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THURBER CONSULTANTS LTD.

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November 19, 1980

File: 15-23-9

Lands Section
Town Planning and Lands Division
Dept. of Local Government
Government of the N.W.T.
Yellowknife, N.W.T.
X1A 2L9

Attention: Mr. R.M. Larson

RE: GRANULAR MATERIAL RESOURCE INVENTORY
FORT SMITH, N.W.T. 81

Dear Sir:

This letter and attachments present the results of a Phase I and Phase II Granular Material Resource Inventory Study in an area near Fort Smith, N.W.T. The scope of the work was to identify potential gravel deposits in a designated area to the north of Highway No. 5, and between 30 and 60 km west of Fort Smith, N.W.T. The study area, which is hereinafter referred to as the Salt River Upland, is shown on the appended location map (Figure 1).

A proposed approach to the work was described in our letter of July 2, 1980. Authorization to proceed with the work was given in your letter of July 16, 1980. The scope of the work was increased slightly as per our letter of September 10, 1980, to allow for the purchase and examination of high level aerial photographs.

1. INVESTIGATION

The first step in the investigation entailed a review of published geological maps and reports. This was followed by a detailed examination of low level aerial photographs from which it was found that the study area had very complex landforms. It was therefore necessary to order and examine high level aerial photographs to gain an appreciation of the regional

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The first step in the investigation entailed a review of published geological maps and reports. This was followed by a detailed examination of low level aerial photographs from which it was found that the study area had very complex landforms. It was therefore necessary to order and examine high level aerial photographs to gain an appreciation of the regional geology and geomorphology. A field visit was made on October 21 and 22, 1980 after completion of the airphoto interpretation. Traverses were made across the area by 4-wheel drive vehicle and by foot in order to confirm the airphoto interpretation. Samples were collected at natural exposures and from shallow hand excavated test pits. Grain size analyses were carried out on three samples. Gradation curves, selected photographs of the gravel exposures and xerox copies of the main interpreted high level (1:54,000 scale) aerial photographs are appended.

2. BEDROCK GEOLOGY

The Salt River Upland is a discontinuous escarpment formed in resistant limestone and dolomite rock belonging to the Little Buffalo Formation of Devonian age. These rocks overlie the Chinchaga Formation which consists of laminated gypsum, salt, fine-grained limestone and dolomite. Rocks of the Chinchaga Formation also underlie much of the terrain adjacent to the Salt River Upland. Solution of gypsum and anhydrite of the Chinchaga Formation has resulted in the development of spectacular karst features throughout the Salt River Upland and adjacent areas. These karst features include depressions and steep-sided sink holes of varying diameters. Although Precambrian rocks are not exposed in the search area, their presence a short distance to the northeast results in a significant component of rocks such as granite and gneiss in till of the area.

3. SURFICIAL GEOLOGY

The interpretation of the surficial geology in the search area was complicated by:

(a) the high density of sink hole development which tends to mask the true surface expression of a landform unit, and

(b) the complexity of events which occurred during the deglaciation of the Great Slave Lake - Lake Athabasca region (Cameron, 1922; Craig, 1965).

Four major surficial deposits were distinguished within the study area boundaries:

Till: This is a reddish-brown, stony, sandy soil exhibiting some plasticity (see Photos 1 and 4). It contains subangular fragments of Precambrian rocks and larger more rounded rock fragments derived from local limestones and dolomites. Most rocks range from 2 cm to 25 cm in diameter but some erratic granite boulders reach

2 m in diameter. The maximum observed thickness of the till (at Little Buffalo Falls) is between 10 and 12 m. The upper part of the till has been washed by Glacial Lake McConnell, which covered the study area during deglaciation. A lag-type of granular deposit resulting from the washing process may be found in certain areas. This lag deposit consists of about 1 m of gravel and sand (see Photo 2).

Glaciolacustrine Deposits: Glaciolacustrine silts and clays are not common in the area. They were found at the base of gravel pits on the Salt River Upland, in road cuts near Lobstick Creek and overlying the till at isolated locations . They are frequently reddish-brown, laminated, highly plastic and are often interbedded with reddish-orange sand.

Beach and Related Gravels: Large volumes of gravel are draped over topographically higher portions of the Salt River Upland. The origin of these granular deposits may be described by the following sequence of events: During the last glacial period glaciers inundated the area and left a thick sequence of glacial till overlying bedrock. Between 10,000 and 12,000 years ago these glaciers began to melt and retreat. Meltwater became impounded in glacial Lake McConnell which once extended from approximately Fort McMurray through Lake Athabasca and Great Slave Lake to Great Bear Lake. This body of water covered the Salt River Upland. As the glaciers retreated farther and farther northeast, more drainage paths developed and the level of glacial Lake McConnell slowly fell. As shorelines developed around the topographically higher portions of the Salt River Upland, the till was reworked. Fine material was washed away and settled in deeper water adjacent to Salt River Upland, and coarse material was concentrated in situ in the form of beach ridges. Because these beaches developed at quasi-stable lake levels, they follow contours around the hills; (see Photos 3 and 4) and because the lake level was, in the longer term, systematically falling, the beach ridges are draped down the sides of the hills. The beach ridges are visible on aerial photographs as a series of fine white lines following contours around the larger hills.

The beach ridges occur mainly on Salt Mountain, but similar deposits are expected on Hill 1 and Hill 2 to the west (see air photographs). This assessment is based on the similarities of airphoto pattern (i.e. the fine white lines) between these hills and Salt Mountain, since lack of time and inaccessiblity did not allow field checking of Hill 1 and Hill 2.

Dune Sand: Limited areas of sand dunes containing a yellow-brown, fine to medium grained, uniform sand were also found in the search area. These deposits are small and widely separated, and therefore do not represent a significant granular borrow source.

3. BORROW ASSESSMENT AND RECOMMENDATIONS

The internal structure of the beach ridge gravel deposits is quite heterogeneous (see Photos 5, 6 and 7) because lateral changes in texture often occur within several metres. The gradation is fairly coarse and varies from a uniform gradation of mostly gravel sizes to a well-graded mixture of sand and gravel. The amount of material in the soil mass in excess of the 75 mm size varies from 25% to 100%.

Three samples were taken from beach ridges in the Salt Mountain area. The gravel is composed mainly of limestone and dolomite rocks. Some of the surfaces of the rocks are coated with a crusty calcareous precipitate. The soil at each sample location had approximately 25% coarser than 75 mm. Grain size curves for material finer than 75 mm from each sample are shown in Figure 2. These grain size curves indicate a clean, coarse sandy gravel. On the basis of these grain size distributions and preliminary petrological analysis of the samples, the gravel would be suitable for general fill and road sub-base, and, with some degree of processing, for base course and surfacing materials for roads and for the production of concrete or asphalt aggregate.

Gravel deposits over the flatter slopes of Salt Mountain occur in a series of undulating ridges with an amplitude of about 1 m. On steeper slopes, the ridges are more bench like with a tread of about 6 m and a rise of about 3 m (see Photo 8). The maximum observed thickness is in the N.W.T. Highways Pit where gravel and sandy gravel is approximately 7 m thick. The total area covered by the Salt Mountain (2.3 x 10^6 m^2) Hill 1 (5.0 x 10^6 m^2) and Hill 2 (2.3 x 10^6 m^2) deposits is very approximately 9.6 million m^2. If it is assumed that a thickness of 2 m exists over these areas, a resource of approximately 19.2 million m^3 may be available in the search area. Any thin lag-type deposits would represent additional granular resources over and above this estimate.

The deposits in the Hill 1 and Hill 2 areas are thought to be similar in all respects to those on Salt Mountain. In view of this all three areas are attractive, but the fact that Salt Mountain is already extensively explored and is readily accessible makes it the most attractive prospect. Before we can proceed with preparation of a cost estimate for a Phase III study, as per the request in your letter of July 16, 1980, it would be helpful if your Department could indicate any preferred area(s) for exploration on Salt Mountain, Hill 1 or Hill 2. We assume that each of these areas is available for exploration, and that none is restricted by environmental or other regulations. It would also be necessary to know the quantities you require, together with their intended uses. A Phase III study would involve the excavation of test pits at approximately 50 m spacings, and the collection and laboratory analysis of representative samples.

Thank you for the opportunity to carry out this study. We look forward to further involvement in Phase III. If any of the foregoing requires clarification please do not hesitation to contact us.

Yours very truly,
Thurber Consultants Ltd.,
D.A. Lindberg, P.Eng.
Review Engineer

K.W. Savigny, P.Eng., P.Geol.
Project Engineer

KWS/mm

Attachments

LIST OF REFERENCES

1. Cameron, A.E. (1922). Postglacial Lakes in the Mackenzie River Basin, N.W.T.; Can. J. Geology, 30, pp.337-353.

2. Camsell, C. (1903). Region Southwest of Fort Smith, N.W.T.; Geol. Surv. Can. Ann. Rpt., Vol. XV, 1902-03, Pt.A., pp. 151A-169A.

3. Craig, B. (1965). Glacial Lake McConnell, and the Surficial Geology of Parts of Slave River and Redstone River Map-Area, District of Mackenzie; Geol. Surv. Can., Bull. 122.

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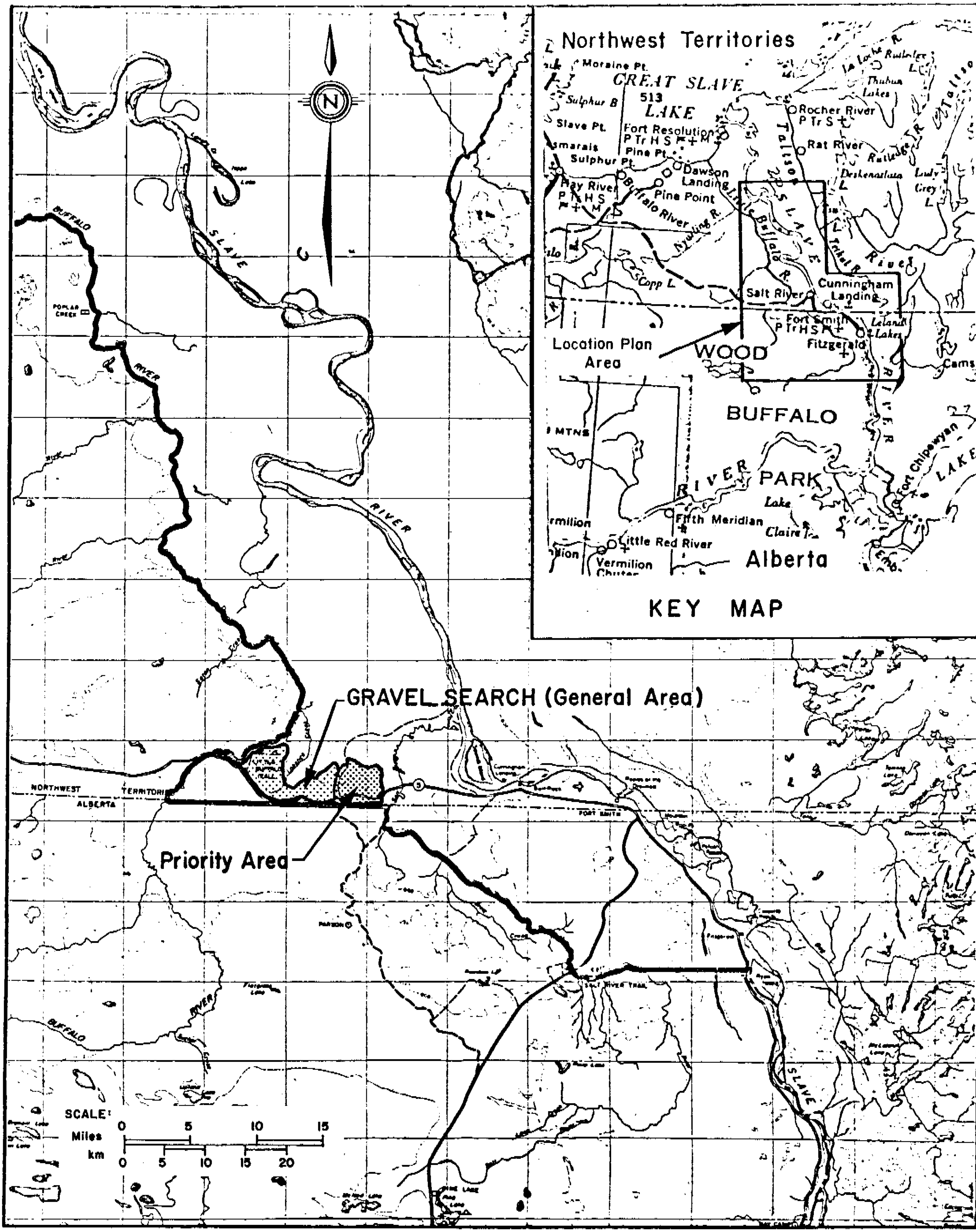

LOCATION PLAN

GRANULAR MATERIAL RESOURCE INVENTORY
FORT SMITH N.W.T.

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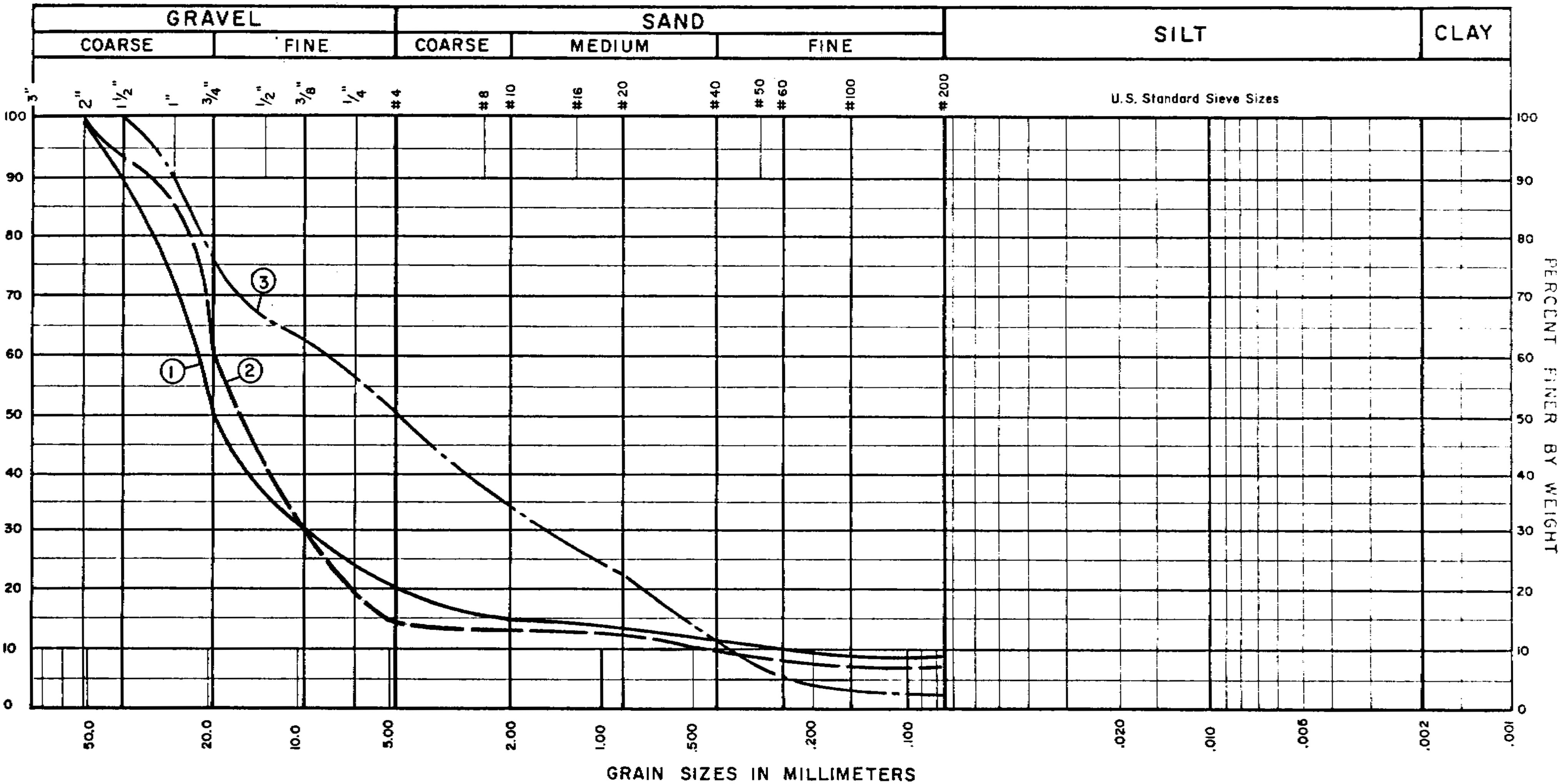
FIGURE I

Unified Soil Classification System & N.R.C. Field Description (Modified with clay size at 0.002 mm)



Nat. Water Content			%
Liquid Limit			
Plastic Limit			
Plastic Index			

	①	②	③
Clay	9.0	7.0	%
Silt			2.5
Sand	11.0	7.5	48.5
Gravel	80.0	85.5	49.0

Classification

NOTE: SAMPLE 1: MAIN SALT MTN PIT (S.of Hwy.5)
SAMPLE 2: SUMMIT OF SALT MTN
SAMPLE 3: HWY 5 WEST OF SALT MTN

CLIENT	DEPT OF LOCAL GOV'T/N.W.T.
PROJECT	FORT SMITH GRANULAR BORROW INVENTORY
LOCATION	SALT MOUNTAIN AND AREA
SAMPLE	SEE NOTE ABOVE
TEST DATE	28/10/80 FILE Nº 15-23-9

FIGURE 2

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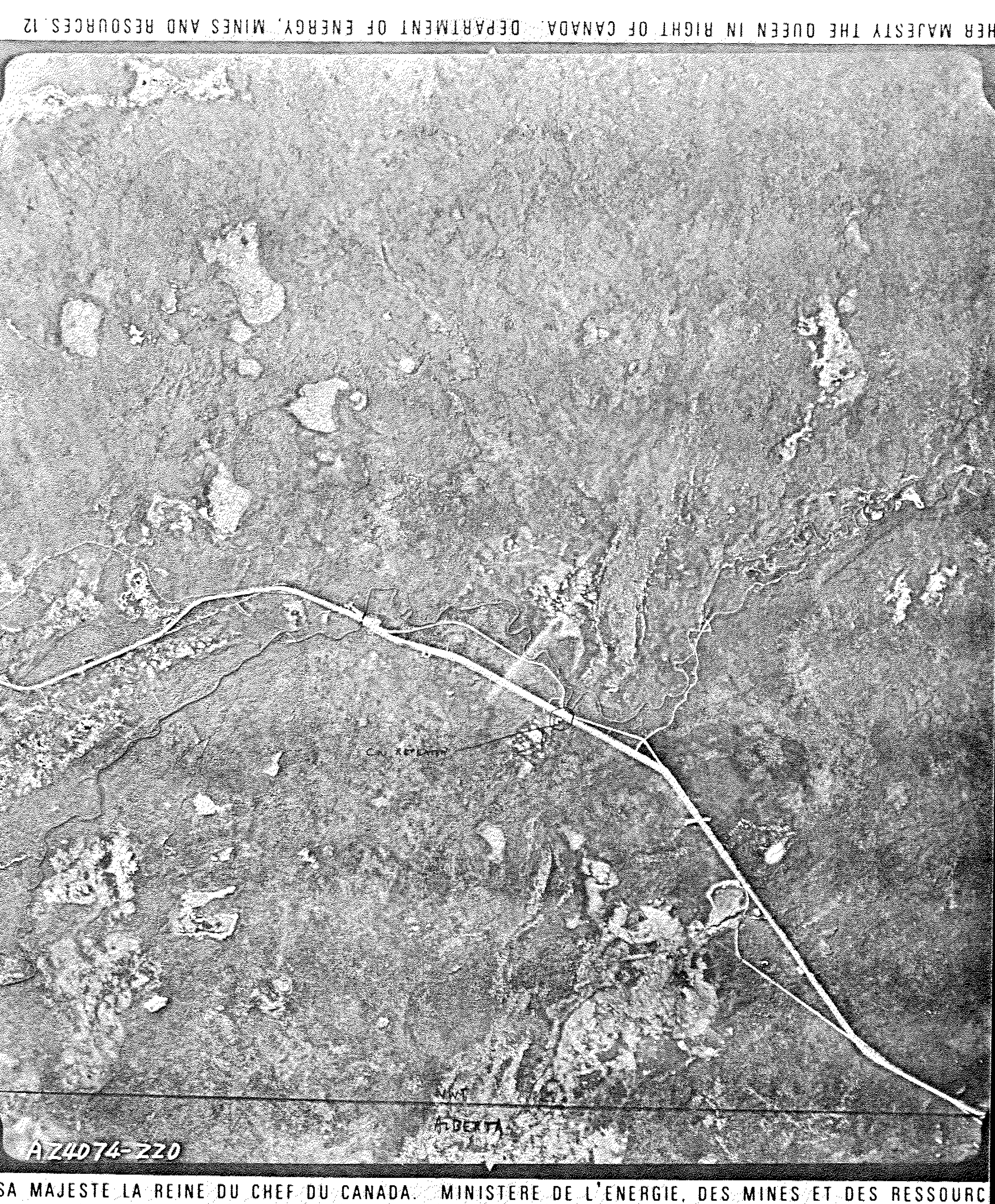
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ALBERTA
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SA MAJESTE LA REINE DU CHEF DU CANADA. MINISTERE DE L'ENERGIE, DES MINES ET DES RESSOURC

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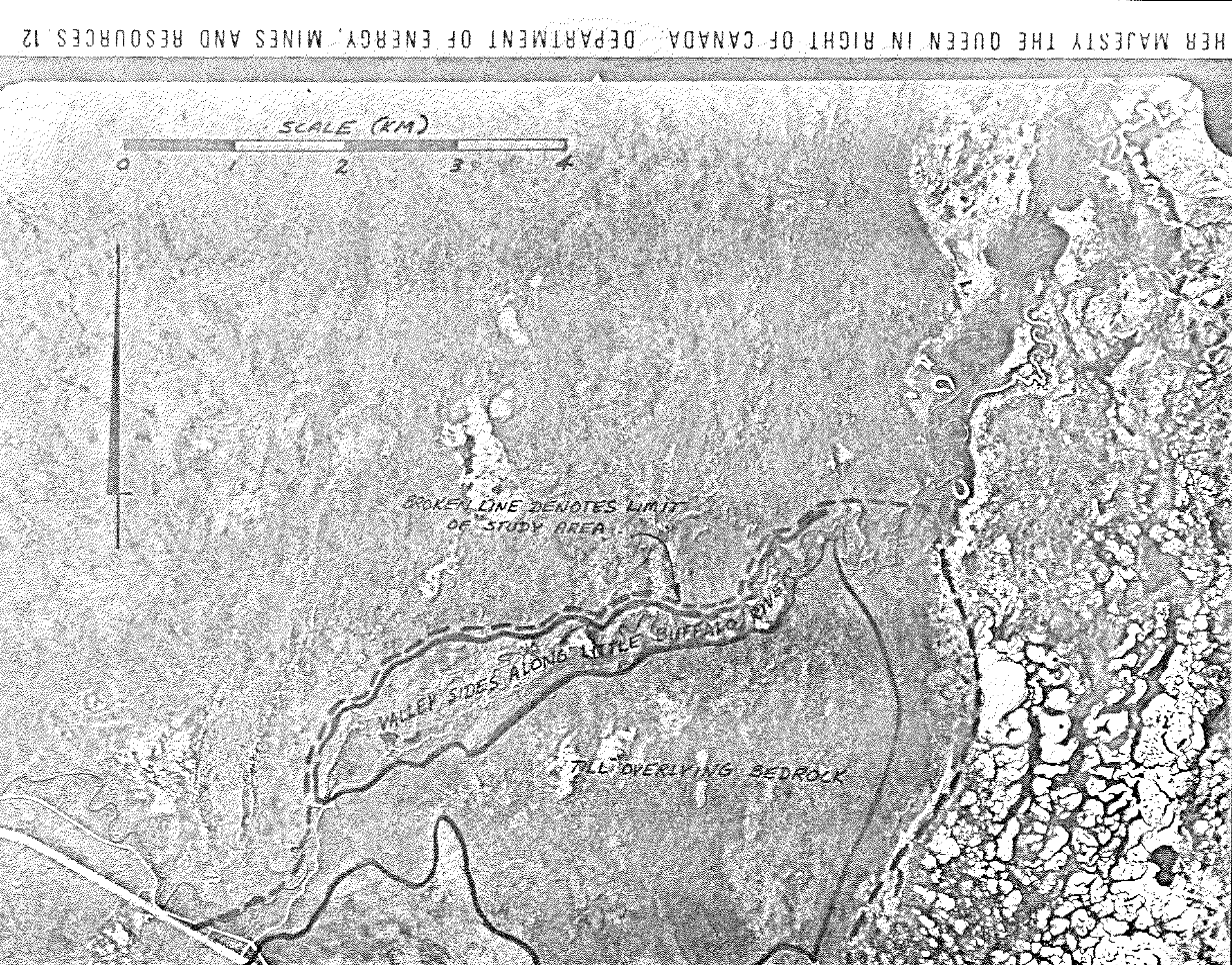
HER MAJESTY THE QUEEN IN RIGHT OF CANADA. DEPARTMENT OF ENERGY, MINES AND RESOURCES 12
SCALE (KM)
0 1 2 3 4
BROKEN LINE DENOTES LIMIT OF STUDY AREA
VALLEY SIDES ALONG LITTLE BUFFALO RIVER
TILL OVERLYING BEDROCK
HILL 2
BEACH RIDGE GRAVEL OVERLYING TILL
TILL OVERLYING BEDROCK
silty sand (till) exposed
Photo 2
HWY 5
GLACIOLACUSTRINE SILT AND CLAY CUT BY MANY SINK HOLES
varved clay exposed
NWT
ALBERTA
A24074-221
SA MAJESTE LA REINE DU CHEF DU CANADA. MINISTERE DE L'ENERGIE, DES MINES ET DES RESSOURCES

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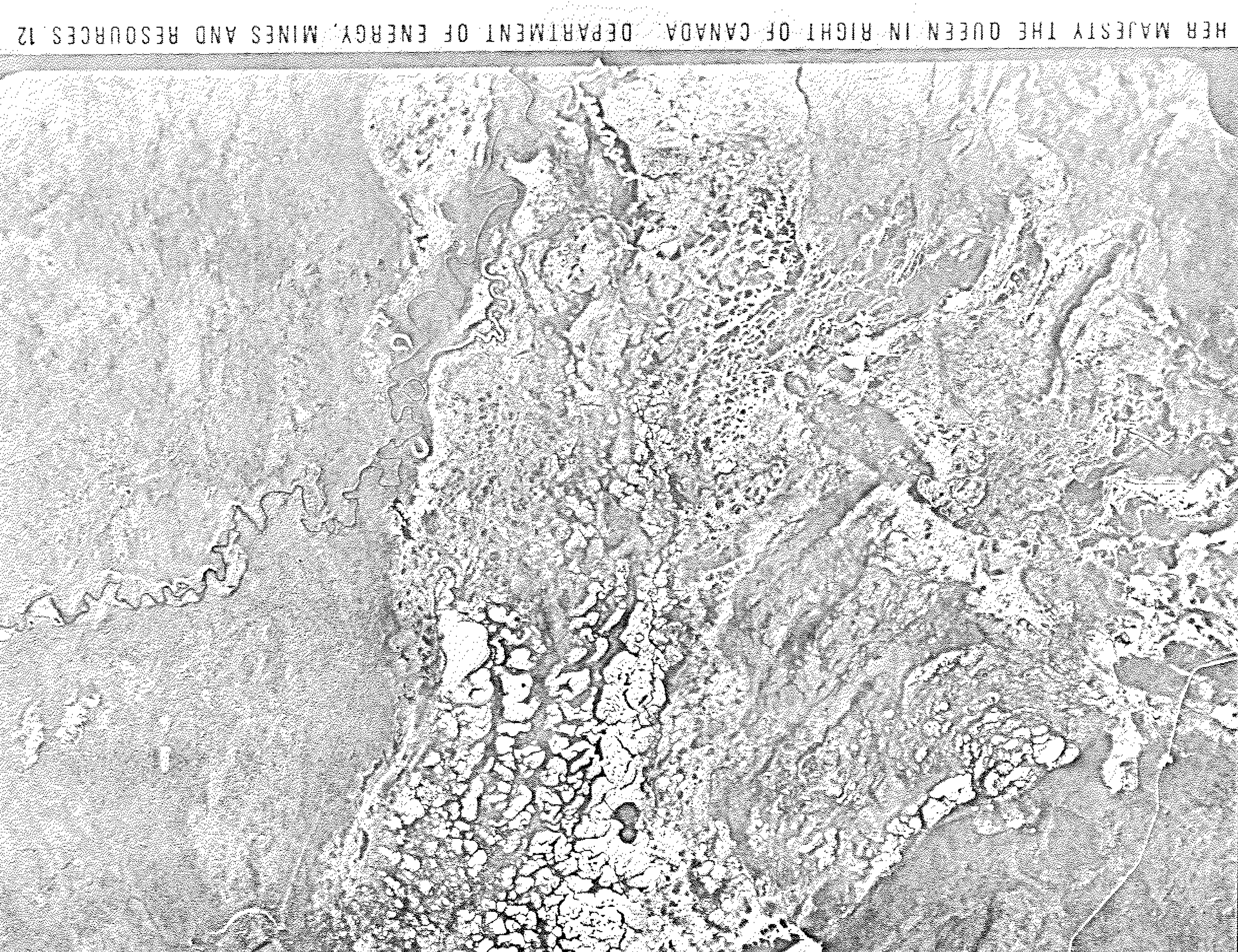
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SA MAJESTE LA REINE DU CHEF DU CANADA. MINISTERE DE L'ENERGIE, DES MINES ET DES RESSOURC

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SCALE (km)
0 1 2 3
LINE DENOTES LIMIT OF STUDY AREA
SHALLOW TYPE GRAVEL DEPOSITS
TILL OVERLYING BEDROCK
HILL 1
BEACH RIDGE GRAVEL OVERLYING TILL
PRIORITY STUDY AREA EAST OF THIS LINE
LAG TYPE GRAVEL DEPOSITS
TILL OVERLYING BEDROCK
SALT MOUNTAIN
BEACH RIDGE GRAVEL OVERLYING TILL
Photo 3
Photo 4
Sample Photo 2
Sample
Sample Photo 7
HWY 5
Photos 1, 5 and 6.
A24074-223

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HER MAJESTY THE QUEEN IN RIGHT OF CANADA. DEPARTMENT OF ENERGY, MINES AND RESOURCES 12
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A MAJESTE LA REINE DU CHEF DU CANADA. MINISTERE DE L'ENERGIE, DES MINES ET DES RESSOURCES

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Photo 1: Glacial till with a high content of pebble and cobble sized particles. Note that most rocks are limestone or dolomite and relatively few rocks (granites, etc.) are present.

Photo 2: Shallow lag deposit worked out at the side of Highway 5. Note large boulders at the surface which is typical of a lag deposit.

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Photo 3: Beach gravels, Salt Mountain - Site of Sample 2.

Photo 4: Beach gravels overlie till in roadside along Highway 5 on the Salt Mountain Hill. Note the till in this photograph is much less coarse than that shown in Photo 1.

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Photo 5: Bedding and gradation at NWT highway pit, Salt Mountain. Note abundance of limestone and dolomite rocks.

Photo 6: Bedding and gradation at NWT highway pit, Salt Mountain. Note sandy lenses and variation in size of rocks.

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Photo 7: Gravels in Pit 2, site of Sample 3. Note well rounded clasts, abundance of limestone and dolomite rocks, bedding structures and general gradation contrast among different beds.

Photo 8: Beach ridges containing coarse gravel on east slope of Salt Mountain. On steeper slopes such as this the beach ridges are like benches on the hill side.