OFFICE AIRPHOTO SEARCH
FOR
FOUNDATION AND SURFACING MATERIALS
FOR
NAHANNI BUTTE AIRSTRIP
VICINITY
NAHANNI BUTTE SETTLEMENT, 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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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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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.

V -- COLOR-CODED LEGEND

The following color code helps to highlight the expected quality of the prospects mapped on mosaic sheets 1 to 13 even though these same prospects are already rated in Table 1: See Figure 1

Fair to good

Fair

Poor to fair <u>or</u> poor to fair locally

Poor <u>or</u> very poor

VI -- TABLE 1

GRAVEL PROSPECTS IN THE NAHANNI BUTTE AREA

Prospect Number	Landform Type	Rating	Comments
1, 2	Outwash	Poor	Doubtful but worth checking. Prospect 2 looks a little more promising than Prospect 1. These prospects lie south of the Blackstone River.
3	Alluvial terraces	Poor	May be some thin sandy gravels in bends of Blackstone River. Examine along cut line crossing one of these two areas.
4	Floodplain deposits	Very poor	I don't expect anything but coarse sands here but there could be enough sorting at these river bends to get some coarseness. These are easy to check by chopper and spade or I would not have included them. Worth checking.
5	Outwash	Very poor	Doubtful that anything exists here but the prospect is easy to check because of old airstrip nearby. Try 2 or 3 holes, if possible, at "X's".
6,7,8	Ice-contact ridges and knobs	Some areas may be fair locally	These are a tough group of prospects to assess the potential. Some of this group definitely look like sand or gravel but some may be till/bedrock as well. If the general area appeals to you then you should get at least 1 or 2 holes into each prospect area with the heli-drill. In Prospect 7 first try at the "X" indicated as a preferred location to start testing. These prospects appear to be deposits that were trapped along the upper boundary of a stagnant melting valley glacier -- i.e. in a kame terrace setting. But most have been eroded or have slumped downslope by now and are not recognizable as kame terraces.

Prospect Number	Landform Type	Rating	Comments
9	Bedrock or eroded kame terrace	Poor	Lineations in this small knob could be in bedrock (dolomite or limestone) or they could be ice wedges in granular material.
10	Bedrock or eroded kame terrace	Poor	Very doubtful but check closely.
11, 11A	Alluvial fans	Poor to fair	Prospect 11 is poor but 11A may be fair. All fans mapped in this report may be overstocked with fines but fans developed from dolomite/limestone bedrock have a better chance of having less fines and of being useable.
12	Talus	Fair	Talus expected to be developed from dolomite bedrock; may be fairly competent aggregate.
13	Kame terrace remnants	Poor to locally fair	Same general area as Prospects 6 and 7 and same origin.
14	Alluvial fan	May be fair	Large deposit but it will likely have a near-surface water table because of attendant stream; however it will definitely be permafrost-free.
15,16	Outwash	Poor to fair?	Most easterly of two areas mapped appears to be most promising.
17	Ice-contact deposits	Poor	This group appears to be morainal (till) deposits or,alternatively, granular ice-contact deposits. Will need to be checked out.
17A	Fan	Poor	A small alluvial fan.
19, 20	Alluvial fans	Fair	Likely developed from limestone bedrock. Again, their viability for use will depend on the amount of fines (say percent passing the 71 μm sieve); very large deposits.

Prospect Number	Landform Type	Rating	Comments
21	Fan deltas?	Fair	These mapped areas may be remnants of a breached fan delta into an arm of an old glacial lake that stood at about 1500 - 1700 feet in this area. But this is conjectural. Try a few holes a "X's" shown.
22	Ice-contact prospect	May be fair locally	One of the same areas shown in Prospect 8.
23	Alluvial fans	Fair if not over-stocked with fines	Numerous large and small alluvial fans along east side of Nahanni Range. Expect coarser near "throat" (outlet end) of fan and finer (siltier) near the distal end (easterly in this case) of the fans.
24	Alluvial fans	Same as 23	Same comments as 23.
24A	Kame terraces	Poor to very poor	May be very small ice contact (kame) eroded terraces.
25	Outwash?	Poor	May be some shallow outwash coarse sands or sandy gravels along Bluefish Creek valley bottom adjacent to tops of banks of present-day creek.
26	Landslide debris	?	Debris from an old massive slide out of the north face of Nahanni Butte is completely covered by trees. Coarseness of slide debris can only be determined by on-site inspection. Selected areas of these debris deposits would only be of value if they are comprised of small enough rock fragments to be accepted by a primary crusher -- say less than 30" diameter at very most. My guess would be that the fragments will be smaller at the distal end (north) of the debris located on the north side of Bluefish Creek but this is only a guess.

Prospect Number	Landform Type	Rating	Comments
27	Breached outwash	Fair	These two areas lying on either side of Bluefish Creek, appear to be remnants of once-more-extensive outwash deposits on the floor of Bluefish Creek Valley. Most of the original deposit appears to have been eroded away by present-day valley widening.
28	Alluvial fans	Likely fair if of dolomite or limestone origin	These deposits are quite close to Nahanni Settlement and airstrip. One could haul across the Liard River in the winter and stockpile at selected locations.
29,30,32	Outwash	29 - Poor 30 - Fair	Prospect 30 looks a little more interesting than 29. Check with holes in each.
31	Fan	Poor to fair?	The source area for this fan cuts across some shale bedrock even though the main source appears to be higher up in dolomite bedrock. Present trail cuts across base of fan.
32A, 32B	Ice-contact and/or eroded kame terrace remnants	Poor to very doubtful	Small very questionable prospects; check only if in area with chopper.
32C	Alluvial fans	Fair if aggregate competent	May be overstocked with fines. The old "pudding-like" slides to the northwest of 32C are classical. They are likely located in siltstones, sandstones and shales with little or no competency.
33,34,35, 36,36A	Alluvial fans	Poor	Likely formed from sandstone of poor competency.

Prospect Number	Landform Type	Rating	Comments
37	Outwash delta	Poor at "C" to fair-to-good at "A"	This deposit appears to be a glaciofluvial outwash delta; materials belonging to this delta must have been deposited into an old glacial lake -- perhaps an arm of Glacial Lake McConnell that followed the low where the Laird River now is found. Elevation of this body of water appears to have dropped from over 700 feet down to +600 feet over a period of time. Granular materials were deposited at each lake stillstand. In any case Level A is likely the coarsest, B next coarsest and C the finest (silts and fine sands). The kettles in Area C suggest that either large blocks of glacier ice were deposited with the sands at time of deposition of this lower-level delta or, alternatively, Area C developed extensive ground ice, postglacially, and then this ice decayed over the last 5000 years.
38	Alluvial terraces	Fair?	Rather remote terraces near Yohin Lake.
39	Huge alluvial fans	Poor	Though these are huge fans developed at the base of the Liard Range they are likely composed of very soft bedrock (shales, soft sandstones, etc.).
40	? Slide debris or glaciofluvial valley train deposits	Doubtful	Very remote.
41	Alluvial fans	Poor	Expect composed of soft bedrock debris and highly overstocked with fines; too remote to be of interest.

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 Nahanni Butte 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 Nahanni Butte area will be either sandstone, mudstone, shale, dolomite or limestone

4. Till: expected to be shaley to limey 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) The Nahanni and Liard mountain ranges and the Nahanni River all run pretty well in a north/south direction. Because nearly all of the prospect areas are located along the lower flanks of these major topographic features one does not need to cross them at right angles with haul routes. That is, haul from most prospects would be parallel to these features following in roughly a north/south direction. For this reason I see the haul problems in the Nahanni Butte area being about the same as those at Trout Lake -- a general wetness to the terrain, attendant tree cover and the peatlands that inhabit low-lying areas. These are the impediments rather than topography. There may be an exception to this for the group of so-called kame terrace remnants that are located on either side of the Nahanni Range but fairly high upslope, probably at between 2000 and 3000 feet of elevation. If any of these prospects prove up and were to be exploited then it would be advisable for us to select preferred haul routes

from them in order to get down to the 600 or 700 foot level. But these still would not be very difficult haul routes as one would be hauling loaded downslope and empty upslope. And I suspect they would be winter hauls.

3) As noted in telephone discussions with our 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.

4) A comparison of haul distances from competing prospects can be made directly from Figure 1 where 10-, 15-, and 20-mile radii are shown.

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 or talus 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 talus sites -- i.e., are the dolomites and limestones hard and durable or are they soft and friable?

2) The depth of overburden at, and haul distance to, quarry or talus 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 or for crushing talus debris.

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 serious problem at quarry, talus, or gravel pit sites at the latitude that exists at Nahanni Butte. However, there may be some local permafrost here in prospects that are shaded most of the time or where the prospect area is mantled by a thick peat layer.

XI -- OBSERVATIONS, CONCLUSIONS AND RECOMMENDATIONS

Following are a few general thoughts on the Nahanni Butte study:

1) There are areas of exposed dolomites and limestones that are located fairly near the Nahanni airstrip site (see colored area on Figure 2 of the bedrock map in this report). I suspect these are much more competent than the shales and perhaps even the sandstone prospects mapped at Trout Lake. Thus the alternative of quarrying bedrock or the crushing of talus deposits that are derived from these particular bedrock types may be more enticing than the bedrock prospects that we mapped in the Trout Lake area.

2) The highest level delta of the 3-level prospect mapped along the Nahanni River (Prospect 37) may be a very good deposit. I have rated it as fair-to-good rather than good-to-excellent because it may have a great deal of shale or other soft rock types in it. Or it may have some permafrost(?) in it. And of course it is pretty distant from the Nahanni Settlement and the proposed airstrip site. However it certainly is the best-looking glaciofluvial prospect in the Nahanni Butte area though there are many smaller prospects that are much more practical from the haul-distance aspect. As a result, you will likely wish to check out these closer-in prospects first.

3) I have shown a large number of alluvial fan deposits. They are associated with both the Nahanni and Liard Mountain ranges. You probably need not worry too much about checking the fan deposits at the base of the Liard Range because they are likely composed of softer rock than those at the Nahanni Range and are higher in the silt (fines) fraction and consequently have more permafrost. And finally, most of them are much farther away from the airstrip and Nahanni Settlement sites than are those alluvial fans associated with the Nahanni Range.

4) 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

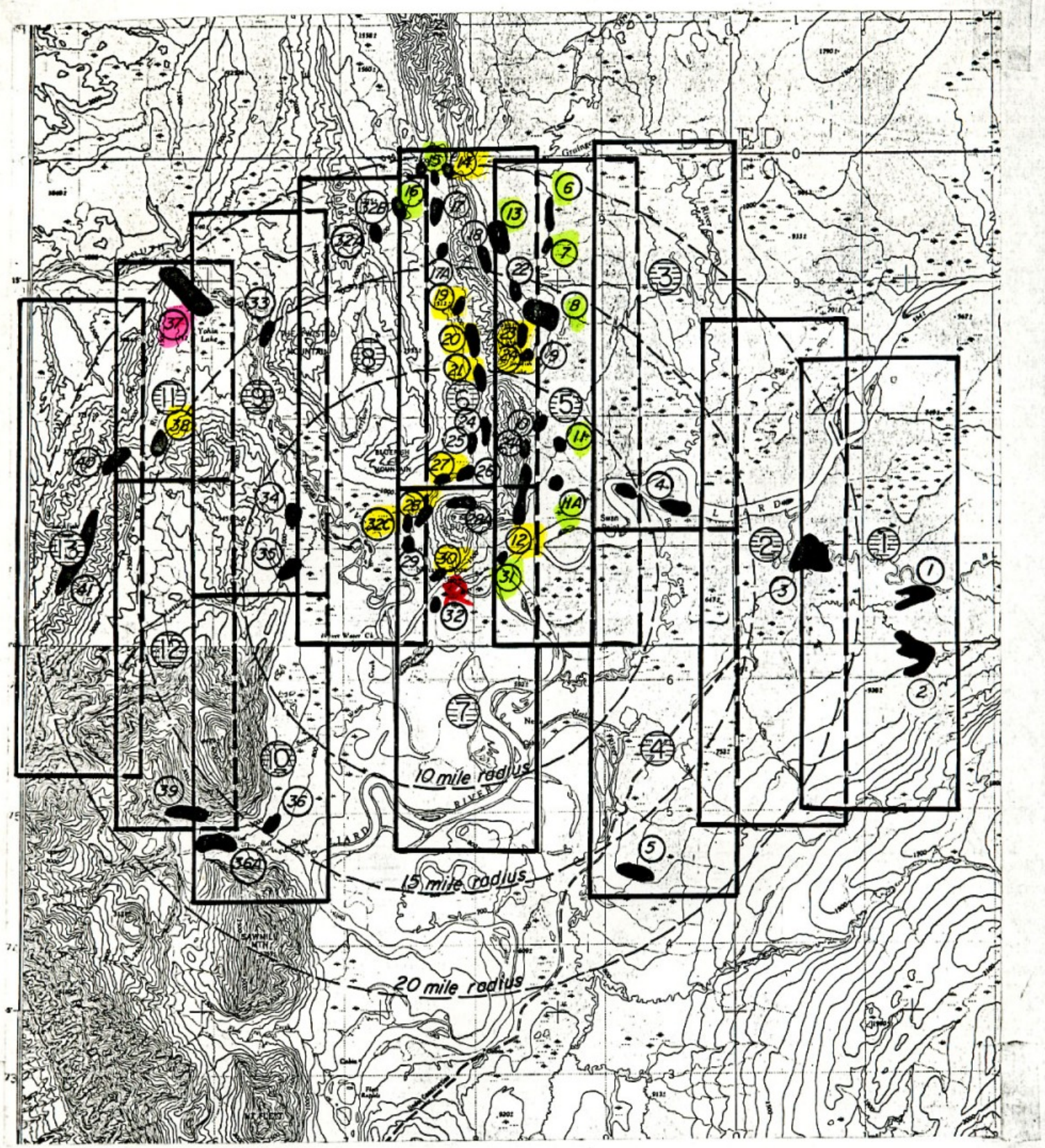
TERRAIN ANALYSIS For a given purpose, the process of identifying, classifying, mapping and interpreting the significance of terrain features, typically performed from maps, airphotos or nonphotographic imagery

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 13 AND
RELATIVE HAUL DISTANCES AND LOCATIONS
OF SAND, GRAVEL AND TILL PROSPECTS IN
VICINITY OF NAHANNI BUTTE, NWT

0 5 10 15 20 MILES

J.D. Mollard And Associates Limited
March, 1984

FIGURE 1

LEGEND

CENOZOIC

QUATERNARY

Qal — *Alluvial sands and silts of Liard River and lower South Nahanni River*

MESOZOIC

CRETACEOUS

Ks — *Sandstone, fine-grained, olive grey*

Kps — *Shale, dark grey; siltstone*

LOWER CRETACEOUS

lKsj — *FORT ST. JOHN GROUP: Shale, dark grey, fissile, concretionary, gypsiferous; siltstone*

lKg — *GARBUTT FORMATION: shale, grey, rusty weathering*

CARBONIFEROUS AND PERMIAN

CPMu — *MATTSON FORMATION: Upper part: grey sandstone, limestone, shale*

CPMm — *Middle part: grey and brown sandstone*

CPMl — *Lower part: grey sandstone, shale, coal*

MISSISSIPPIAN

Mf — *FLETT FORMATION: limestone, grey, thinly bedded, crinoidal, argillaceous, silty; shale; sandstone; dolomite*

Mc — *CLAUSEN FORMATION: shale, black, fissile, non-calcareous; thin limestone*

My — *YOHIN FORMATION: sandstone, thinly bedded*

DEVONIAN

UPPER DEVONIAN

uDk — *KOTCHO FORMATION: shale, limestone*

uDt — *TETCHO FORMATION: limestone*

uDtr — *TROUT RIVER FORMATION: limestone, sandy limestone*

uDn — *REDKNIFE FORMATION: siltstone, shale*

uDjm — *JEAN MARIE MEMBER, REDKNIFE FORMATION: bioclastic limestone*

uDfs — *FORT SIMPSON FORMATION: shale, dark grey and greenish grey, fissile; siltstone, thinly bedded (may include undifferentiated HORN RIVER FORMATION)*

DMBR — *BESA RIVER FORMATION: shale, dark grey; siltstone*

uDsh — *Shale, black, fissile; mudstone; limestone (may be partly Mississippian)*

uDs — *Siltstone, calcareous; mudstone, silty*

uDc — *Undivided (in structure section C-D only)*

PALEOZOIC

MIDDLE DEVONIAN

mDhn — *HORN RIVER FORMATION: shale, black, pyritic, fissile, brittle*

mDn — *NAHANNI FORMATION: limestone, grey, finely crystalline to bioclastic, thickly bedded; dolomite, finely crystalline*

mDh — *HEADLESS FORMATION: shale, dark grey, calcareous; argillaceous limestone*

mDl — *LANDRY FORMATION: limestone, grey, finely crystalline, thickly bedded (equivalent to mDm)*

mDm — *MANETOE FORMATION: dolomite, coarsely crystalline, vuggy, massive (equivalent to mDl)*

mDf — *FUNERAL FORMATION: limestone argillaceous, thinly bedded; shale, dark grey (equivalent to mDa and mDm)*

mDa — *ARNICA FORMATION: dolomite, finely crystalline, partly finely porous and vuggy, banded dark and medium grey weathering; brecciated in part*

LOWER DEVONIAN

lDs — *SOMBRE FORMATION: dolomite (in structure sections only)*

lDc — *CAMSELL FORMATION: dolomite, sandy (in structure sections only)*

SILURIAN

Sd — *Dolomite, silty, finely crystalline; light brown; sandstone, quartzose, grey; buff weathering*

ORDOVICIAN

OmK — *MOUNT KINDLE FORMATION: dolomite, massive, reefy, grey, finely crystalline, in part porous and vuggy; dolomite, argillaceous, thinly bedded; grey weathering*

CAMBRIAN ?

Cd — *Dolomite, cryptocrystalline to finely crystalline, pink and grey, silty; sandstone quartzose, fine-grained, grey and pink; orange and red weathering*

PROTEROZOIC

HELIKIAN ?

(In structure sections only)

APHEBIAN ?

(In structure sections only)

MIDDLE DEVONIAN

mDm — *Undivided FUNERAL and HEADLESS FORMATIONS*

(In structure sections only)

mD1 — *Undivided ARNICA, LANDRY, HEADLESS and NAHANNI FORMATIONS*

mD2 — *As above with MANETOE FORMATION. LANDRY FORMATION may be absent*

mD3 — *Undivided BEAR ROCK and NAHANNI FORMATIONS; MANETOE and HEADLESS FORMATIONS may be present*

CO — *Undivided Cambrian ? and OmK (In structure sections only)*

Rock outcrop

Geological boundary (approximate, assumed)

Bedding, measured (horizontal, inclined, vertical)

Bedding estimated (horizontal, inclined, vertical)

Fault

Normal fault (hachures on hanging wall)

Thrust, reverse fault (teeth on hanging wall)

Anticline (arrow indicates plunge)

Syncline (arrow indicates plunge)

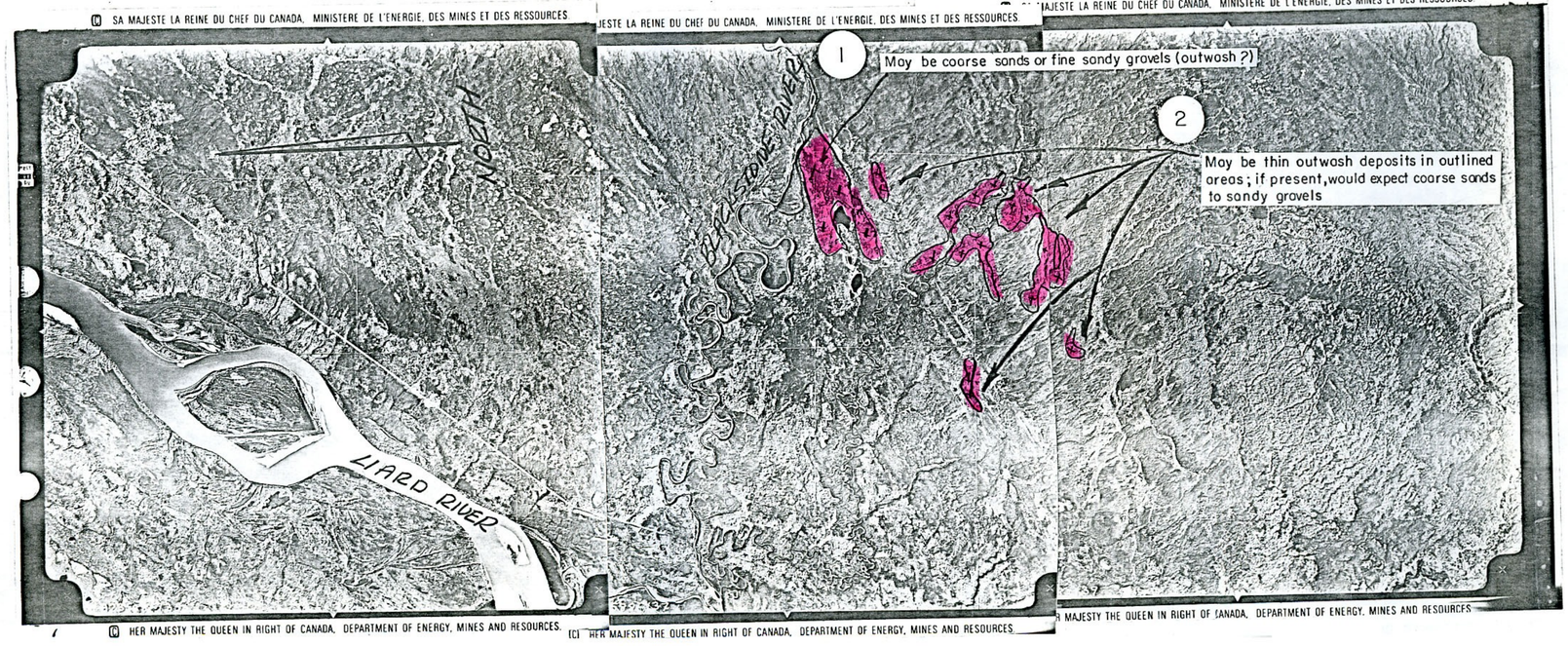
Location of measured section

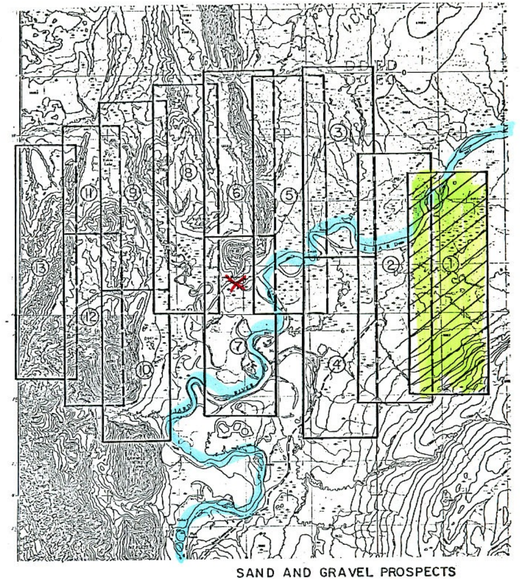
Well, abandoned

Mineral prospect (galena) Pb

BEDROCK MAP
OF
NAHANNI BUTTE AREA

FIGURE 2





SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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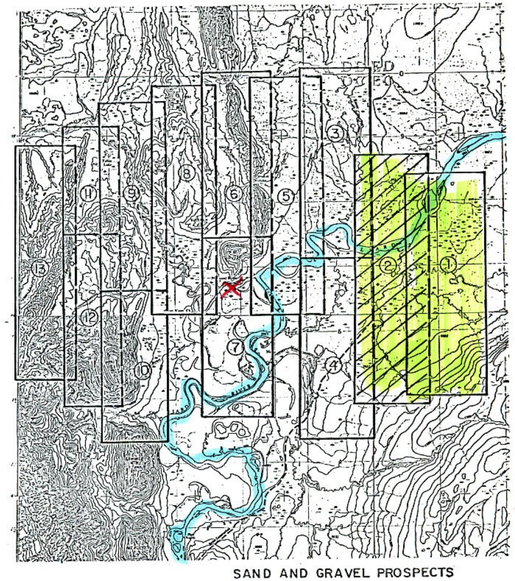
SHEET 1 of 13



SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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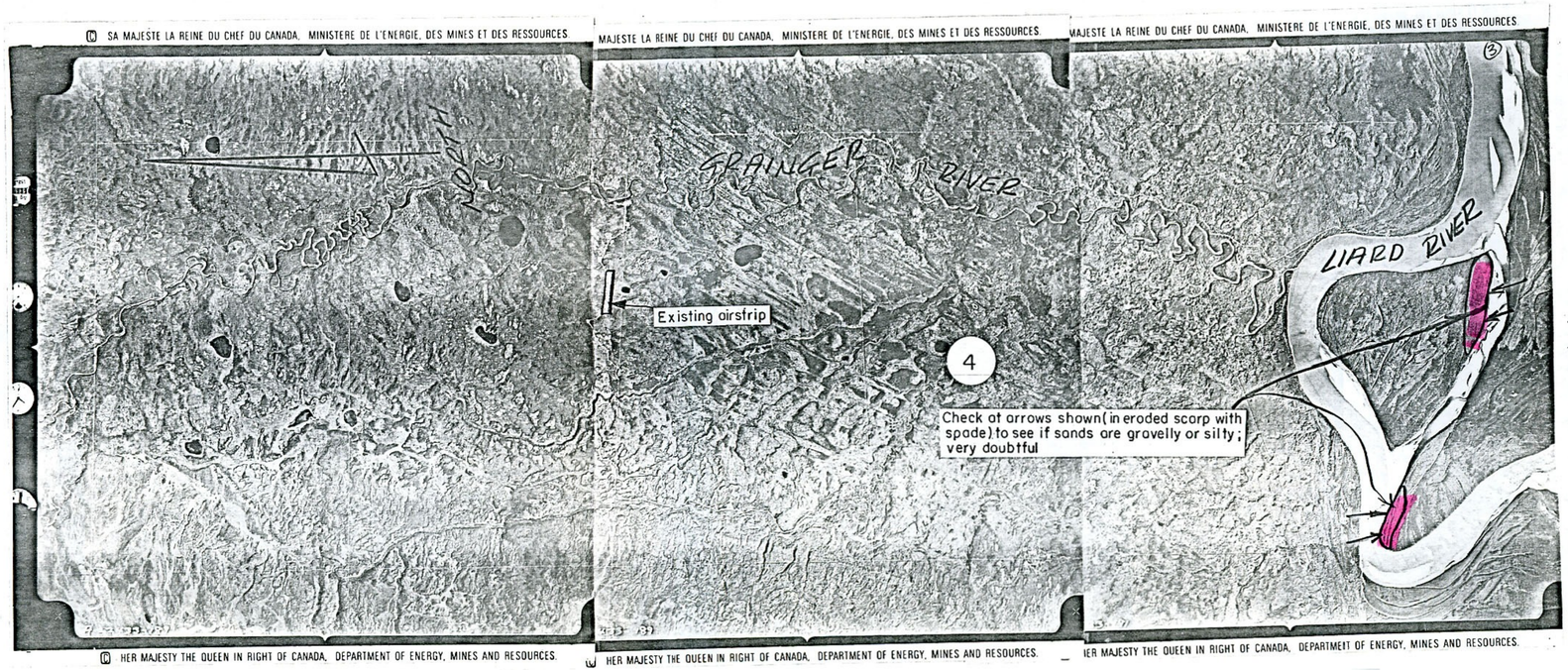
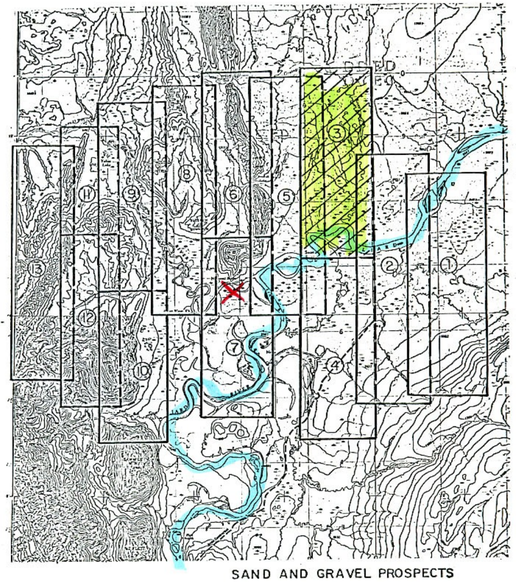
SHEET 2 of 13





SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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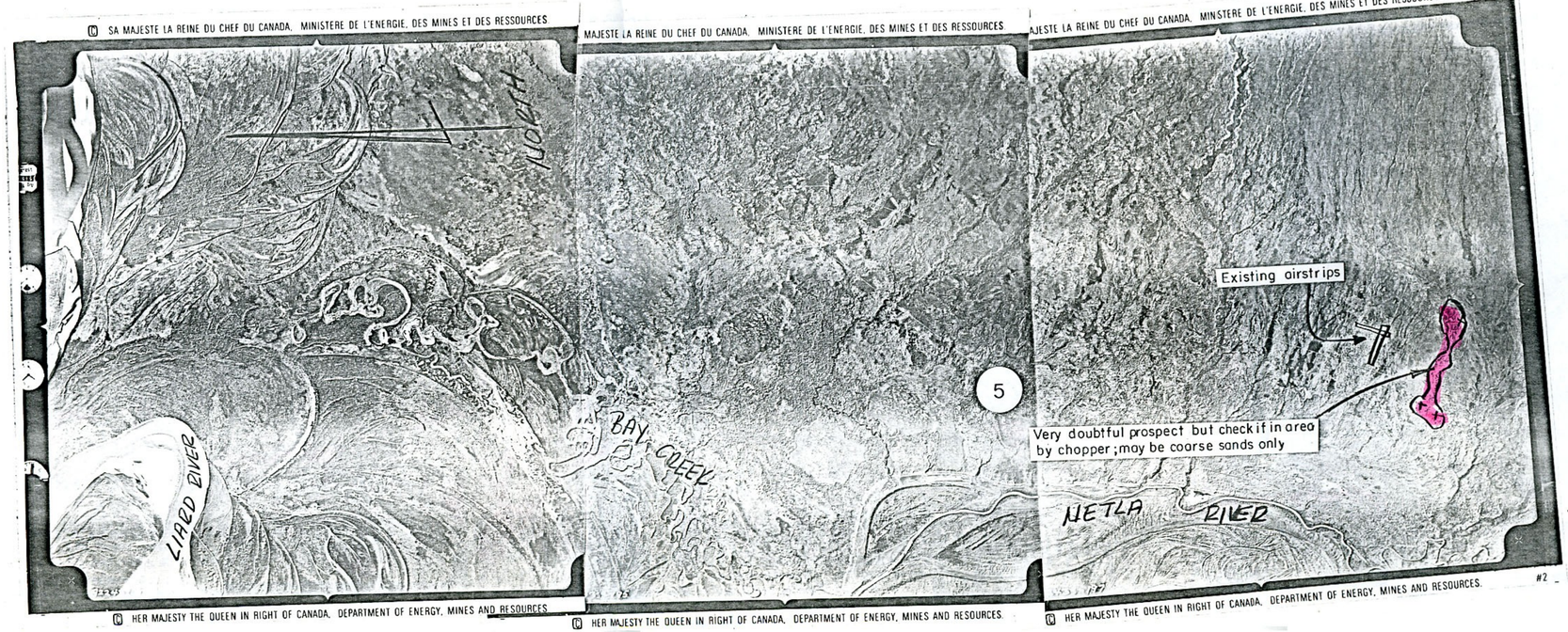
3



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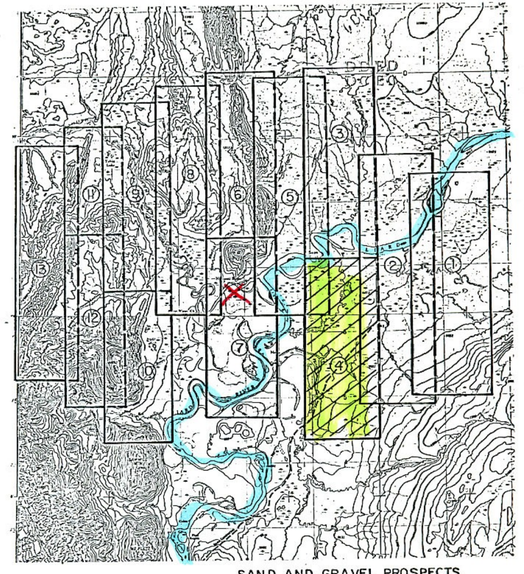
#2



SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

J.D. Mollard And Associates Limited
March, 1984

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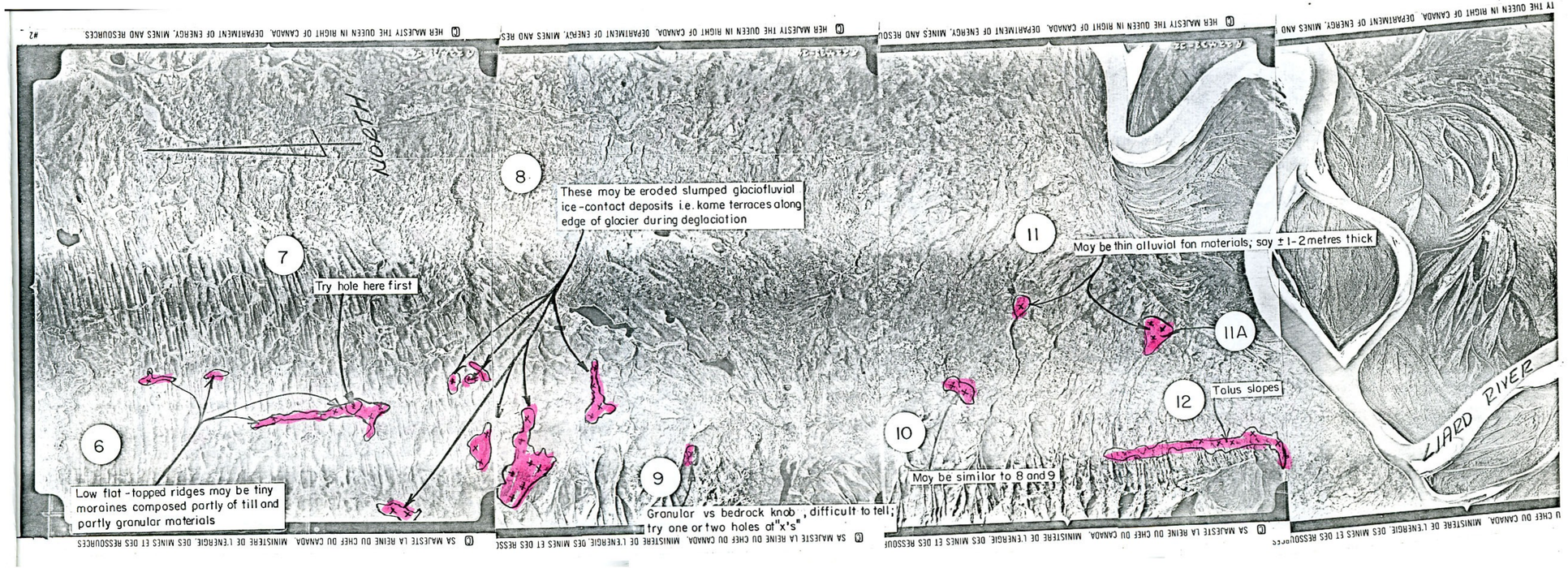

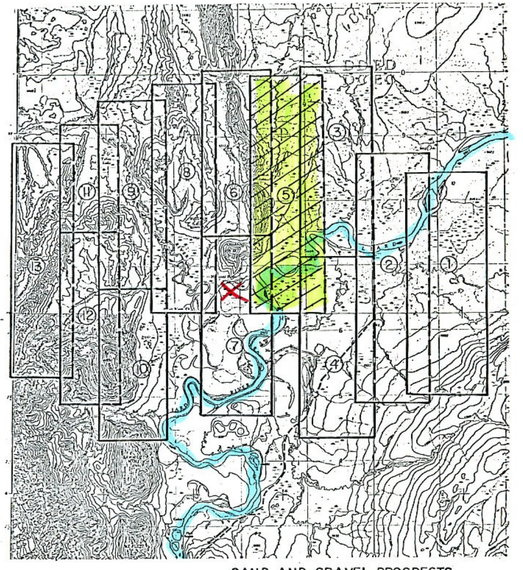

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

J.D. Mollard And Associates Limited
March, 1984

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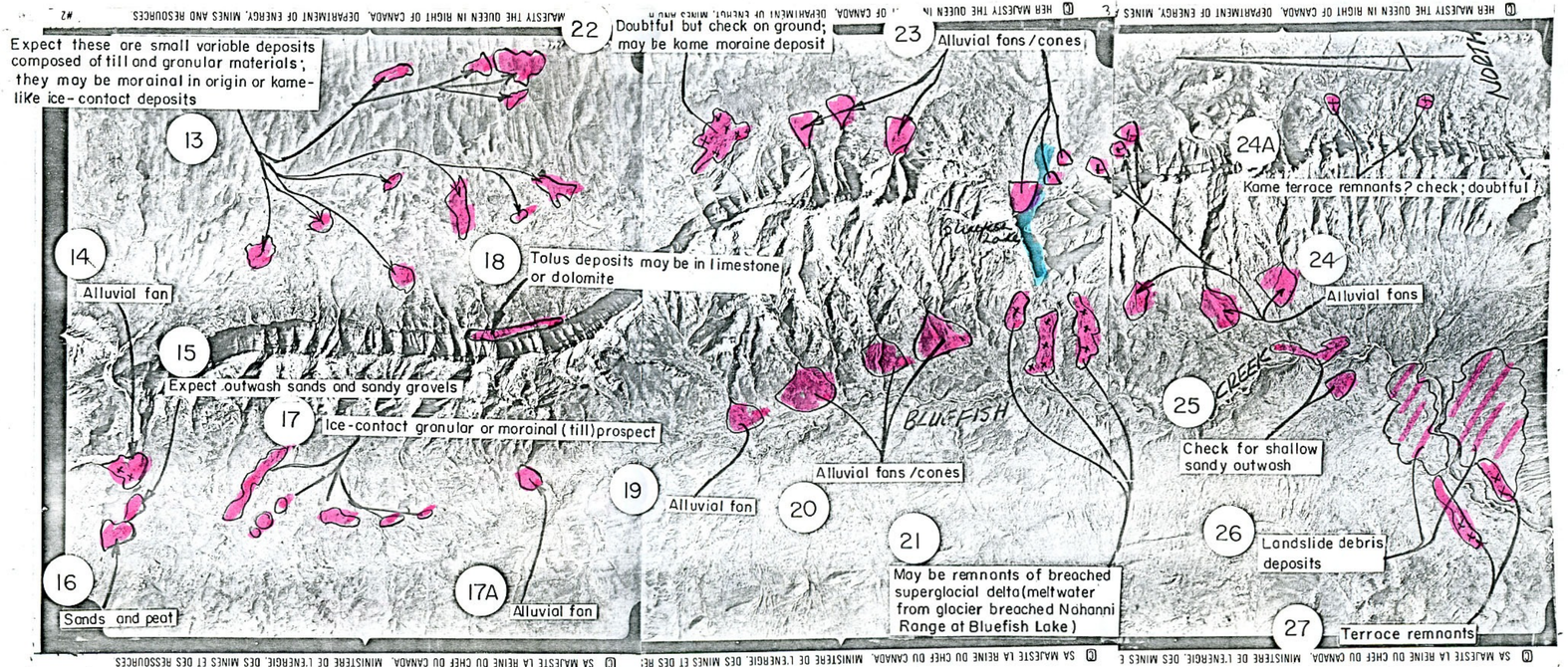

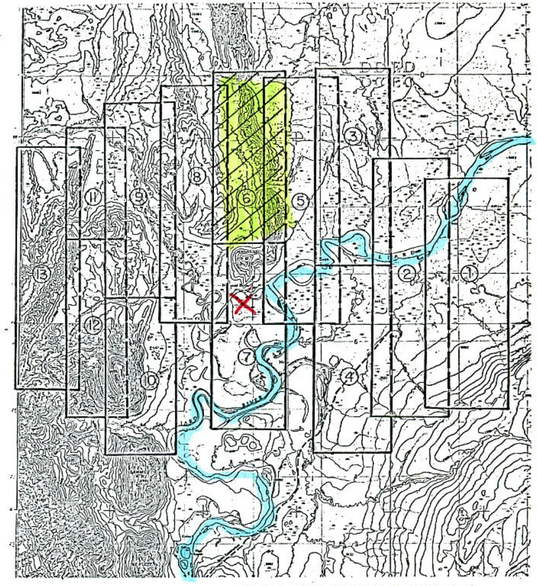

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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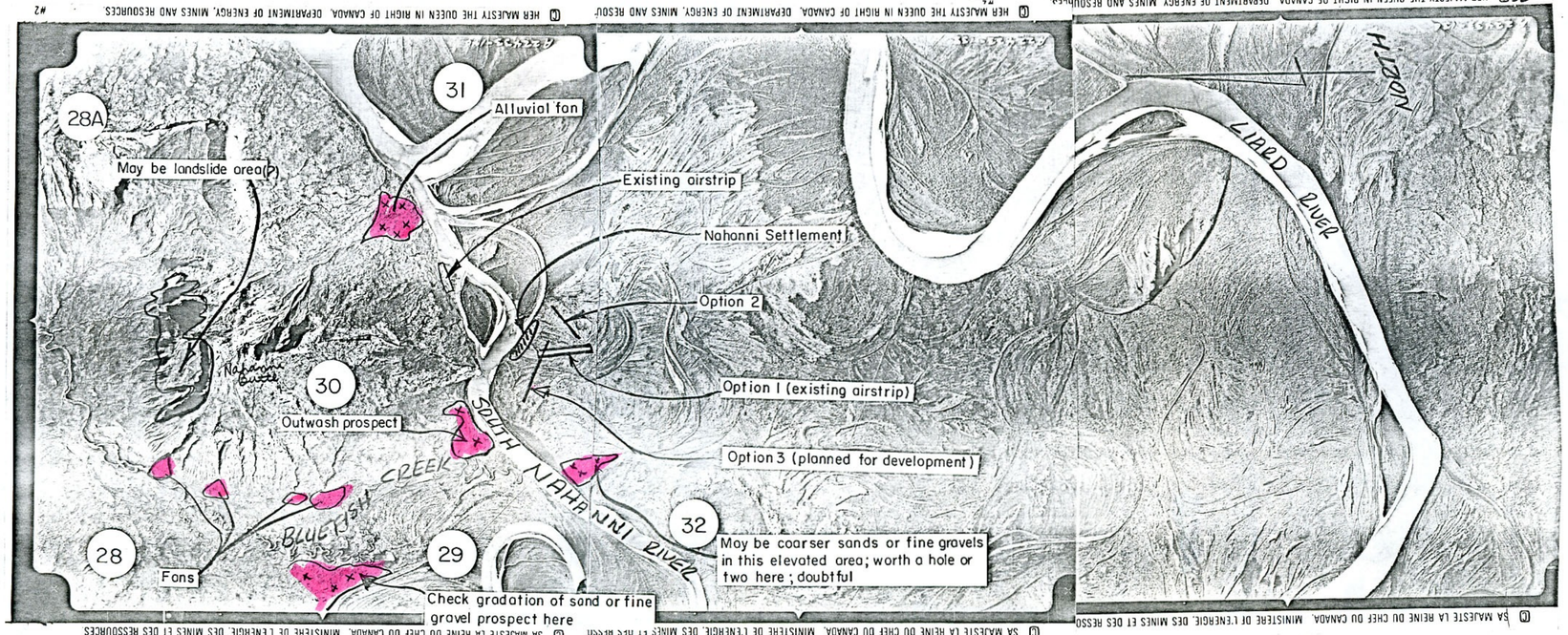

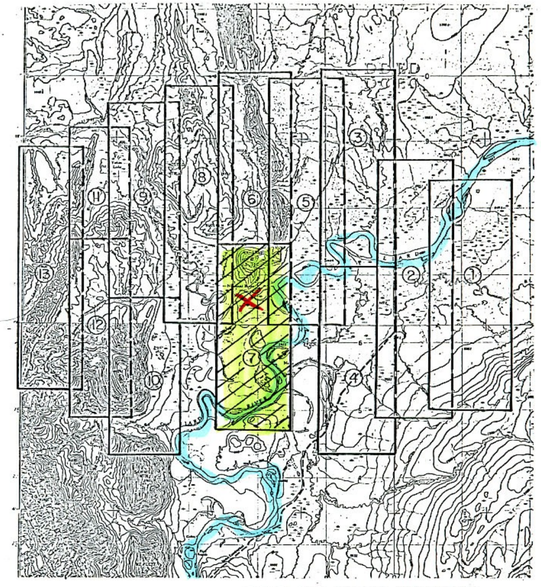

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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March, 1984

32B

Ice-contact prospects

32A

May be eroded remnants of glaciofluvial kame terraces

NORTH

Very recent slides

Overflow Creek

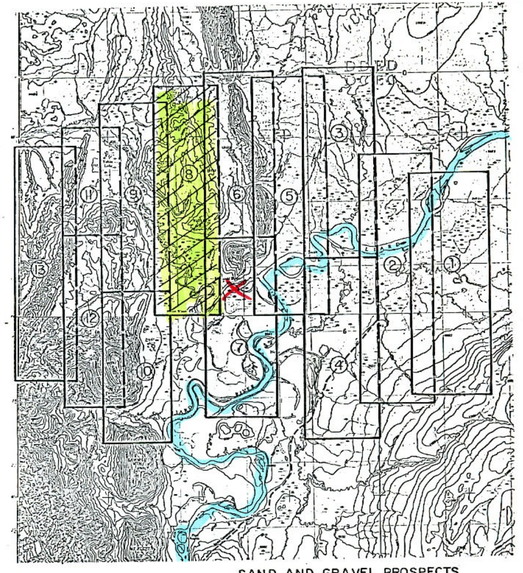
32C

Alluvial cones

Old landslide (source of debris)

Slide debris

SOUTH NAHANNI RIVER



SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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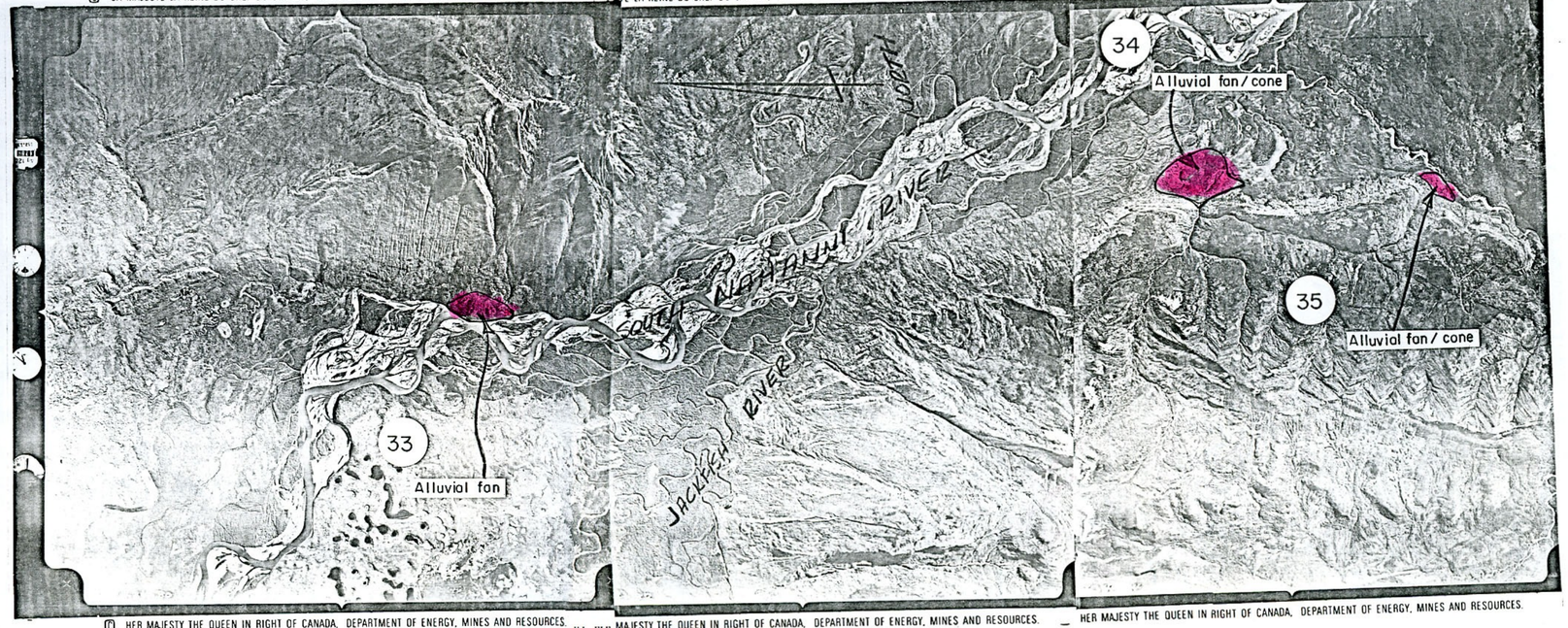

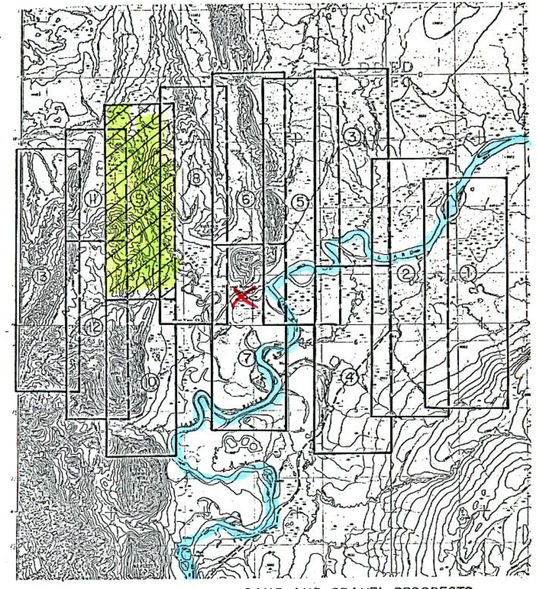

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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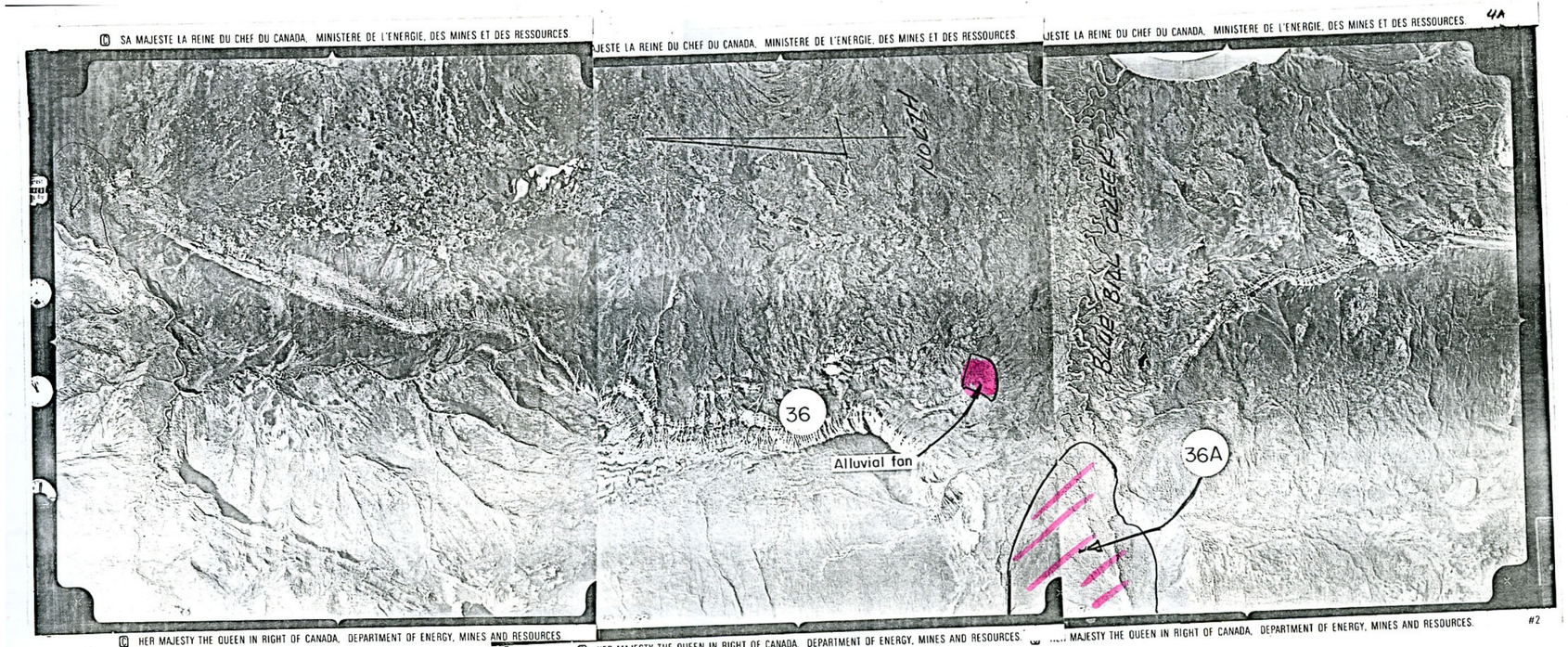
4A



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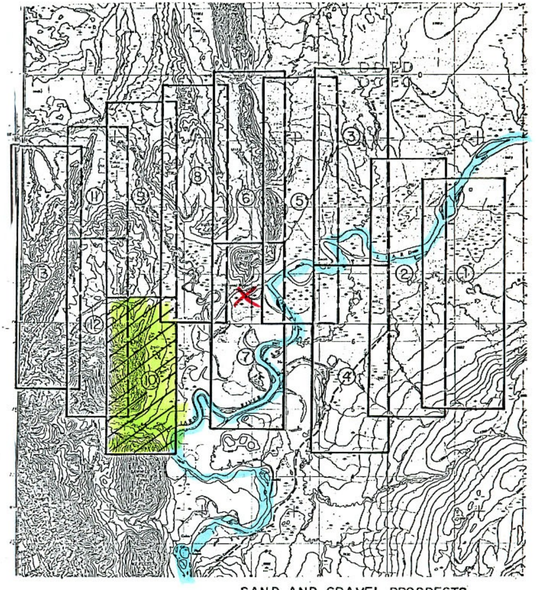

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

J.D. Mollard And Associates Limited
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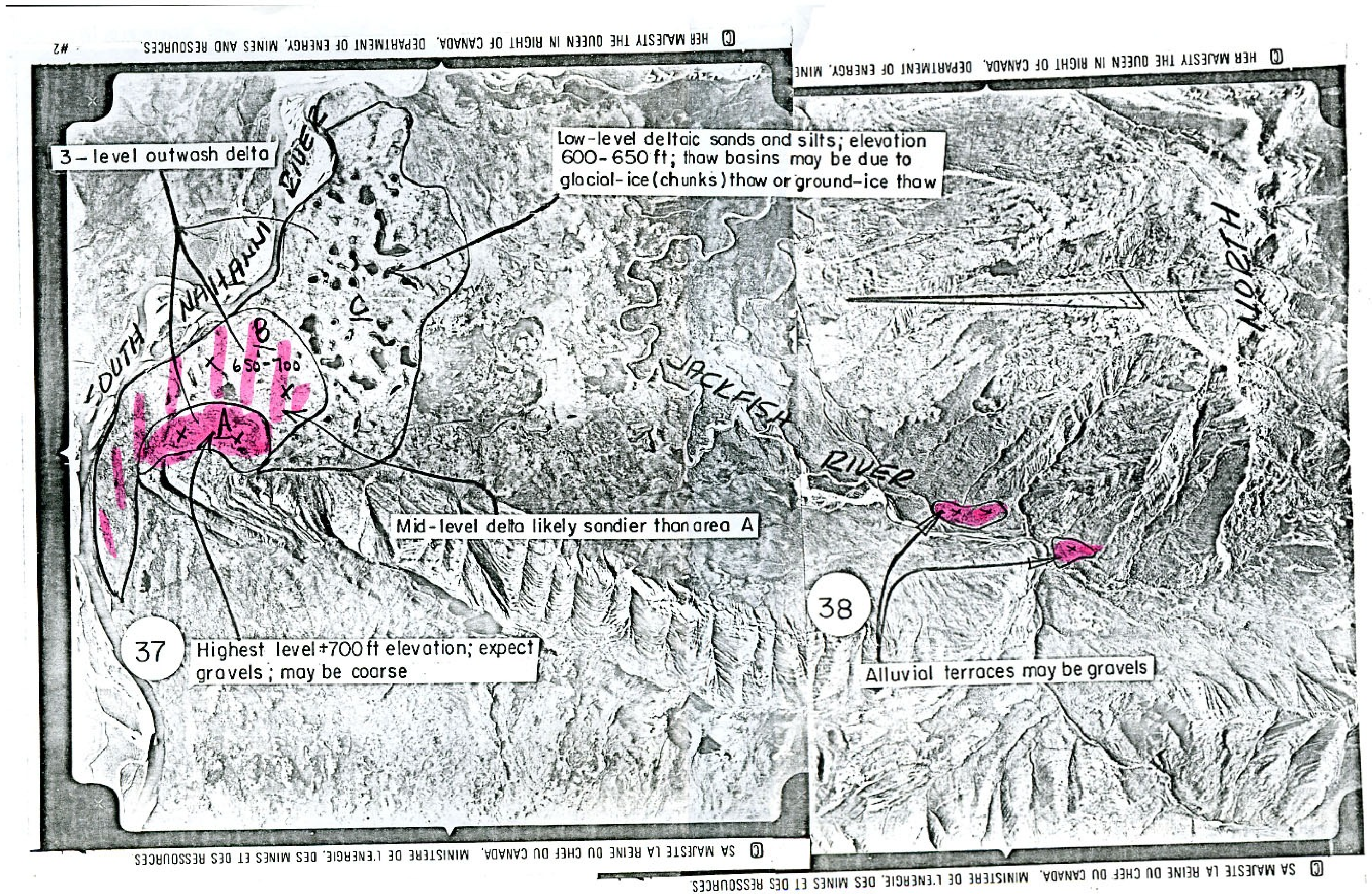

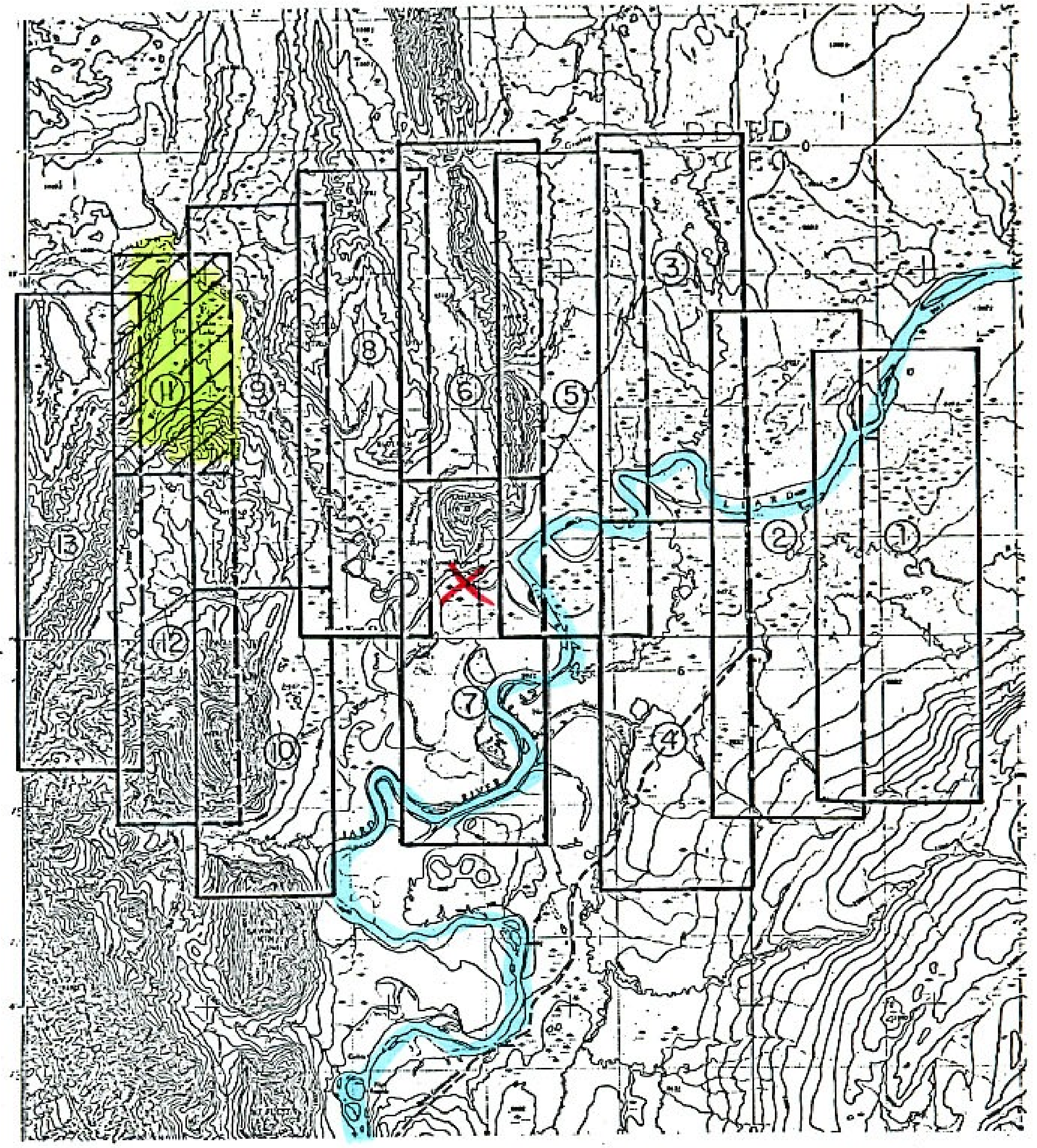

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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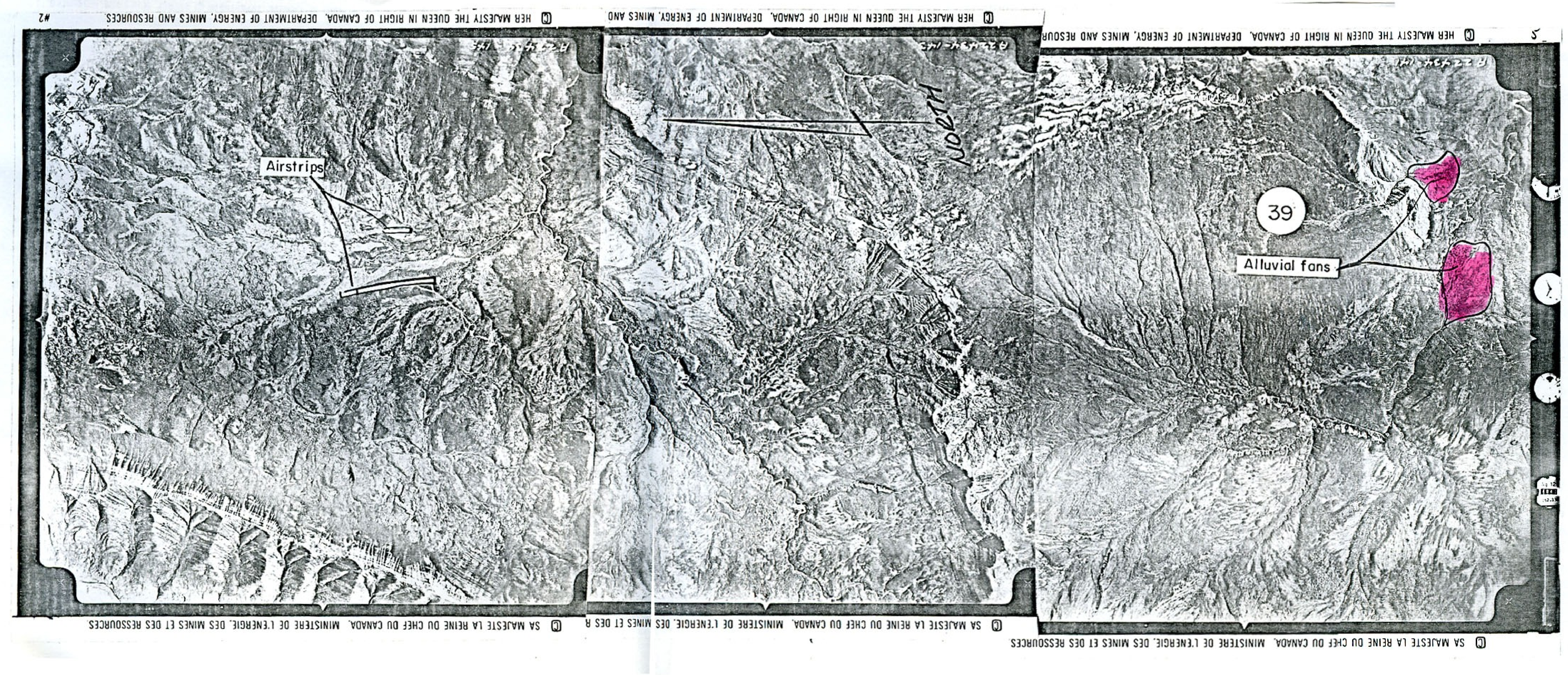

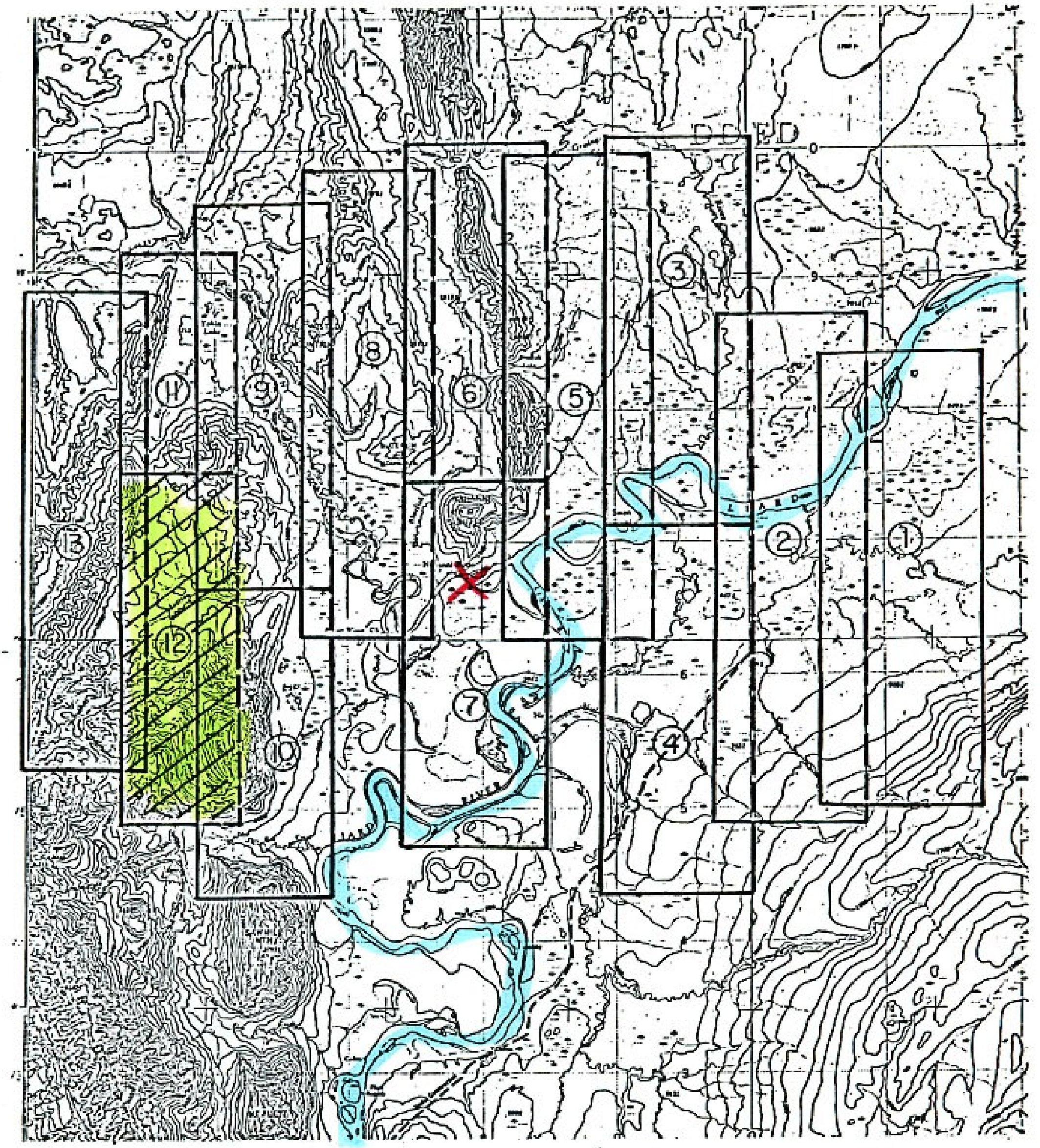

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5km

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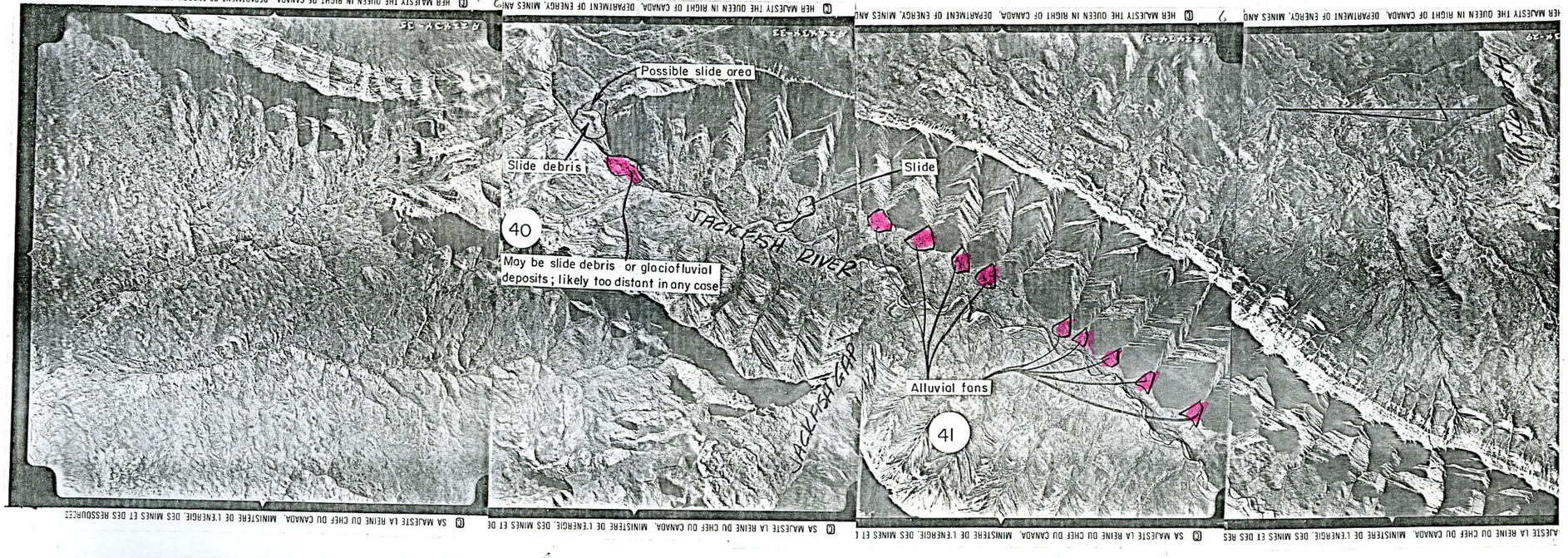

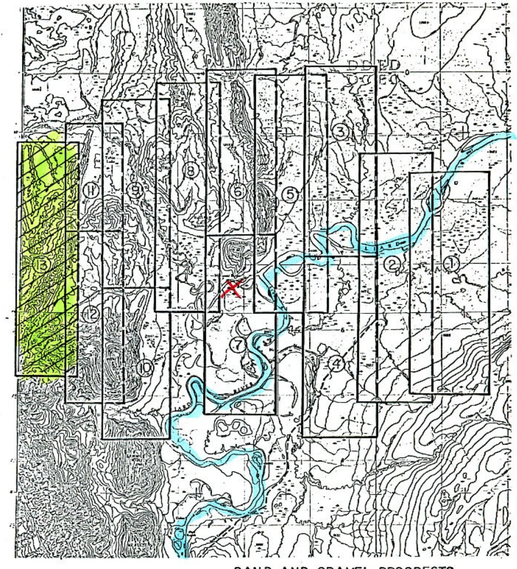

SAND AND GRAVEL PROSPECTS

0 1 2 3 4 5 km

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END OF REPORT