 14





SAND AND GRAVEL PROSPECTS

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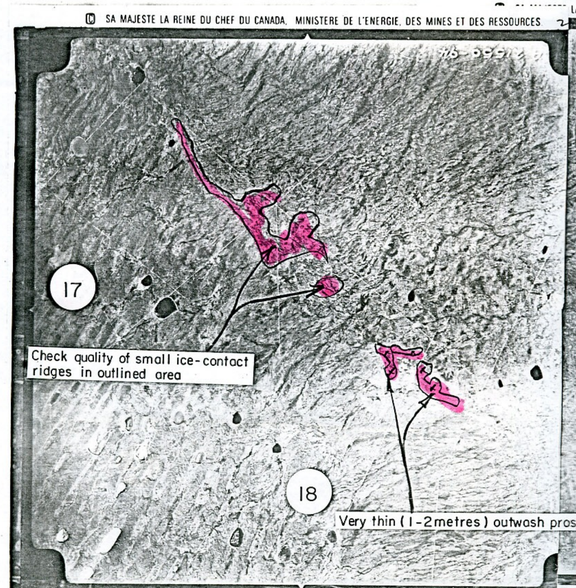
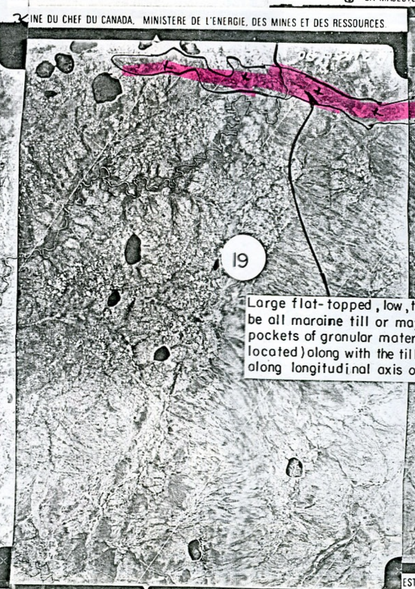
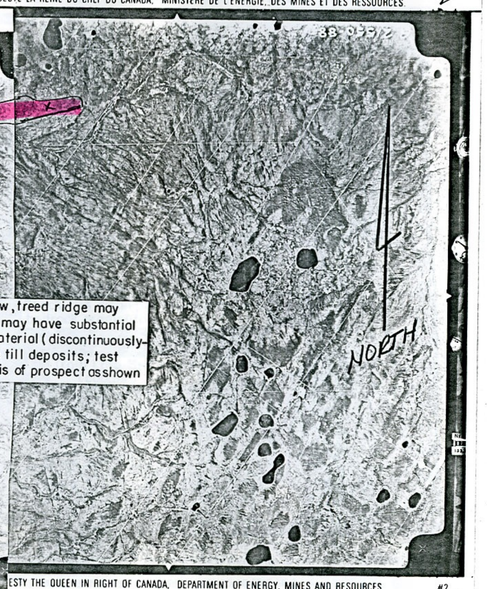
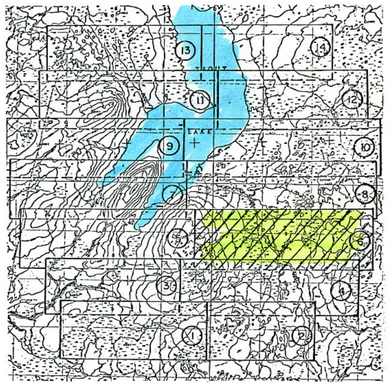
SHEET 5 of 14









SAND AND GRAVEL PROSPECTS

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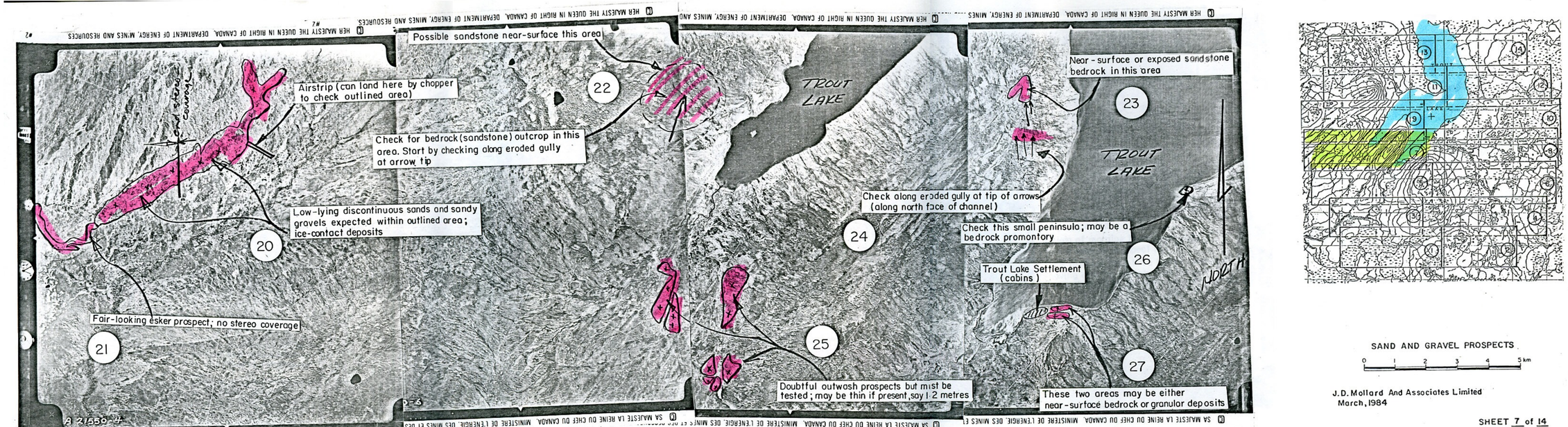
SHEET 6 of 14



SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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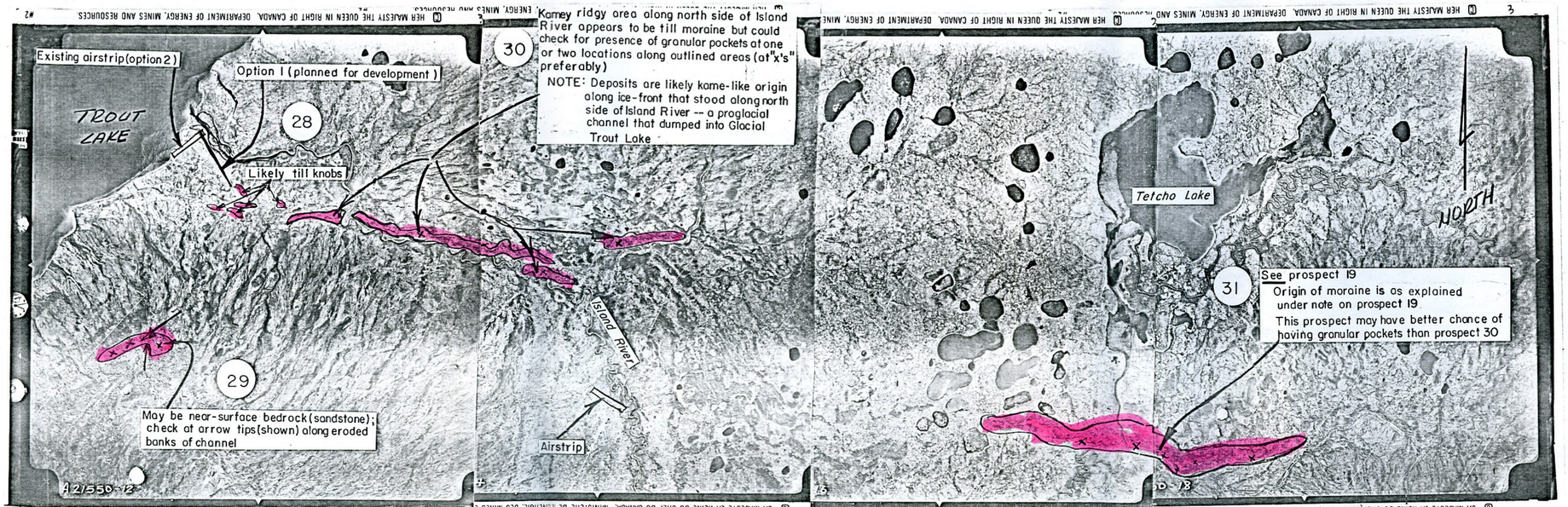

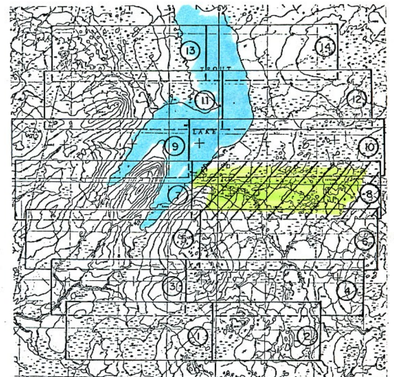

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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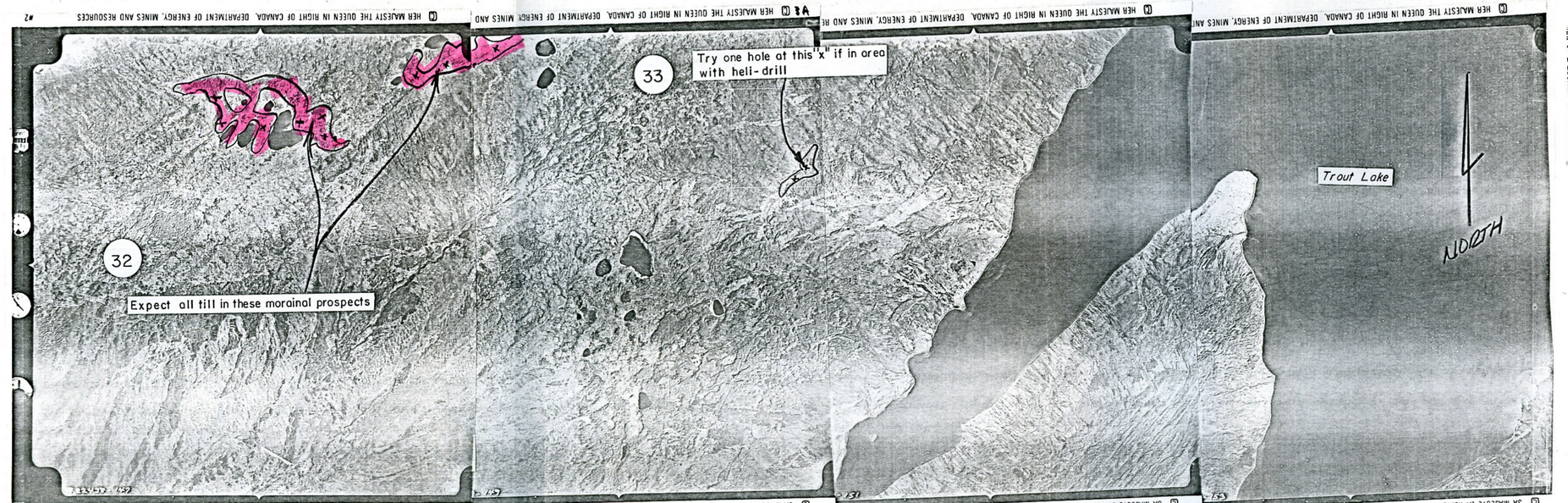

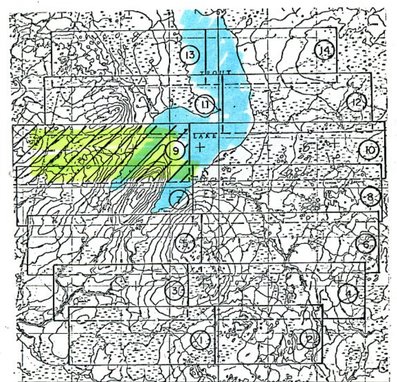

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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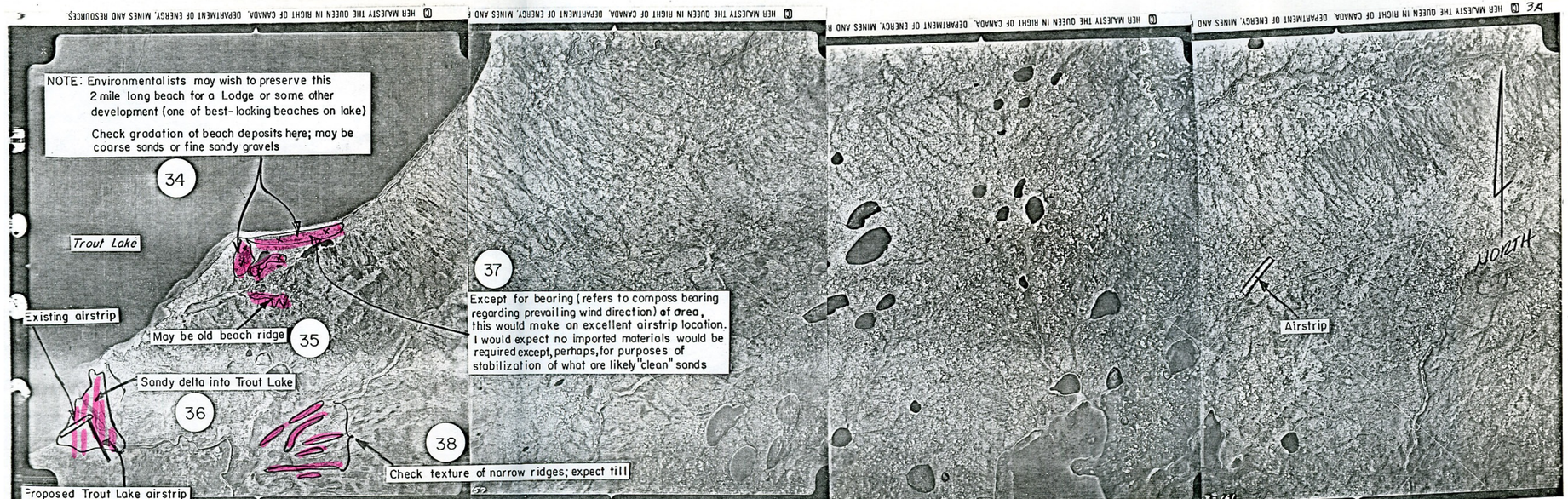

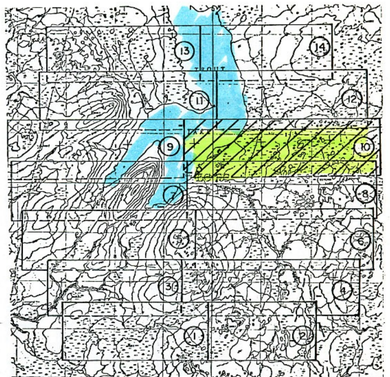

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5

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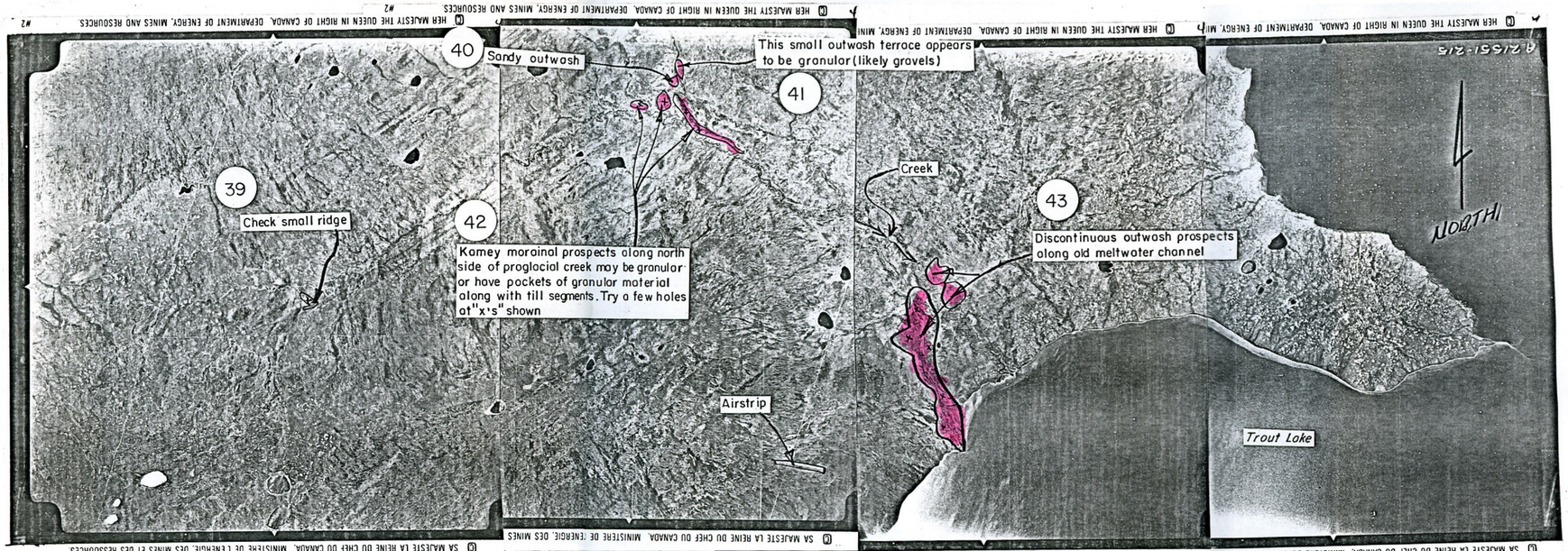

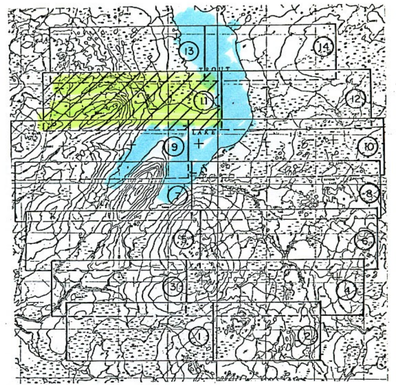

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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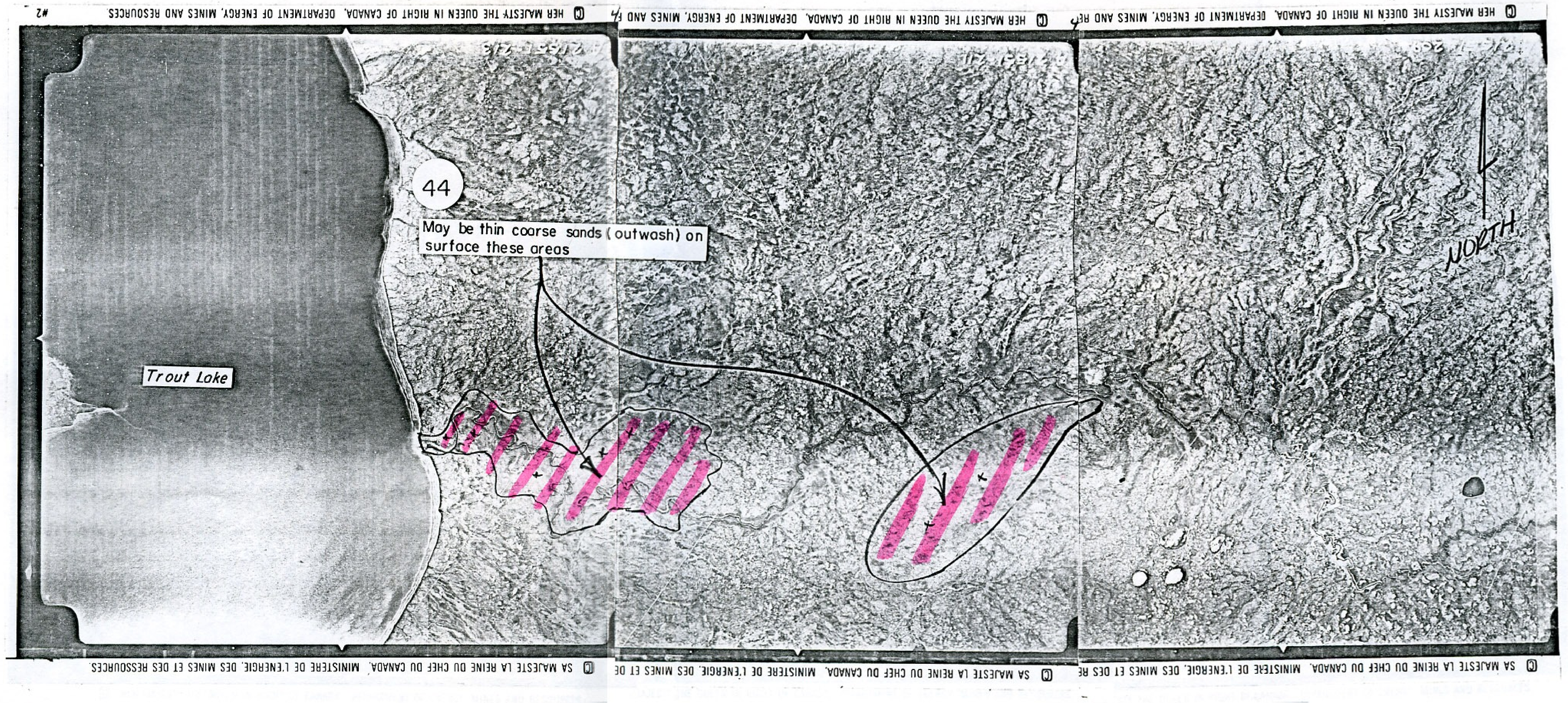

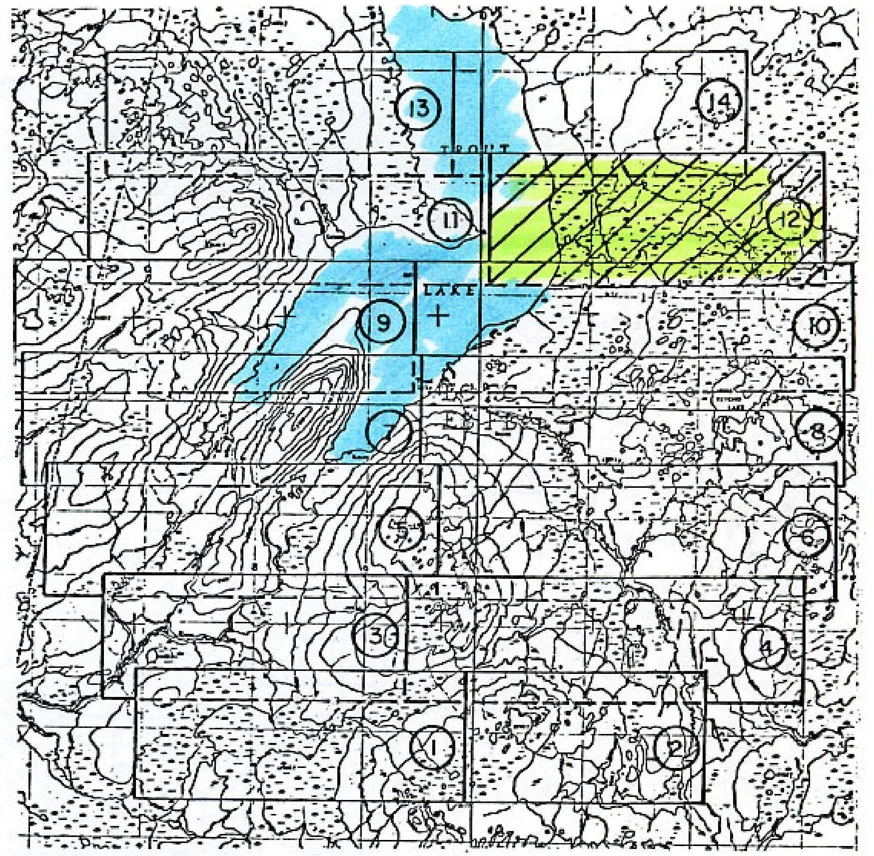

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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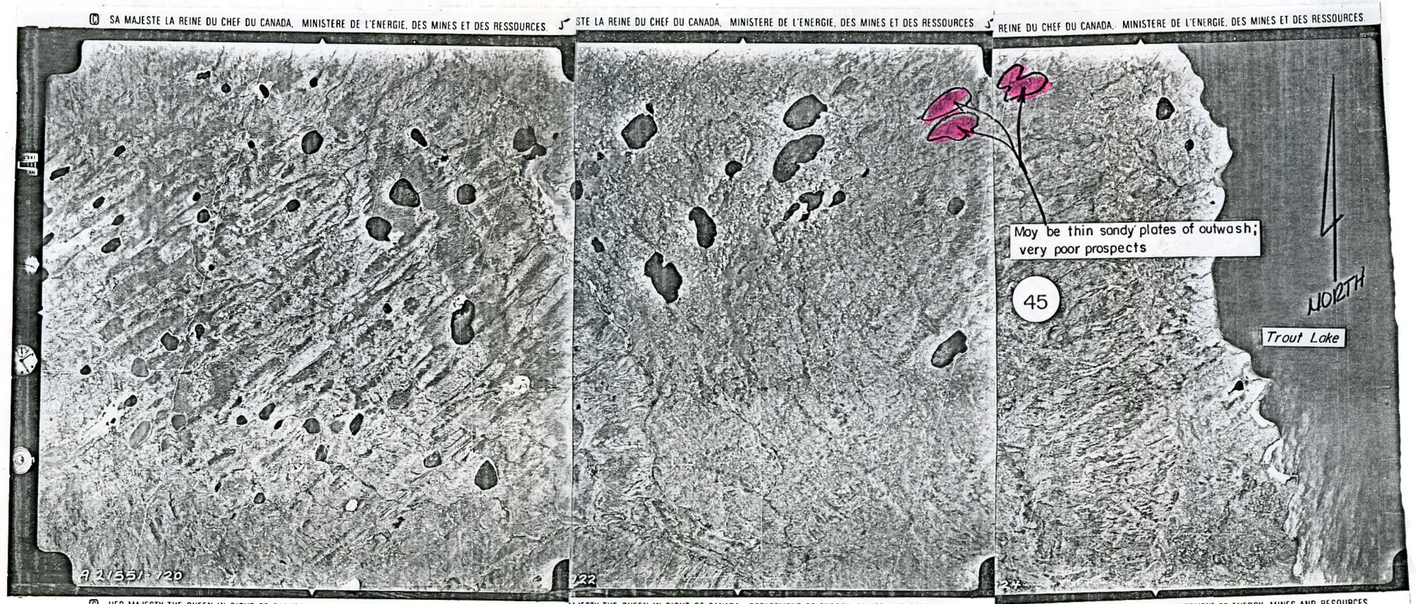

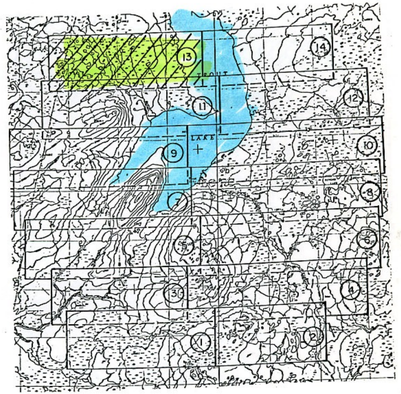

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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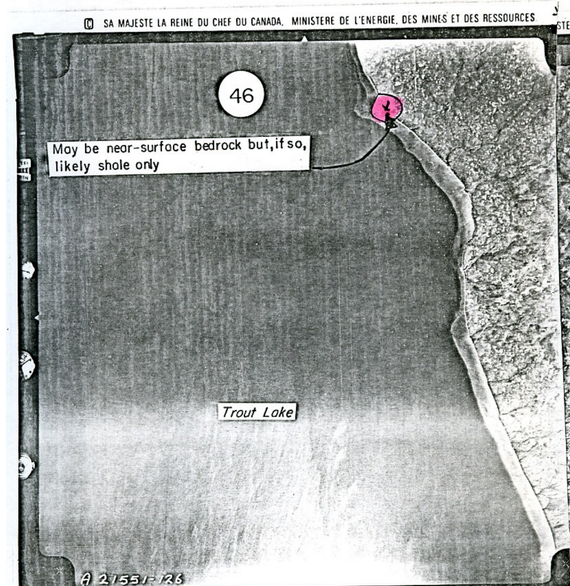

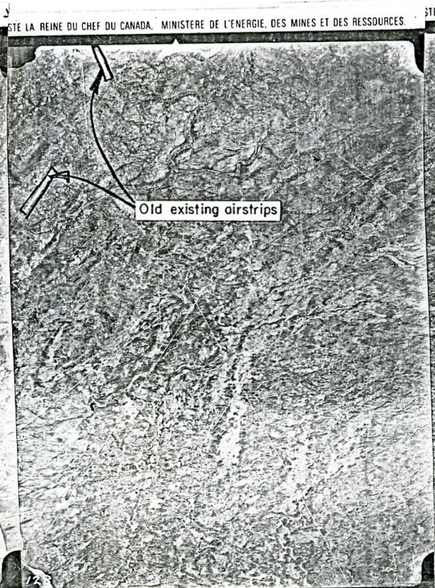

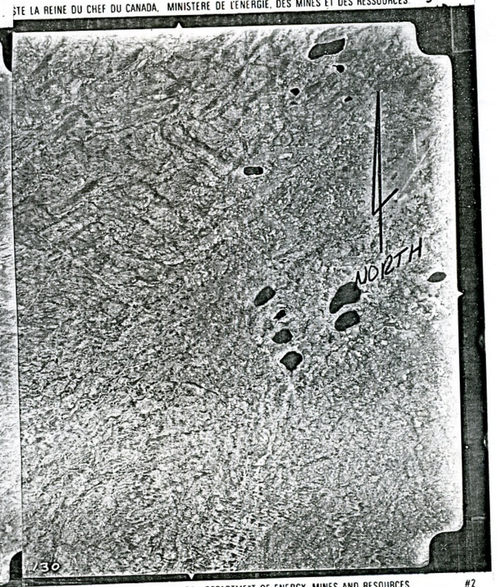

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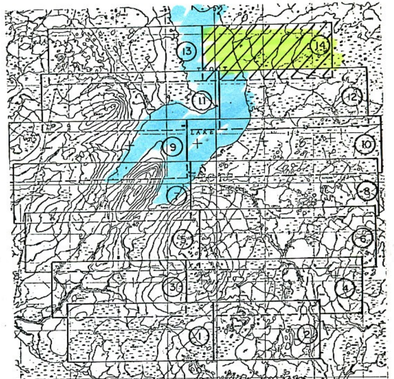

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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END OF REPORT