SUMMARY OF CONSTRUCTION-MATERIAL SOURCES ALONG MACKENZIE VALLEY PIPE LINE RESEARCH LIMITED ROUTE -- PRUDHOE BAY TO FORT McPHERSON, NWT, VIA THE ARCTIC COASTAL ROUTE

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Prudhoe Bay to the Egaksrak River

Large volumes of sand, gravel, and cobbles occur along the active floodplains of major braided river channels, particularly along the wider segments of stream channels. In addition, small quantities of fine sand occur in the elevated (and therefore "dry frozen") portions of larger sand dunes in vicinity of the Sagavanirktok River delta. In a few localities, sand and gravel may also be obtained from small isolated, windswept ridges and plateaus that are erosional remnants of old valley-train and glacial-outwash granular deposits.

Sand and gravel deposits below the active floodplains of rivers crossing the Arctic North Slope are erratically frozen and unfrozen. In some places, localized unfrozen zones may extend several tens of feet in depth. However, these more deeply unfrozen zones cannot be reliably predicted without carrying out considerable costly field exploration. Therefore, in estimating recoverable quantities of sand and gravel in streambeds we have assumed an extensive active layer that is only two (2) feet thick.

Gravel particles may be platy or lensy in shape where they have been derived from thin-bedded metasediments, carbonate rocks, shales, siltstones, and sandstones. In general, however, construction-material sources are plentiful across this segment of route; and the granular materials are expected to be hard, cobbly, subrounded and acceptable in quality and in gradation.

Egaksrak River to the Babbage River

Large volumes of sand, gravel, and cobbles occur along the active floodplains of major braided river channels. Large areas of bedrock also occur along parts of the route and are available nearby for quarrying. The bedrock consists mainly of sedimentary rock types (sandstone, shale, limestone, dolomite) except in vicinity of the Alaska-Yukon border, where somewhat older and harder bedrock types occur locally. They consist of Precambrian sedimentary rocks, slightly metamorphosed sedimentary rocks (metasediments), and some granitic rock types. Here quartzites, indurated conglomerates, hard limestones and dolomites, and cherts are common rock types. These rocks are considered suitable in concrete and for earth fill construction.

Small, isolated mesa-like occurrences of eroded outwash and kame-terrace sand and gravel lie east of the Firth River between the proposed route alignment and the Beaufort Sea. Because they are smaller in quantity, more variable in composition, have thinner active layers, and carry deeper overburden, these granular deposits are considered inferior to the coarser, more-durable-appearing gravels in the beds of the Firth and large nearby rivers.

Babbage River to Fish River

Large volumes of sand, gravel, and cobbles are available from the active floodplains of braided river channels. North of the route, particularly, small quantities of sand, gravel, and cobbles may be obtained from elevated, windswept, "dry" glaciofluvial landforms -- such as kame hillocks, kame-terraces, erosional remnants of once-larger outwash aprons and glacial deltas (north of Peat Lake and south of Shingle Point airstrip) -- and from postglacial fluvial sand and gravel terraces having a relatively thinner silt overburden (e.g., along the Blow River north and also south of its junction with Purkis Creek).

Between the Babbage and Fish River, the fluvial terraces and active floodplains contain considerable amounts of sand and gravel derived from the erosion of thin-bedded shale and sandstone; in these situations, the alluvial sediments will be high in shale, dirty and high in sand sizes, with platy and lenticular shapes on particles 3/4 to 1½ inches across. Therefore, the rock types in streambed deposits east of the Babbage River are considered to be much inferior in quality to those occurring between Prudhoe Bay and the Babbage River.

As noted above, the shales give rise to platy, disc-shaped gravel particles; moreover, gravels eroded from quartzose sandstone interbeds in the predominantly shale sequence often tend to form an armour that caps finer, dirty, and more shaly sediments.

Fish River to the junction of the Coastal and Mountain Route Alternates at a point south of Stony Creek

Large areas of exposed Cretaceous shale and sandstone bedrock occur along the eastern front of the Richardson Mountains. In general these are relatively soft, friable, and crumbly bedrocks. Smaller volumes of sand and gravel may also be obtained from the bed of the steep-gradient (alluvial cone and alluvial-fan apex) portions of streams flowing out of the Richardson Mountains toward the Mackenzie River Delta. The middle reaches of the bed of Willow River also contains sand and gravel.

Careful field examination is required to select the best quarry sites -- i.e., those containing the hardest and more durable-looking bedrock strata. The harder, more resistant rocks will occur as prominent ledges, ribs, and flat-irons and buttes at higher elevations, as in vicinity of latitude 68°03', longitude 135°30'. The more massive sandstones also occur in the walls of Stony Creek about mid-way between the Peel River and the mountains to the west. Economically recovered sand and gravel can be harvested from the beds of the Rat River, Stony Creek and Vittrekwa River some 15 or so miles above their junction with the Peel River or Mackenzie River delta sediments.

General Comment

Large quantities of sand and gravel are available from wider sections of the active flood plain of large rivers crossing the Arctic North Slope. These deposits may have to be extracted after heavy spring floods and, sometimes possibly, even after large floods have occurred in July or August. These floods are typically "flashy" -- that is, short-lived, high runoff floods.

We feel that sand, gravel, and cobbles in the larger rivers between Prudhoe Bay and the Babbage River in the Yukon will be suitable for fill and also for use as concrete aggregate. However, particle shape (shales, thin flaggy sandstones) and chemically deleterious rock particles (opaline cherts, perhaps) should be carefully examined and accelerated freeze-thaw tests run on these materials if they are to stand severe physical weathering conditions. These generally coarse alluvial sediments contain minor silty gravel along with clean, permeable gravel and some sandy lenses at depth.

River beds between the Spring River and the Rat River near Fort McPherson will likely contain high proportions of soft disc-shaped gravel particles where they have been derived from weaker Cretaceous shales and sandstones. Although this is the poorest section from the standpoint of good concrete aggregate, we feel that suitable construction material sources can be found at 1) alluvial cones and the apices of steep-gradient alluvial fans, where larger streams break out of confined canyons; and 2) localities having ribs, ledges, buttes and flat-irons of more erosion-resistant bedrock.

In assuming that only two feet of material would be harvested from the beds of major rivers, we feel that removal of such a thin layer 1) would cause minimum disturbance to the pattern of stream erosion and deposition (to the river regime), 2) would provide coarser granular materials than is likely to occur at greater depths, 3) would entail excavation in unfrozen materials and thus result in economic recovery operation. The alluvial granular materials are locally gap-graded and contain some silt. Generally, however, the surface layer is better washed and contains less silt and less sand sizes than the deeper-lying substrata. Material from possible quarry rock sites on the east face of the Richardson Mountains may be most economically transported from higher elevations in the mountain front to the pipeline right-of-way by a suitable conveyer system, such as was used at Portage Mountain Dam. At least this is a possibility worth considering.

The moisture content of weathered shale is a critical factor in the slaking of this material after it is thawed. If the shale is relatively dry (the condition often found below about 15 feet below level outcrops and back from steep valley walls), then the shale materials will likely stand up tolerably well in road and airstrip fills. This seems to be the case at any rate in the road fill currently being constructed out of shale in the area just west of Arctic Red Village.

	Deposit No. 94				Deposit No. 95			
Intended use of material	airport	original pump-station No. 1	roads		roads			
Location where material required -- milepost	40.7	40.7	40.7-48		48-58			
Volume of material required in cubic yards x 10^5	1.5	2.5	1.46		2			
Haul distance in miles	± 3	± 3	± 4 average		± 6 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	90				8			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	180				16			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Sagavanirktok River; suitable for granular fill and concrete aggregates; check for deleterious material Note: Refers to same deposit, same pumpstation, and airport as deposit No. 1				alluvial sand, gravel, and cobbles on active floodplain of Sagavanirktok River (main channel); suitable for granular fill and concrete aggregates; check for deleterious material			

	Deposit No. 96				Deposit No. 97			
Intended use of material	roads				roads	supplement to deposit No. 98		
Location where material required -- milepost	58-70				70-78			
Volume of material required in cubic yards x 10^5	2.4				1.6			
Haul distance in miles	± 5 average				± 4 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	7				10			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	14				20			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Kaderoshilik River; suitable for granular fill and concrete aggregates; check for deleterious material				alluvial sand, gravel and cobbles on active floodplain of Shaviovik River; suitable for granular fill and concrete aggregates; check for deleterious material			

	Deposit No. 98				Deposit No. 99			
Intended use of material	airport	pump-station No. 2	roads			roads		
Location where material required -- milepost	83.0	83.0	78-90			90 - 105		
Volume of material required in cubic yards x 10^5	1.5	2.5	2.4			3		
Haul distance in miles	7	7	± 9 average			± 8 average		
Estimated volume of material available per foot of depth in cubic yards x 10^5	3				50			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	6				100			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregate				harvest from riverbed; crush for concrete aggregate			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Kavik River; suitable for granular fill and concrete aggregates; check for deleterious material				alluvial sand, gravel, and cobbl on active floodplain of Staines River; suitable for granular fil and concrete aggregates; check for deleterious material			

	Deposit No. 100				Deposit No. 101			
Intended use of material	airport	pump-station No. 3	roads		airport	pump-station No. 3	roads	
Location where material required -- milepost	117.5	117.5	105-114		alternate or supplement to deposit No. 100 117.5	117.5	114-121	
Volume of material required in cubic yards x 10^5	1.5	2.5	1.8		1.5	2.5	1.4	
Haul distance in miles	± 12	± 12	± 4½ average		± 4	± 4	± 4 average	
Estimated volume of material available per foot of depth in cubic yards x 10^5	5				5			
Estimated recoverable depth in feet	2				2 average			
Estimated volume available in cubic yards x 10^5	10				10			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from streambed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of river at M.P. 108; suitable for granular fill and concrete aggregates; check for deleterious materials				alluvial sand, gravel and cobble along active floodplain of Tamayariak River; suitable for granular fill and concrete aggregates; check for deleteriou materials			

	Deposit No. 102				Deposit No. 103			
Intended use of material	road				road			
Location where material required -- milepost	121-132				132-143			
Volume of material required in cubic yards x 10^5	2.2				2.2			
Haul distance in miles	± 6 average				± 5 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	8				3			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	16				6			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel, and cobbles on active floodplain of Katakturuk River; suitable for granular fill and concrete aggregates; check for deleterious materials				alluvial sand, gravel, and cobbl on active floodplain of Marsh Creek; suitable for granular fil and concrete aggregates; check for deleterious materials			

	Deposit No. 104				Deposit No. 105			
Intended use of material	roads				roads			
Location where material required -- milepost	143-148				148-156			
Volume of material required in cubic yards x 10^5	1.0				1.6			
Haul distance in miles	± 4 average				± 5 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	6				10			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	12				20			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregate			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Itkilyariak Creek; suitable for granular fill and concrete aggregates; check for deleterious materials				alluvial sand, gravel and cobbles along active floodplain of Sadlerochit River; suitable for granular fill and concrete aggregates; check for deleterious materials			

Deposit No.	106				No.			
Intended use of material	airport	pump-station No. 4	roads					
Location where material required -- milepost	161	161	156-165					
Volume of material required in cubic yards x 10^5	1.5	2.5	1.8					
Haul distance in miles	± 2	± 2	± 5 average					
Estimated volume of material available per foot of depth in cubic yards x 10^5	8							
Estimated recoverable depth in feet	2 average							
Estimated volume available in cubic yards x 10^5	16							
Estimated overburden depth and type of material	nil							
Method of mining	harvest from riverbed; crush for concrete aggregate							
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Okpilak River; suitable for granular fill and concrete aggregates; check for deleterious material							

	Deposit No. 107				Deposit No. 108			
Intended use of material	roads				roads			
Location where material required -- milepost	165-173				173-182			
Volume of material required in cubic yards x 10^5	1.6				1.8			
Haul distance in miles	$\pm$ 4 average				$\pm$ 4 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	10				5			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	20				10			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Jago River; suitable for granular fill and concrete aggregates; check for deleterious material				alluvial sand, gravel and cobble on active floodplain of Okerokovik River; suitable for granular fill and concrete aggregates; check for deleteriou material			

	Deposit No. 109	Deposit No. 110
Intended use of material	roads	roads
Location where material required -- milepost	182-193	193-200
Volume of material required in cubic yards x 10^5	2.2	1.4
Haul distance in miles	± 5 average	± 4 average
Estimated volume of material available per foot of depth in cubic yards x 10^5	20	10
Estimated recoverable depth in feet	2 average	2 average
Estimated volume available in cubic yards x 10^5	40	20
Estimated overburden depth and type of material	nil	nil
Method of mining	harvest from riverbed; crush for concrete aggregates	harvest from riverbed; crush for concrete aggregates
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles on active floodplain of Aichilik River; suitable for granular fill and concrete aggregates; check for deleterious materials	alluvial sand, gravel and cobbles on active floodplain of Egaksrak River; suitable for granular fill and concrete aggregates; check for deleterious materials

	Deposit No. 111	Deposit No. 112
Intended use of material	alternate or supplement to deposits 110, 112 and 113	roads
Location where material required -- milepost		200-202
Volume of material required in cubic yards x 10^5		0.4
Haul distance in miles		± 1 average
Estimated volume of material available per foot of depth in cubic yards x 10^5	10	10
Estimated recoverable depth in feet	+20; depends on economic excavation depth	2 average
Estimated volume available in cubic yards x 10^5	200	20
Estimated overburden depth and type of material	may require some stripping of weathered bedrock layer	nil
Method of mining	bedrock quarry; crush for concrete aggregates	harvest from riverbed; crush for concrete aggregates
Notes: type of material, suitability, etc.	sandstone, siltstone, quartzite and fine to coarse-grained limestone, some dolomite, chert nodules and lenses are common; bedrock quarry; suitable for granular fill and concrete aggregates; check for deleterious materials	alluvial sand, gravel, and cobble on active floodplain of Ekaluakat River ; suitable for granular fill and concrete aggregates; check for deleterious material

	Deposit No. 113				Deposit No. 114			
Intended use of material	airport	pump-station No. 5	roads		alternate or supplement to deposit No. 115			
Location where material required -- milepost	206	206	202-206					
Volume of material required in cubic yards x 10^5	1.5	2.5	0.8					
Haul distance in miles	± 4 average	± 4 average	± 3 average					
Estimated volume of material available per foot of depth in cubic yards x 10^5	5				3			
Estimated recoverable depth in feet	2 average				+20; dependent on economic excavation depth			
Estimated volume available in cubic yards x 10^5	10				60			
Estimated overburden depth and type of material	nil				may require some stripping of weathered bedrock layer			
Method of mining	harvest from riverbed; crush for concrete aggregate				bedrock quarry; crush for concret aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles from active floodplain of Siksikpalak River; suitable for granular fill and concrete aggregate; check for deleterious material				Metamorphic rocks of the Neruokpuk Formation; bedrock suitable for granular fill and concrete aggregate; check for deleterious material			

	Deposit No. 115				Deposit No. 116			
Intended use of material	roads				airport	pump-station No. 6	road alternate or supplement to deposit 117 and 118	
Location where material required -- milepost	206-223				246.5	246.5	242-260	
Volume of material required in cubic yards x 10^5	3.4				1.5	2.5	3.6	
Haul distance in miles	$\pm$ 8 average				near site	near site	along right-of way	
Estimated volume of material available per foot of depth in cubic yards x 10^5	30				essentially unlimited supply			
Estimated recoverable depth in feet	2 average							
Estimated volume available in cubic yards x 10^5	60							
Estimated overburden depth and type of material	nil				may require some stripping of weathered bedrock layer			
Method of mining	harvest from riverbed; crush for concrete aggregates				bedrock quarry; crush for concre aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel, and cobbles along active floodplain of Kongakut River; suitable for granular fill and concrete aggregate; check for deleterious material				Precambrian rock and/or limeston shale, sandstone, conglomerate a chert; suitable for granular fil Precambrian rock, limestone and sandstone suitable for concrete aggregates			

	Deposit No. 117				Deposit No. 118			
Intended use of material	roads				roads			
Location where material required -- milepost	223-235				235-242			
Volume of material required in cubic yards x 10^5	2.4				1.4			
Haul distance in miles	$\pm$ 8 average				$\pm$ 3 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	10				5			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	20				10			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregate				harvest from riverbed; crush for concrete aggregate			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Clarence River; suitable for granular fill and concrete aggregate; check for deleterious material				alluvial sand, gravel and cobble along active floodplain of river flowing into Clarence Lagoon; suitable for granular fill and concrete aggregate; check for deleterious material			

	Deposit No. 119	Deposit No. 120
Intended use of material	roads	alternate or supplement to deposits 119 and 121
Location where material required -- milepost	260-270	
Volume of material required in cubic yards x 10^5	2.0	
Haul distance in miles	± 3 average	
Estimated volume of material available per foot of depth in cubic yards x 10^5	8	essentially unlimited supply
Estimated recoverable depth in feet	2 average	
Estimated volume available in cubic yards x 10^5	16	
Estimated overburden depth and type of material	nil	may require some stripping of weathered bedrock layer
Method of mining	harvest from riverbed; crush for concrete aggregates	bedrock quarry; crush for concrete aggregates
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Malcolm River; suitable for granular fill and concrete aggregate; check for deleterious material	Precambrian bedrock and Jurassic shale and sandstone; suitable fo granular fill and concrete aggregates but shale is deleterious material

	Deposit No. 121				Deposit No. 122			
Intended use of material	roads				roads			
Location where material required -- milepost	270-278				278-288			
Volume of material required in cubic yards x 10^5	1.6				2			
Haul distance in miles	± 4 average				± 4 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	10				10			
Estimated recoverable depth in feet	2 average				+20; depends on economic excavation depth			
Estimated volume available in cubic yards x 10^5	20				+200			
Estimated overburden depth and type of material	nil				may require some stripping of weathered bedrock layer			
Method of mining	harvest from riverbed; crush for concrete aggregates				bedrock quarry; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Firth River; suitable for granular fill and concrete aggregates; check for deleterious material				Jurassic sandstone and shale bedrock; suitable for granular fill; sandstone suitable for concrete aggregates			

	Deposit No. 123				Deposit No. 124			
Intended use of material	roads				supplement to deposits 123 and 125			
Location where material required -- milepost	288-292							
Volume of material required in cubic yards x 10^5	0.8							
Haul distance in miles	± 1 average							
Estimated volume of material available per foot of depth in cubic yards x 10^5	0.4							
Estimated recoverable depth in feet	2 average							
Estimated volume available in cubic yards x 10^5	0.8							
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates							
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of tributary to Spring River; suitable for granular fill and concrete aggregate; check for deleterious material				several small deposits of sand and gravel along active point bars on tributary to Spring Rive suitable for granular fill and concrete aggregate; check for deleterious material			

	Deposit No. 125				Deposit No. 126			
Intended use of material	roads				airport	pump-station No. 7	road	
Location where material required -- milepost	292-302				300.5	300.5	302-309	
Volume of material required in cubic yards x 10^5	2.0				1.5	2.5	1.4	
Haul distance in miles	$\pm$ 4 average				$\pm$ 8	$\pm$ 8	$\pm$ 4 average	
Estimated volume of material available per foot of depth in cubic yards x 10^5	1				8			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	2				16			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Spring River; suitable for granular fill and concrete aggregates; check for delterious material				alluvial sand, gravel and cobble along active floodplain of Crow River; suitable for granular fi and concrete aggregates; check for deleterious material			

	No. 127				No. 128			
Intended use of material	road				supplement to deposit No. 129			
Location where material required -- milepost	309-319							
Volume of material required in cubic yards x 10^5	2.0							
Haul distance in miles	± 6 average							
Estimated volume of material available per foot of depth in cubic yards x 10^5	2							
Estimated recoverable depth in feet	2 average							
Estimated volume available in cubic yards x 10^5	4							
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregate							
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Trail River; suitable for granular fill and concrete aggregates; check for deleterious material				small sand and gravel deposits along active bars of Babbage River; suitable for granular fil and concrete aggregates; check for deleterious material			

	Deposit No. 129				Deposit No. 130			
Intended use of material	roads				supplement to deposits 129 and 131			
Location where material required -- milepost	319-338							
Volume of material required in cubic yards x 10^5	3.8							
Haul distance in miles	± 6							
Estimated volume of material available per foot of depth in cubic yards x 10^5	10							
Estimated recoverable depth in feet	+20; depends on economic excavation depth							
Estimated volume available in cubic yards x 10^5	+200							
Estimated overburden depth and type of material	may require some stripping of weathered bedrock layer				nil			
Method of mining	bedrock quarry; crush for concrete aggregates				harvest from river			
Notes: type of material, suitability, etc.	Upper Cretaceous shale and sandstone; suitable for granular fill; sandstone suitable for concrete aggregate				small sand and gravel deposits along active point bars of Walking River; suitable for granular fill and concrete aggregates; check for deleteriou material			

	No. 131				No. 132			
Intended use of material	airport	pump-station No. 8	road		road			
Location where material required -- milepost	341	341	338-353		353-365			
Volume of material required in cubic yards x 10^5	1.5	2.5	3.0		2.4			
Haul distance in miles	$\pm$ 8	$\pm$ 8	$\pm$ 5 average		$\pm$ 4 average			
Estimated volume of material available per foot of depth in cubic yards x 10^5	10				6			
Estimated recoverable depth in feet	2 average				2 average			
Estimated volume available in cubic yards x 10^5	20				12			
Estimated overburden depth and type of material	nil				nil			
Method of mining	harvest from riverbed; crush for concrete aggregates				harvest from riverbed; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand, gravel and cobbles along active floodplain of Blow River; suitable for granular fill and concrete aggregates; check for deleterious material				alluvial sand, gravel and cobbles along active floodplain of Rapid Creek; suitable for granular fill and concrete aggregates; check for deleterious material			

	No. 133				No. 134			
Intended use of material	road				road	airport	pump-station No. 9	
Location where material required -- milepost	365-376				376-390	389.5	389.5	
Volume of material required in cubic yards x 10^5	2.2				2.8	1.5	2.5	
Haul distance in miles	$\pm$ 4 average				$\pm$ 6 average	$\pm$12	$\pm$ 12	
Estimated volume of material available per foot of depth in cubic yards x 10^5	0.6				3			
Estimated recoverable depth in feet	+20; depends on economic excavation depth				2 average			
Estimated volume available in cubic yards x 10^5	12				6			
Estimated overburden depth and type of material	may require some stripping of weathered bedrock layer				nil			
Method of mining	bedrock quarry; crush for concrete aggregates				harvest from riverbed; may require some crushing for concret aggregate			
Notes: type of material, suitability, etc.	Upper Cretaceous shale and sandstone bedrock; suitable for granular fill; sandstone is suitable for concrete aggregate; shale is deleterious for concrete aggregate				alluvial sand and gravel along active floodplain of Fish River; suitable for granular fill and concrete aggregates; check for deleterious material			

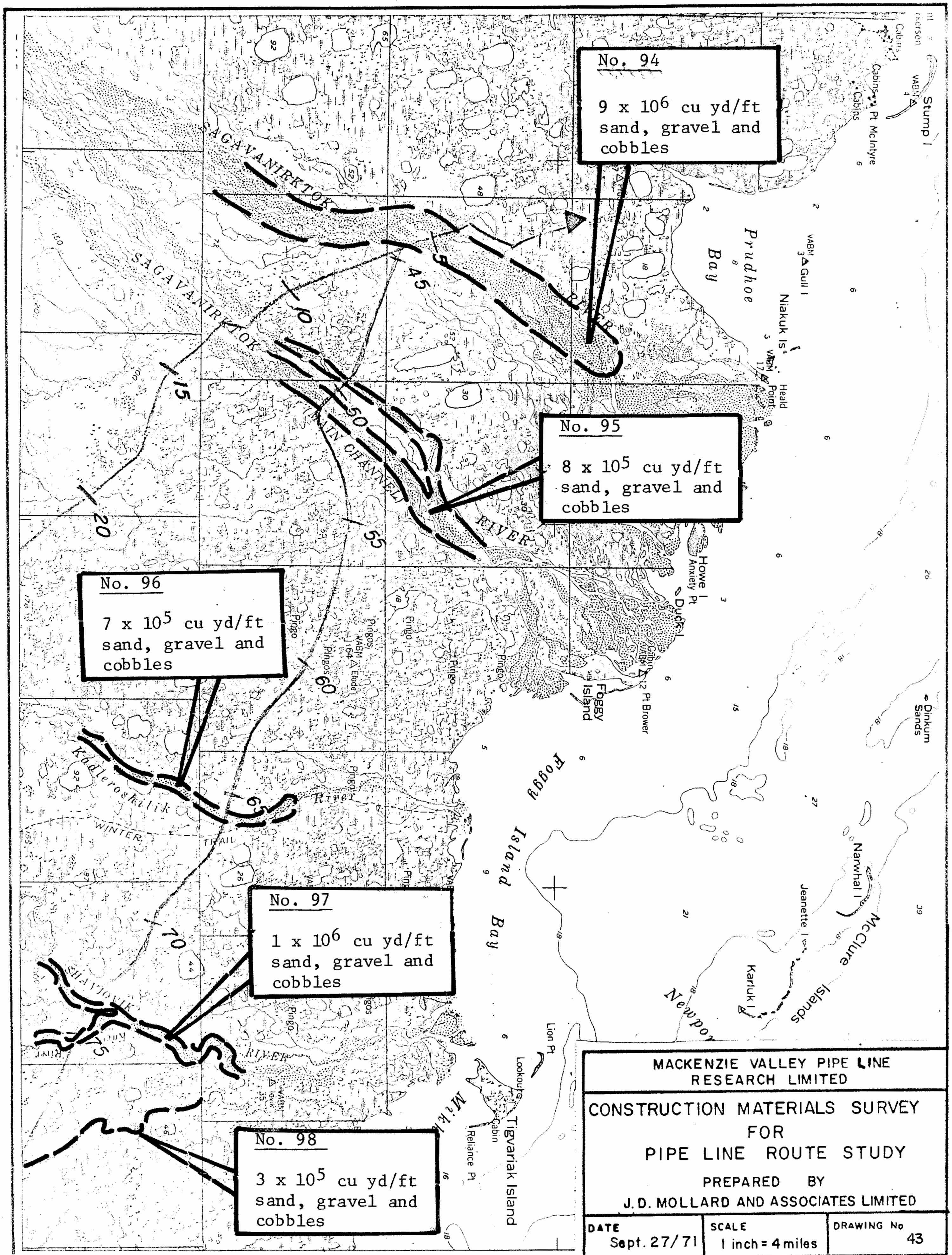
	Deposit No. 135				Deposit No. 136			
Intended use of material	road	supplement to deposit 134 for airport and pumpstation No. 9			airport	pump-station No. 10	road	
Location where material required -- milepost	390-409				431.5	431.5	409-430	
Volume of material required in cubic yards x 10^5	3.8				1.5	2.5	4.2	
Haul distance in miles	± 16 average				near site	near site	depends on location of quarry sites -- up to 8 miles	
Estimated volume of material available per foot of depth in cubic yards x 10^5	8				essentially unlimited supply			
Estimated recoverable depth in feet	+20; depends on economic excavation depth							
Estimated volume available in cubic yards x 10^5	+160							
Estimated overburden depth and type of material	may require some stripping of weathered bedrock layer				may require some stripping of weathered bedrock layer			
Method of mining	bedrock quarry; crush for concrete aggregate				bedrock quarry; crush for concrete aggregate			
Notes: type of material, suitability, etc.	Lower Cretaceous sandstone and shale bedrock; suitable for granular fill; sandstone is suitable for concrete aggregate; shale is deleterious for concrete aggregate				Jurassic and Lower Cretaceous shale and sandstone bedrock; suitable for granular fill; sandstone is suitable for concrete aggregate; shale is deleterious for concrete aggregate			

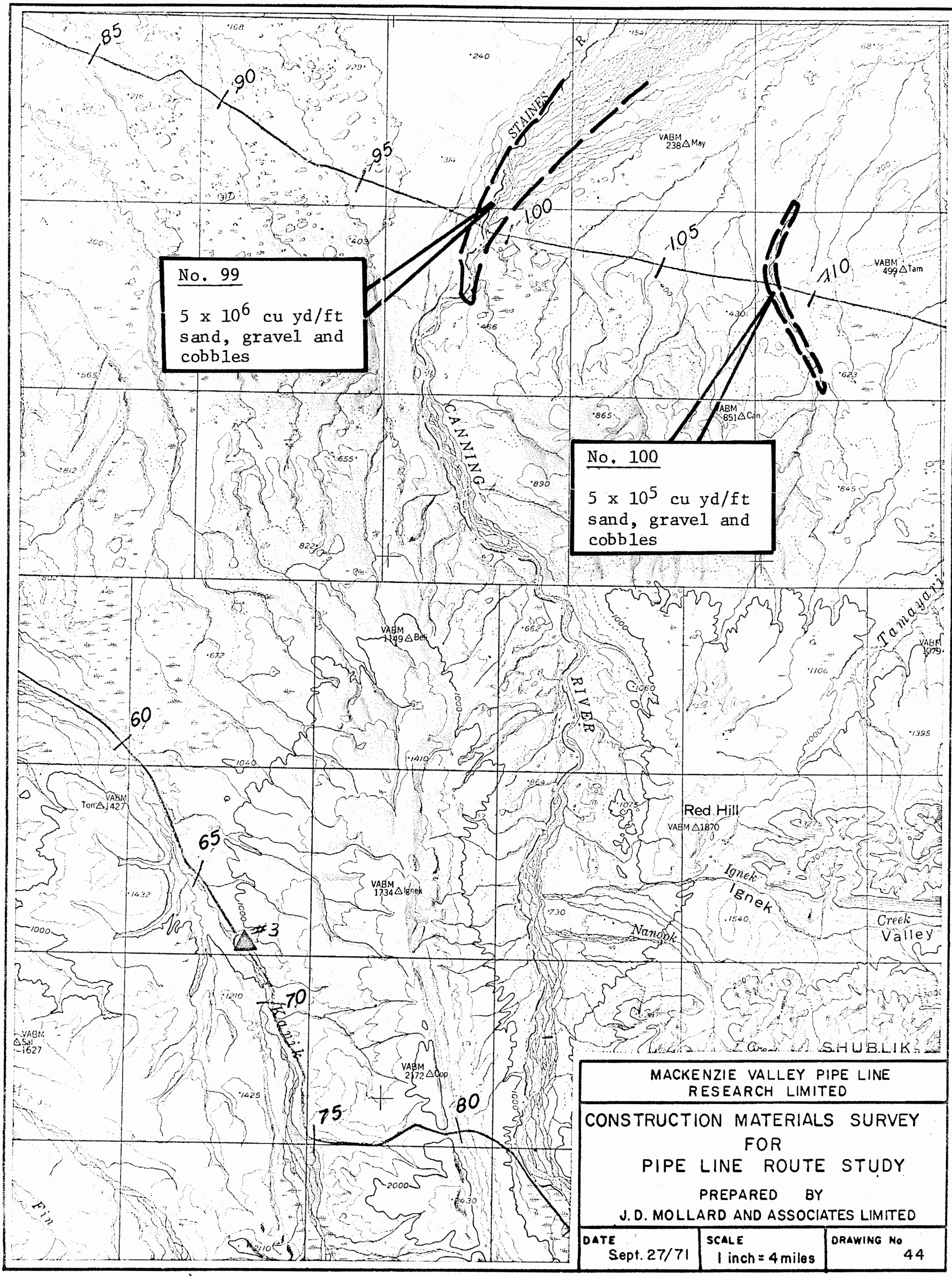
	Deposit No. 136A	Deposit No.
Intended use of material	supplement to deposit 136	
Location where material required -- milepost		
Volume of material required in cubic yards x 10^5		
Haul distance in miles		
Estimated volume of material available per foot of depth in cubic yards x 10^5	0.5	
Estimated recoverable depth in feet	3 average	
Estimated volume available in cubic yards x 10^5	1.5	
Estimated overburden depth and type of material	nil on active bars	
Method of mining	harvest from riverbed	
Notes: type of material, suitability, etc.	alluvial sand and gravel along active floodplain of Willow River; suitable for granular fill; field check suitability for concrete aggregates	

	Deposit No. 137				Deposit No. 138			
Intended use of material	road				supplement to deposit 137			
Location where material required -- milepost	430-440							
Volume of material required in cubic yards x 10^5	2.0							
Haul distance in miles	$\pm$ 6 average							
Estimated volume of material available per foot of depth in cubic yards x 10^5	10				0.3			
Estimated recoverable depth in feet	+20; depends on economic excavation depth				2 average			
Estimated volume available in cubic yards x 10^5	200				0.6			
Estimated overburden depth and type of material	may require some stripping of weathered bedrock layer				nil			
Method of mining	bedrock quarry; crush for concrete aggregates				harvest from riverbed			
Notes: type of material, suitability, etc.	Jurassic or Lower Cretaceous buff, flaggy sandstone bedrock; suitable for granular fill and concrete aggregate; check for deleterious material				alluvial sand and gravel from tributary stream to Husky Channel; suitable for granular fill and concrete aggregates; check for deleterious material			

	Deposit No. 139				Deposit No. 140			
Intended use of material	supplement to deposit 140				road	airport	pump-station No. 11	
Location where material required -- milepost					440-463	459.5	459.5	
Volume of material required in cubic yards x 10^5					4.6	1.5	2.5	
Haul distance in miles					$\pm$ 17 average	$\pm$ 20	$\pm$ 20	
Estimated volume of material available per foot of depth in cubic yards x 10^5	0.3				5			
Estimated recoverable depth in feet	2 average				+20; depends on economic excavation depth			
Estimated volume available in cubic yards x 10^5	0.6				100			
Estimated overburden depth and type of material	nil				may require some stripping of weathered bedrock layer			
Method of mining	harvest from riverbed				bedrock quarry; crush for concrete aggregates			
Notes: type of material, suitability, etc.	alluvial sand and gravel from tributary stream to Husky Channel; suitable for granular fill and concrete aggregates; check for deleterious material				Cambrian limestone, shale, siltstone and evaporites; suitable for granular fill; fiel check for suitability for concrete aggregates			

	Deposit No. 141				Deposit No.			
Intended use of material	road	airport	pump-station No. 11					
	supplement to deposit 140							
Location where material required -- milepost	440-463	459.5	459.5					
Volume of material required in cubic yards x 10^5	4.6	1.5	2.5					
Haul distance in miles	± 8 average	± 8	± 8					
Estimated volume of material available per foot of depth in cubic yards x 10^5	1							
Estimated recoverable depth in feet	3 average							
Estimated volume available in cubic yards x 10^5	3							
Estimated overburden depth and type of material	nil							
Method of mining	harvest from riverbed							
Notes: type of material, suitability, etc.	alluvial sand and gravel along active floodplain of Rat River; suitable for granular fill and concrete aggregates; check for deleterious material							


No. 94
9 x 10^6 cu yd/ft
sand, gravel and
cobbles
No. 95
8 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 96
7 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 97
1 x 10^6 cu yd/ft
sand, gravel and
cobbles
No. 98
3 x 10^5 cu yd/ft
sand, gravel and
cobbles
SAGAVANIRKTOK
SAGAVANIRKTOK
RIVER
MAIN CHANNEL
RIVER
Kadleroshilik
River
WINTER
TRAIL
SHAVIOVIK
RIVER
Prudhoe
Bay
Foggy
Island
Bay
Niakuk Is
Heald
Point
Gull I
Stump I
Pt McIntyre
Cabins
Howe I
Anxiety Pt
Duck I
Foggy
Island
Pt Brower
Dinkum
Sands
Narwhal I
Jeanette I
Karluk I
McClure
Islands
Newport
Lion Pt
Lookout
Tigvariak Island
Reliance Pt
Pingo
Pingos
10
15
20
45
50
55
60
65
70
75
MACKENZIE VALLEY PIPE LINE
RESEARCH LIMITED
CONSTRUCTION MATERIALS SURVEY
FOR
PIPE LINE ROUTE STUDY
PREPARED BY
J. D. MOLLARD AND ASSOCIATES LIMITED
DATE
Sept. 27/71
SCALE
1 inch = 4 miles
DRAWING No
43



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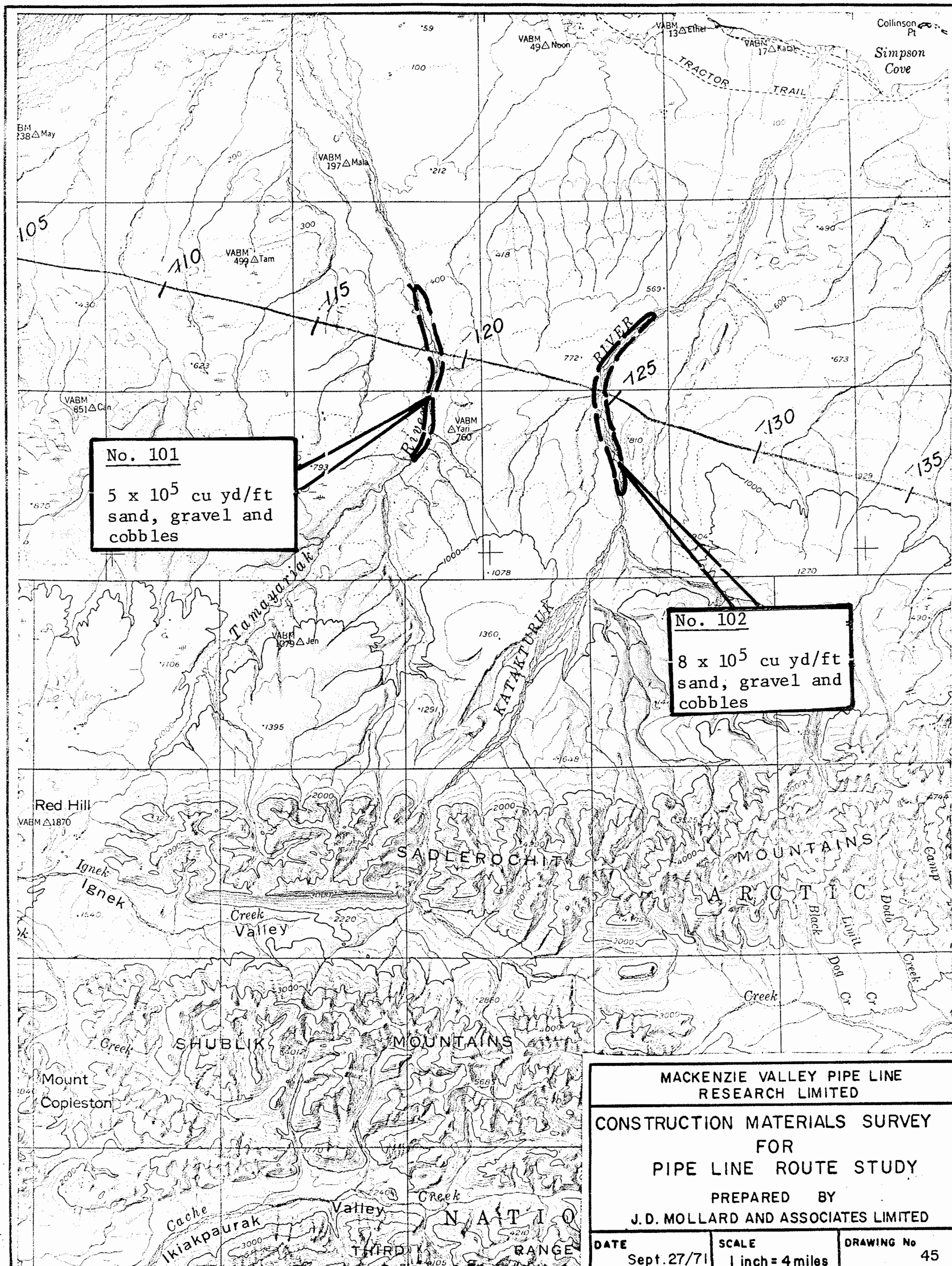
DATE	SCALE	DRAWING No
Sept. 27/71	1 inch = 4 miles	44



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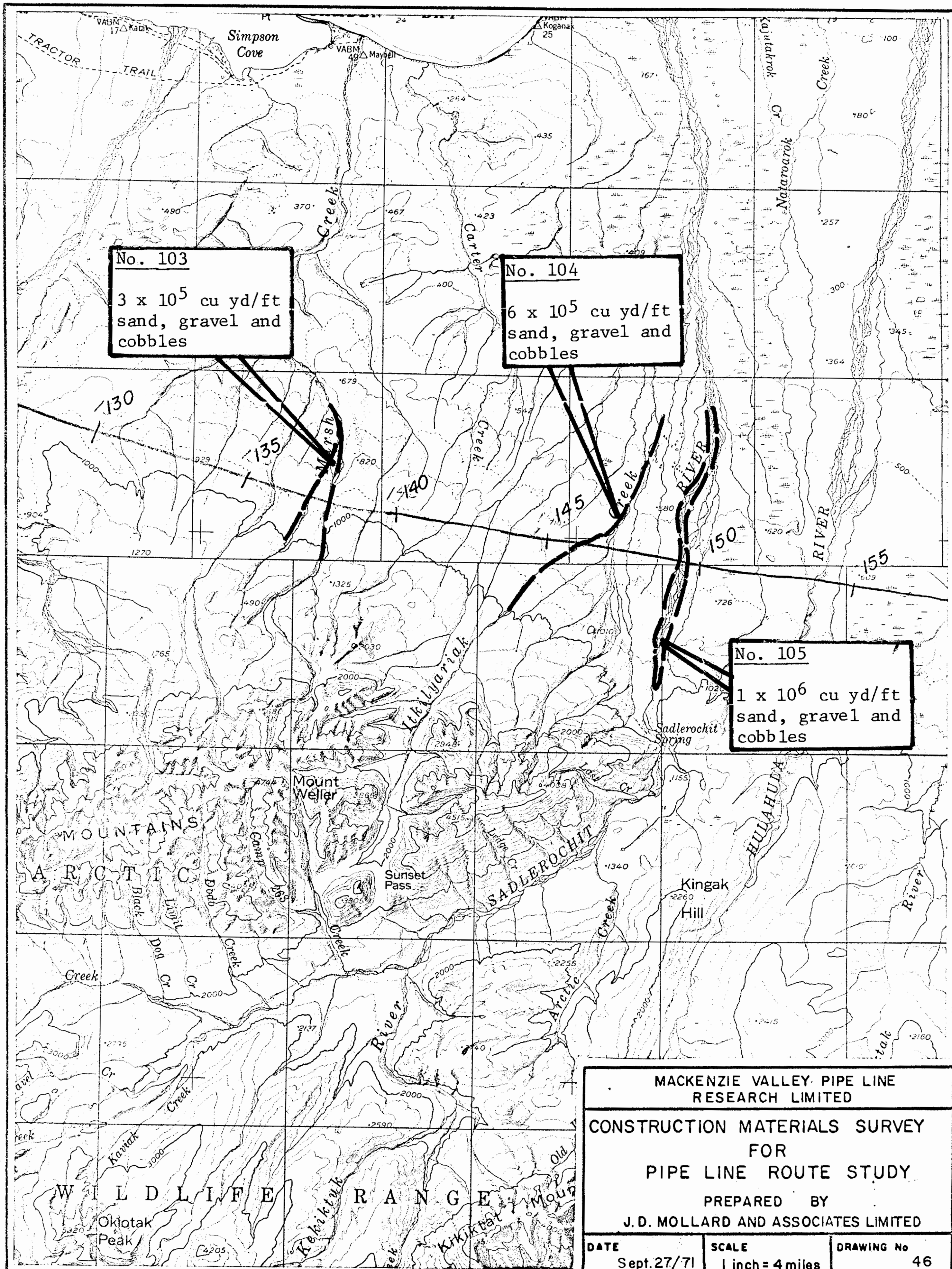
DATE	SCALE	DRAWING No
Sept. 27/71	1 inch = 4 miles	45



No. 103
3 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 104
6 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 105
1 x 10^6 cu yd/ft
sand, gravel and
cobbles
130
135
140
145
150
155
Simpson Cove
TRACTOR TRAIL
Carter
Creek
Nataroarok
Kajutakrok Cr
RIVER
Ikkilyariak
Sadlerochit Spring
Mount Weller
MOUNTAINS
ARCTIC
Sunset Pass
SADLEROCHIT
HULAHULA
Kingak Hill
Black
Dog Cr
Dodo
Camp
Lost Cr
Arctic
River
Kaviak
Kekiktuk
WILDLIFE RANGE
Oklotak Peak
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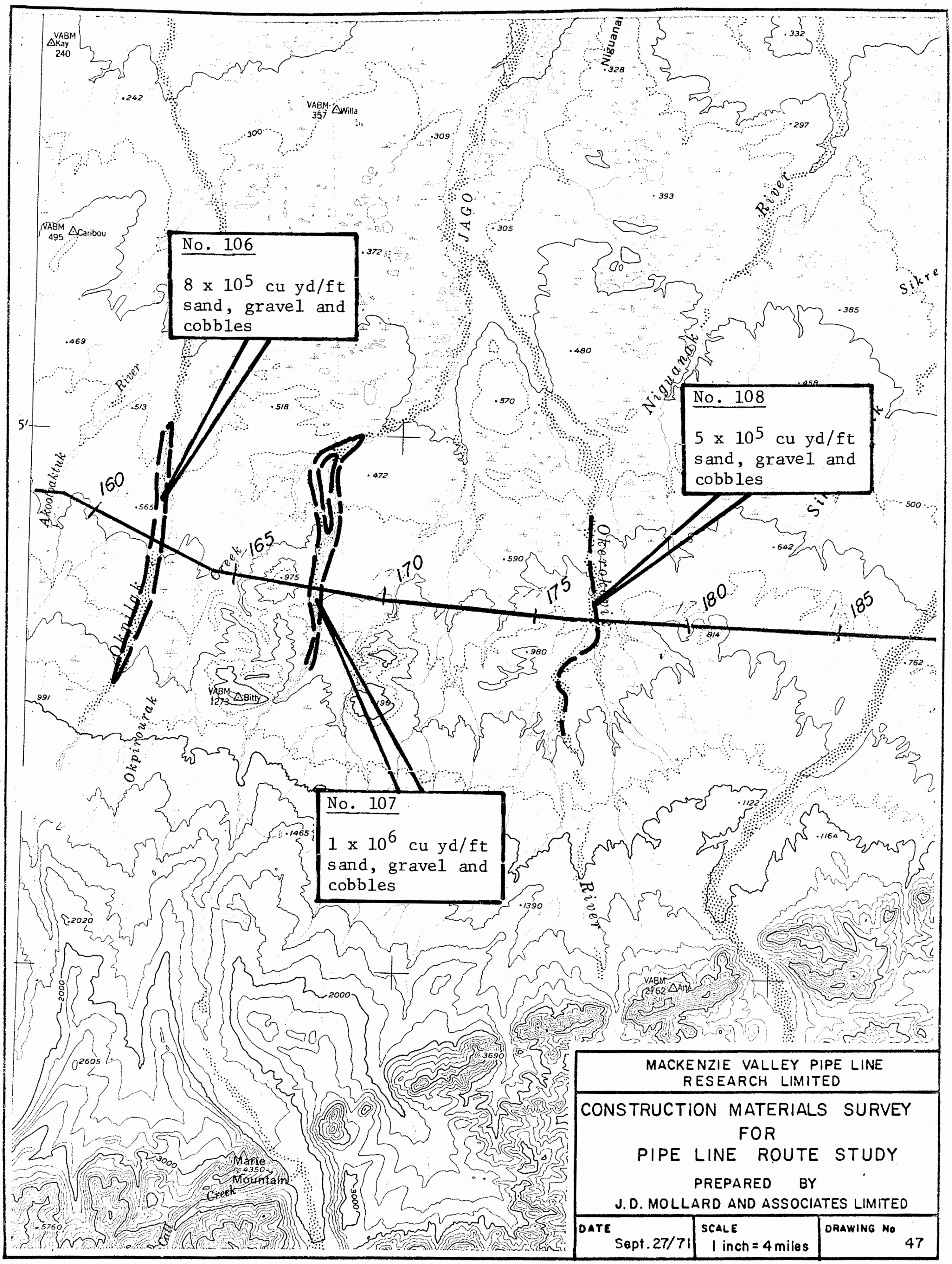
DATE
Sept. 27/71
SCALE
1 inch = 4 miles
DRAWING No
46



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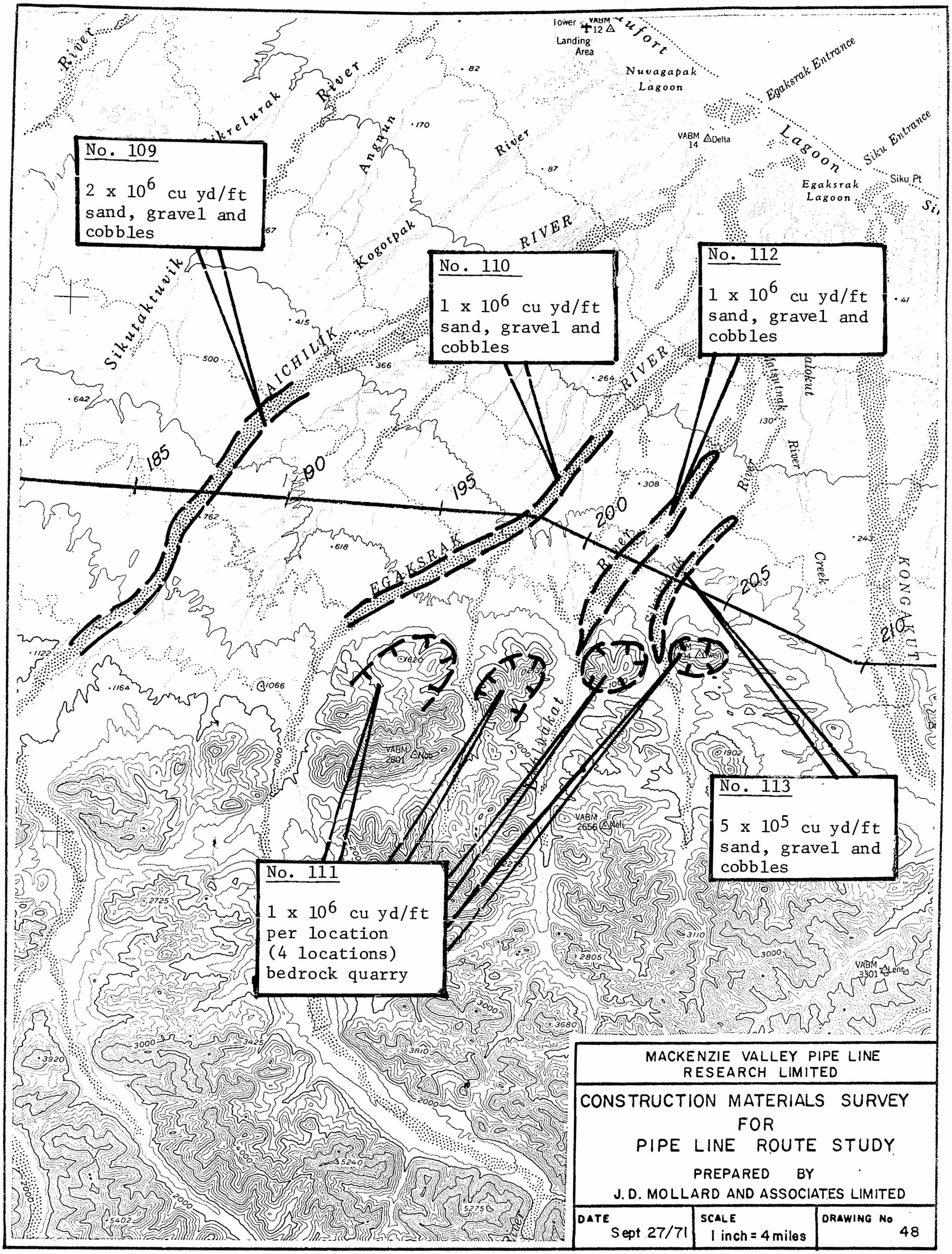
DATE	SCALE	DRAWING No
Sept. 27/71	1 inch = 4 miles	47



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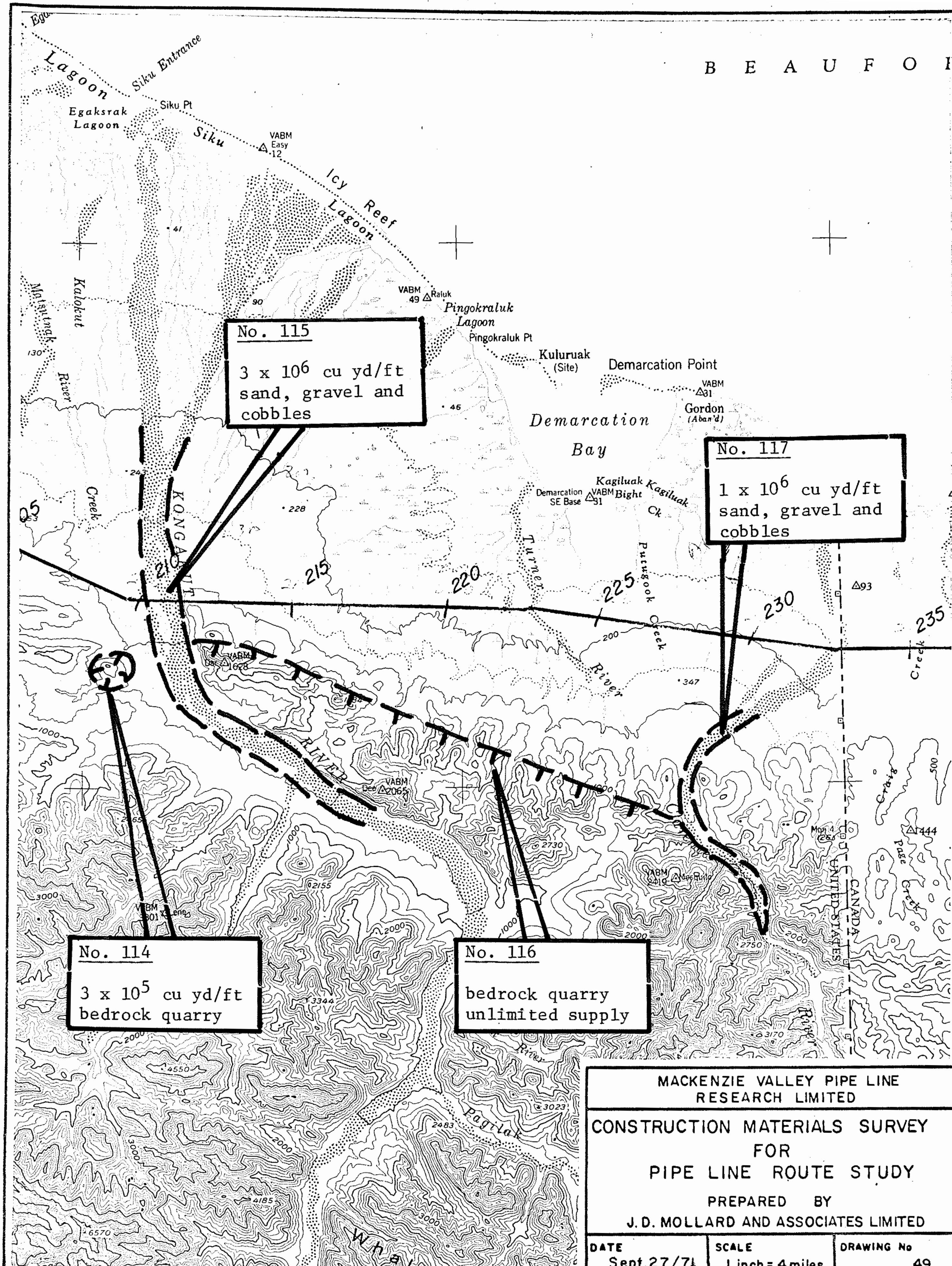
DATE	SCALE	DRAWING No
Sept 27/71	1 inch = 4 miles	48



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CONSTRUCTION MATERIALS SURVEY FOR PIPE LINE ROUTE STUDY

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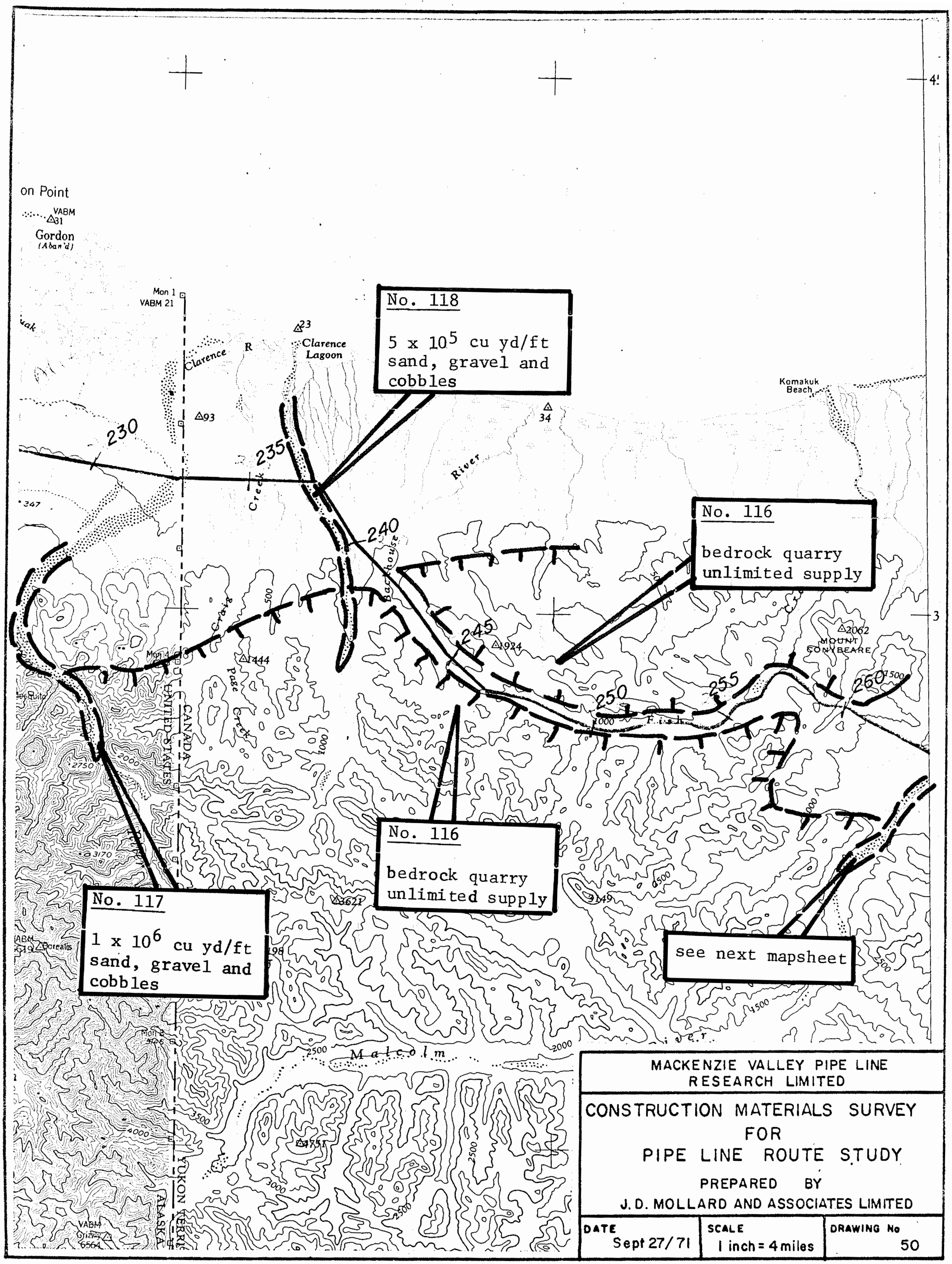
DATE	SCALE	DRAWING No
Sept. 27/71	1 inch = 4 miles	49


No. 118
5 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 116
bedrock quarry
unlimited supply
No. 116
bedrock quarry
unlimited supply
No. 117
1 x 10^6 cu yd/ft
sand, gravel and
cobbles
see next mapsheet
230
235
240
245
250
255
260
Clarence Lagoon
Komakuk Beach
Mount Conybeare
Malcolm
River
UNITED STATES
CANADA
ALASKA
YUKON TERR
MACKENZIE VALLEY PIPE LINE
RESEARCH LIMITED
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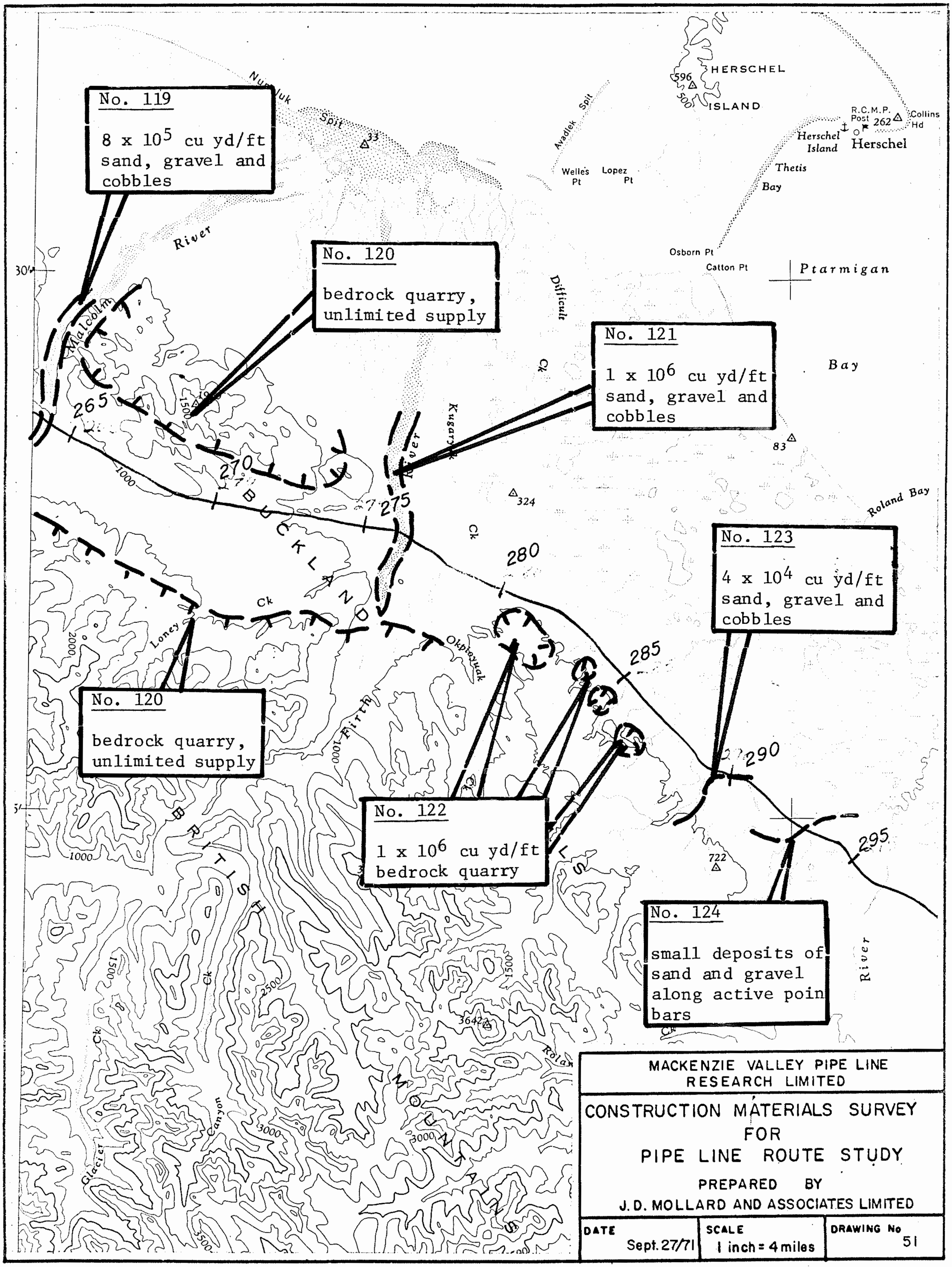
DATE
Sept 27/71
SCALE
1 inch = 4 miles
DRAWING No
50


No. 119
8 x 10^5 cu yd/ft
sand, gravel and
cobbles
No. 120
bedrock quarry,
unlimited supply
No. 121
1 x 10^6 cu yd/ft
sand, gravel and
cobbles
No. 123
4 x 10^4 cu yd/ft
sand, gravel and
cobbles
No. 120
bedrock quarry,
unlimited supply
No. 122
1 x 10^6 cu yd/ft
bedrock quarry
No. 124
small deposits of
sand and gravel
along active poin
bars
HERSCHEL
ISLAND
R.C.M.P.
Post
Collins
Hd
Herschel
Island
Herschel
Thetis
Bay
Osborn Pt
Catton Pt
Ptarmigan
Bay
Roland Bay
Welles Pt
Lopez Pt
Avadlek Spit
Nunaluk
Spit
River
Malcolm
Difficult
Ck
Kugaryuak
River
BUCKLAND
Loney
Ck
Okpioyuak
Firth
BRITISH
MOUNTAINS
Canyon
Glacier
River
265
270
275
280
285
290
295
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SCALE
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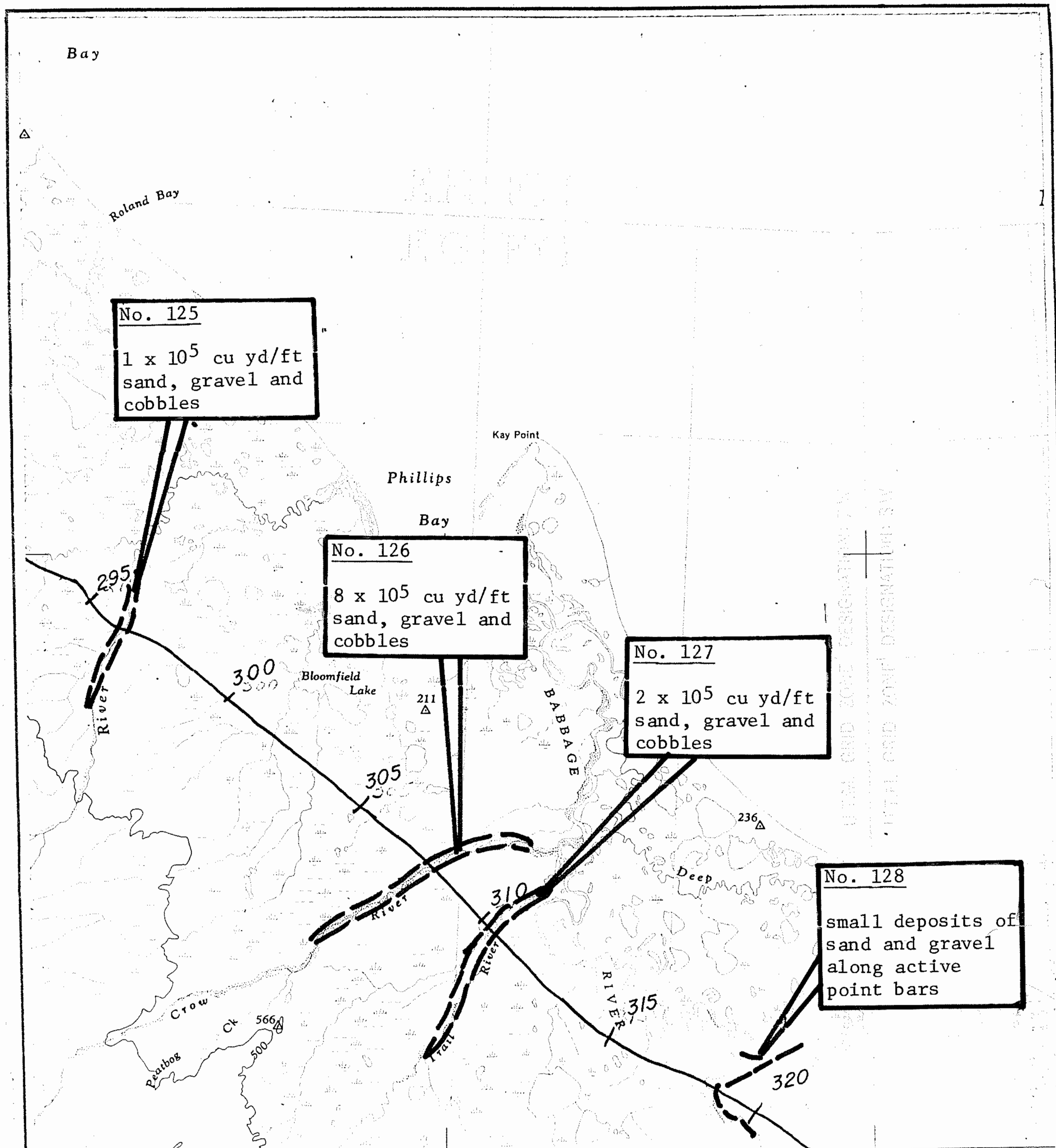
DRAWING No
51



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American Datum 1927
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n feet above Mean Sea Level

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CONSTRUCTION MATERIALS SURVEY FOR PIPE LINE ROUTE STUDY

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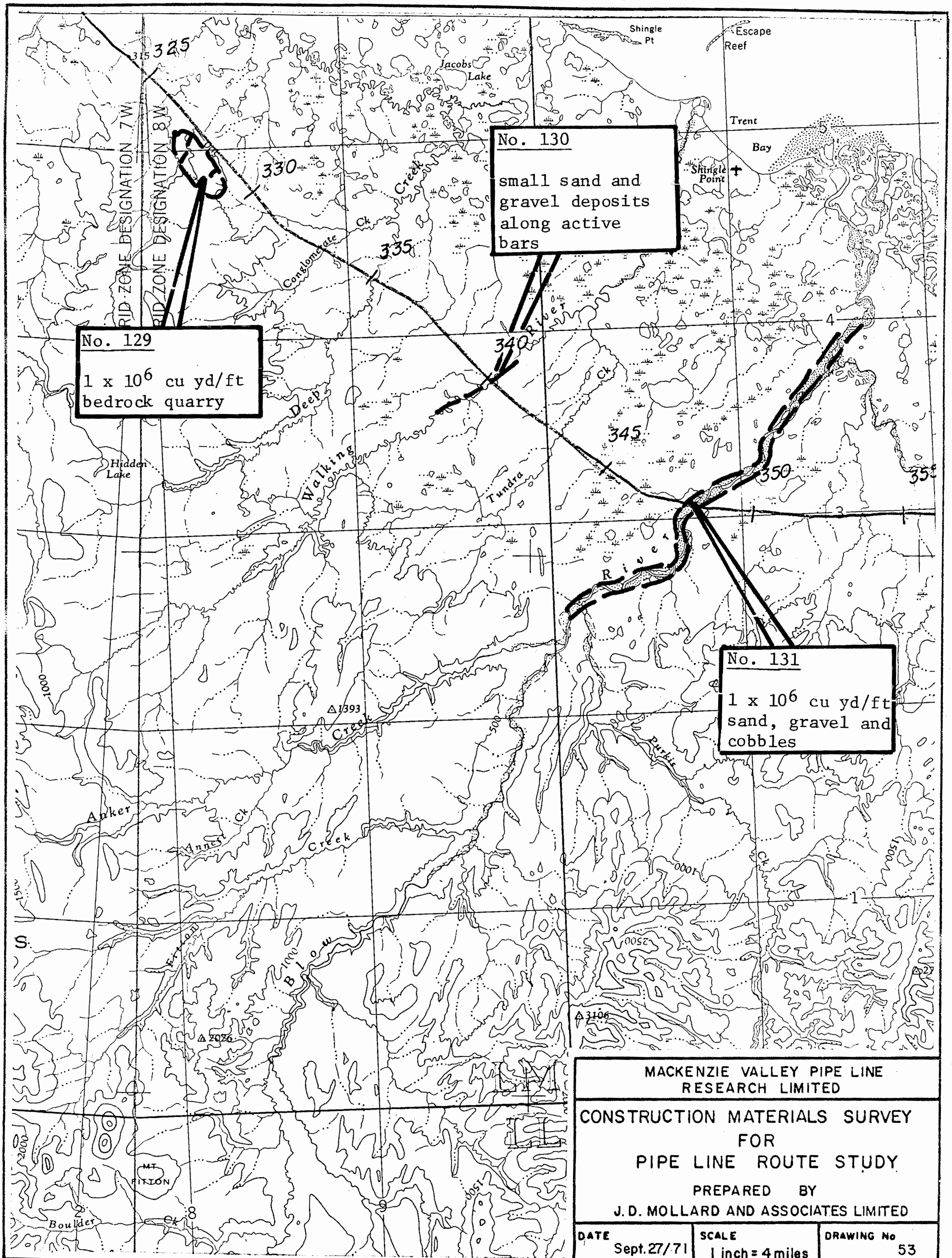
DATE	SCALE	DRAWING No
Sept. 27/71	1 inch = 4 miles	52


No. 129
1 x 10^6 cu yd/ft
bedrock quarry
No. 130
small sand and
gravel deposits
along active
bars
No. 131
1 x 10^6 cu yd/ft
sand, gravel and
cobbles
325
330
335
340
345
350
RID ZONE DESIGNATION 7W
RID ZONE DESIGNATION 8W
Shingle Pt
Escape Reef
Jacobs Lake
Trent Bay
Shingle Point
Conglomerate Ck
Creek
Deep
Walking
River
Ck
Tundra
Hidden Lake
River
Purkis
Anker
Annett Ck
Deep Creek
Creek
Blow
Ck
MT FITTON
Boulder Ck
△1393
△2026
△3106
1000
1500
2000
2500
MACKENZIE VALLEY PIPE LINE
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CONSTRUCTION MATERIALS SURVEY
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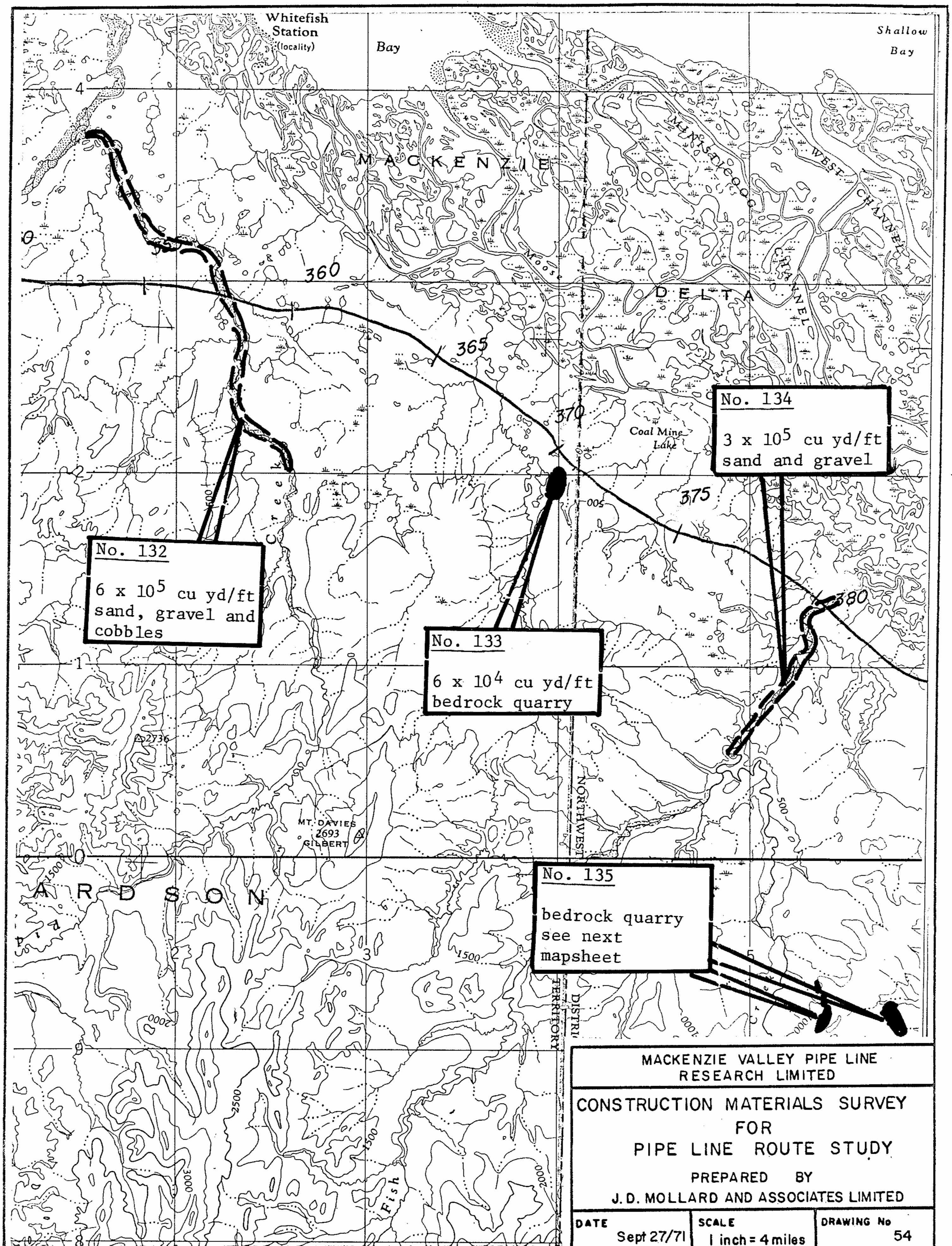
DATE
Sept. 27/71
SCALE
1 inch = 4 miles
DRAWING No
53



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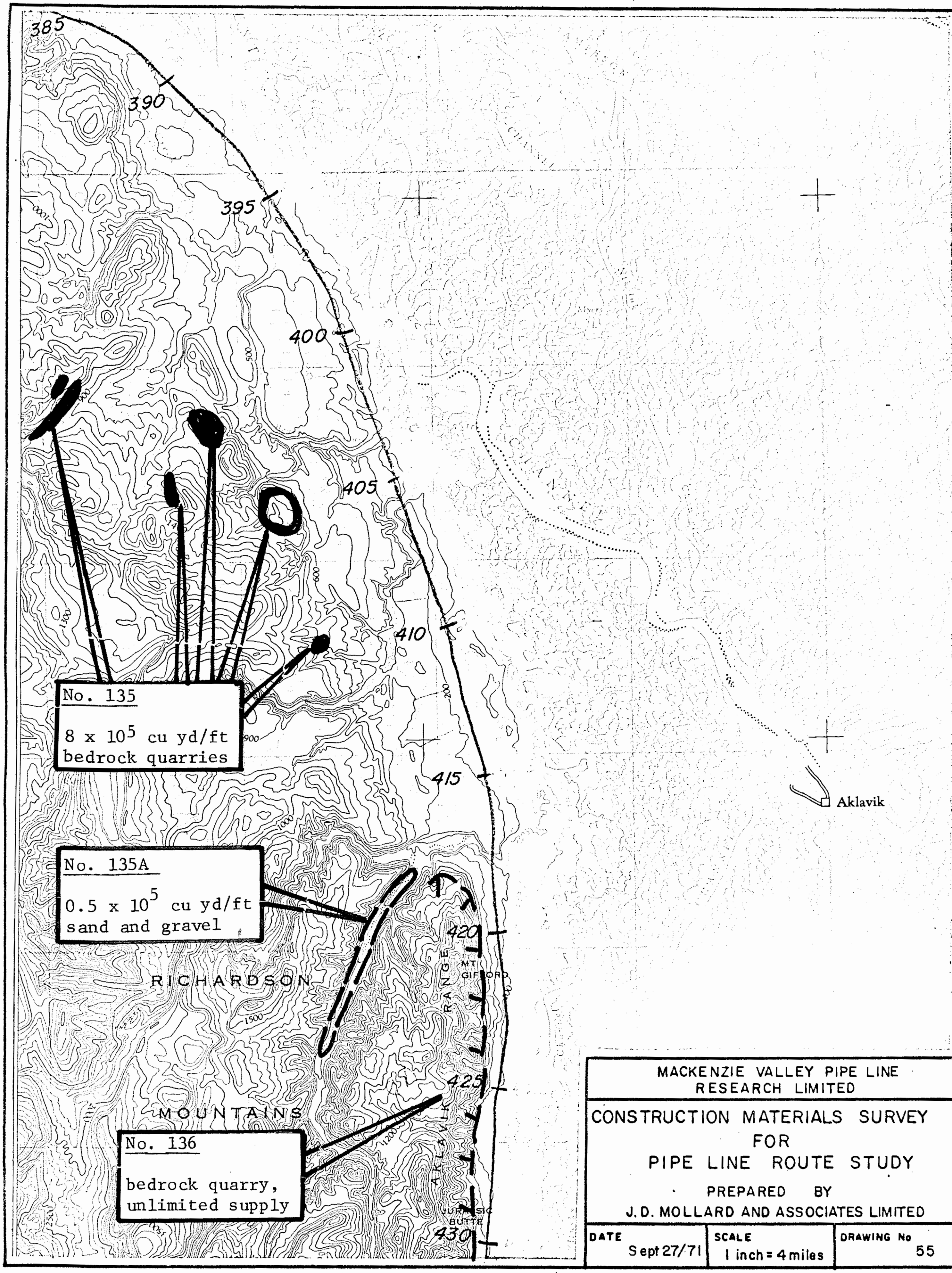
DATE	SCALE	DRAWING No
Sept 27/71	1 inch = 4 miles	54



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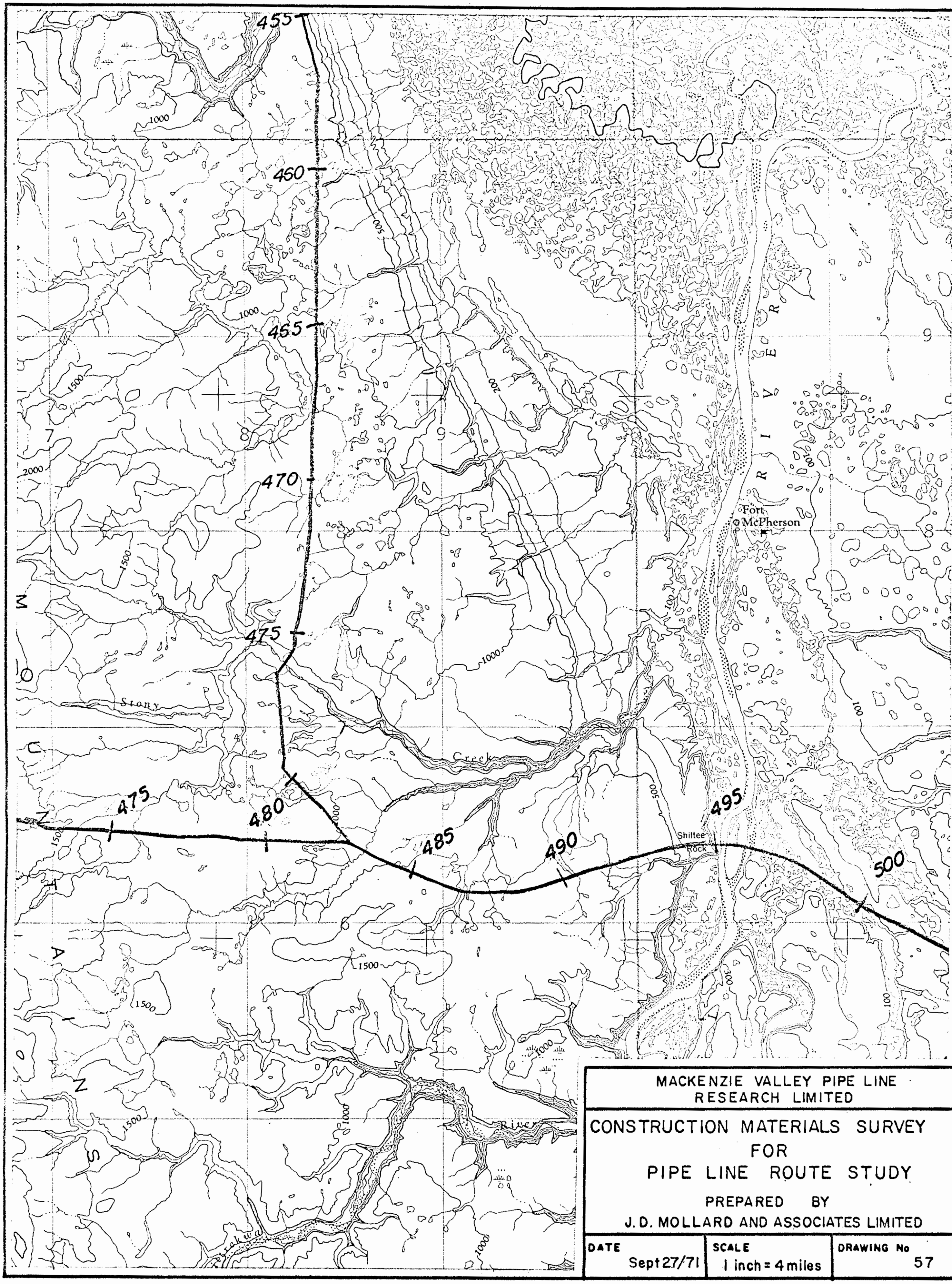
DATE	SCALE	DRAWING No
Sept 27/71	1 inch = 4 miles	55



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DATE	SCALE	DRAWING No
Sept 27/71	1 inch = 4 miles	57

END OF REPORT