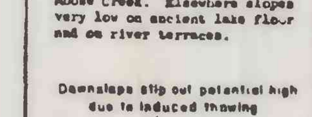
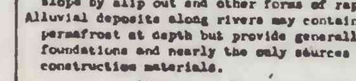
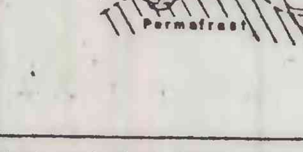
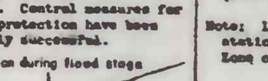
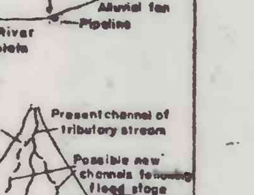
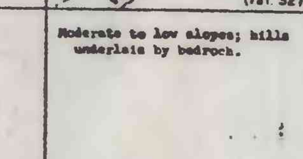
Geologic environmental factors related to TAPS from Valdez to Fairbanks, Alaska

Quadrangles	Topography	Geology of foundations and construction materials	Tectonics	Floods	Other factors	Sources of data: Numbers refer to list of sources; principal map references given first
Valdez A-7	Moderate to low slopes on subdued bedrock hills adjacent to steep mountains.	Bedrock and alluvial fans provide good foundations and possible sources of riprap and gravel respectively.	Seismic zone 3. Intensity VII-XI during 1964 earthquake, but no significant effects on bedrock. No faults mapped.	Probably not subject to flooding.	------------------------------	3, 8, 29
Valdez A-6, A-5, A-4, B-4, B-3	Steep slope south of Thompson Pass. Low to moderate slopes on bedrock benches adjacent to Keystone Canyon and Tsina River. Elsewhere slopes are low along pipeline route.	Fine-grained deposits below Worthington Glacier and in upper Tiekel valley contain discontinuous permafrost and may be subject to frost heave and differential settlement. Areas of rubble on steep slope may be subject to downslope movement under load. Bedrock and coarse-grained alluvium provide good foundations and possible sources of riprap and gravel respectively.	Seismic zone 3. Intensity VII-XI during 1964 earthquake; severe ground breakage extensive in alluvium along Lowe River, locally elsewhere in alluvium; no significant effects on bedrock. No faults mapped. Lineaments and joint sets seem to have no apparent significant bearing on pipeline integrity.	Lowe River valley subject to flooding. Potential washout problems on Bear Creek, Sheep Creek and other alluvial fan crossings as channel changes occur. Sudden release of water from glacier dammed lakes may cause exceptional scour along Bear Creek, Sheep Creek, and Lowe River.	Avalanche and snowslide potential high locally between Keystone Canyon and Upper Tiekel River valley.	3, 6, 7, 17, 19, 29
Valdez C-4, D-4, Gulkana A-3, A-4	Steep slopes on bluffs in unconsolidated deposits at several valley crossings and marginal to Tonsina River and Moose Creek. Elsewhere slopes very low on ancient lake floor and on river terraces.  CROSS SECTION OF PIPELINE PARALLEL TO TERRACE MARGINS	Permafrost present within a few feet of the surface in fine-grained lake deposits that locally contain numerous lenses of clear ice; on flat ground differential settlement and locally complete loss of bearing strength result from thawing; on steep slopes thawing can result in complete failure of slope by slip out and other forms of rapid erosion. Alluvial deposits along rivers may contain sporadic permafrost at depth but provide generally good foundations and nearly the only sources of construction materials.  LONGITUDINAL SECTION OF PIPELINE CROSSING RIVER VALLEYS	Seismic zone 2. Intensity VII-XI during 1964 earthquake; moderate to minor local ground breakage. No faults mapped.	Tonsina, Klutina, and Tazlina River valleys subject to flooding; depth of potential scour not known. Sudden release of water from glacier-dammed lakes may cause exceptional scour along Tonsina and Tazlina Rivers.	Talik problem: within the area of lake deposits local areas that are marshes in summer do not freeze in winter as deep as the top of the permafrost table; an unfrozen layer (talik) of water or water saturated material 1-2 ft thick thus exists under hydrostatic pressure between the seasonal frost layer (about 2 ft thick) and permafrost. During winter excavation, when the seasonal frost is penetrated, large volumes of water can be released, causing severe icing problems. (ref. 10)	5, 9, 10, 17, 19, 20, 29
Gulkana B-3, B-4	Steep slopes on bluffs in unconsolidated deposits at Gulkana River crossing. Very low slopes on deposits of ancient lake floor.	----do--	Seismic zone 2. Intensity VII-XI during 1964 earthquake; minor local ground breakage. No faults mapped.	Probably not subject to floods.	Potential talik problem. See above.	5, 9, 10, 11, 12, 17, 29
Gulkana C-3	Low to moderate slopes along margins of subdued bedrock hills. Low slopes on ancient lake floor deposits and associated shore features.	Permafrost present within a few feet of the surface in fine-grained lake deposits that locally contain numerous lenses of clear ice; differential settlement and locally complete loss of bearing strength result from thawing. Hills of granite and greenstone provide good foundations and greenstone may provide riprap. Gravel may be available locally from lake shore deposits around hills.	Seismic zone 2. Intensity II-VI during 1964 earthquake; no significant ground breakage effects. No faults mapped.	No floods anticipated.	Potential talik problem. See above.	5, 9, 10, 11, 12, 29
Gulkana D-3	Low to moderate slopes along margins of subdued bedrock hills and on intervening moraines. Low slopes on ancient lake floor and associated shore features.	Permafrost present within a few feet of the surface in fine-grained lake deposits that locally may contain lenses of clear ice; differential settlement and locally complete loss of bearing strength result from thawing. Moraines and lake shore features contain permafrost but provide generally good foundations; gravel available locally. Bedrock hills provide good foundations; riprap may be available from greenstone.	----do--------------------------	----do-----------------------	Potential talik problem. See above.	5, 9, 10, 11, 12, 29
Mount Hayes A-3, A-4	Low to moderate slopes on hummocky moraines and related features. Low slopes on river flood plains.	Moraines and related features contain discontinuous permafrost but provide generally good foundations except in some depressions underlain by peat and fine-grained material. River alluvium contains only sporadic permafrost and provides good foundations except for high water table near rivers and in areas of peat and silt deposits near Gulkana River and Fish Creek.	----do--------------------------	Floods possible along Phelan Creek and Gulkana River.	------------------------------	5, 24, 29
Mount Hayes B-4	Low to moderate slopes on hummocky moraines and related features. Low slopes on river flood plains and on alluvial fans.	Moraines and related features contain discontinuous permafrost but provide generally good foundations except in some depressions underlain by peat and fine-grained material. Alluvium contains only sporadic permafrost and provides good foundations except for high water table near Delta River. 	Seismic zone 2. Pipeline crosses Denali Fault Zone. No historic displacement recorded on this segment, but 3 miles west of pipeline 10-20 ft of vertical displacement appears on postglacial alluvial fan. (ref. 27) Within 100 miles east and west of here the following displacements have been recorded: (refs. 14, 27) up to 7 km right lateral during Pleistocene; up to 0.4 km right lateral during Holocene; at least 6 m apparent vertical during Holocene. Microseismic activity on Denali Fault Zone about 10 microquakes per day, magnitude less than minus one on short term observation. (ref. 1) ". . . the Denali Fault is active in some sense along its entire length east of Mount McKinley . . . and it should not be dismissed as a relic fault of no current tectonic importance." (ref. 1) Detailed mapping south of Denali Fault Zone shows rocks intricately faulted (refs. 16, 28)	Flooding and concomitant channel changes along Delta River and tributary alluvial fans possible. Control measures for highway protection have been reasonably successful.  	Castner and Canwell glaciers possibly subject to surging. (ref. 26) Note: Location of pumping station within Denali Fault Zone considered inappropriate.	1, 2, 14, 16, 18, 22, 24, 26, 27, 28, 29
Mount Hayes C-4	Moderate to locally steep side-hill slopes along margin of moraine-covered bedrock upland. Low slopes on river flood plain and on alluvial fans.	Moraines and related features contain discontinuous permafrost but provide generally good foundations except on locally steep hillside slope where this morainal and alluvial deposits overlying bedrock may be subject to differential settlement and downslope movement. Alluvium contains only sporadic permafrost and provides good foundations except for high water table near Delta River.	On boundary between seismic zones 2 and 3. No faults mapped.	----do-----------------------	Black Rapids Glacier has surged in historic time (1936-37). (ref. 15)	15, 24, 26, 29
Mount Hayes D-4	Low to moderate slopes on hummocky moraines. Low slopes on broad outwash plains.	Outwash and morainal deposits contain sporadic to discontinuous permafrost, but provide good foundations except for one area of silt and peat with permafrost at shallow depth that could be avoided easily. Outwash provides extensive source of gravel.	On boundary between seismic zones 2 and 3. Postglacial fault scarp 10-15 ft high extends to about 1 mile east of pipeline.	Flooding possible at Delta River crossing.	------------------------------	23, 29
Big Delta A-4	----do--------------------	----do--	Seismic zone 3. No faults mapped.	No floods anticipated.	------------------------------	24, 29
Big Delta A-5, B-5, B-6, C-6	Moderate slopes on hummocky moraines and on sides of smooth loess-covered bedrock hills and ridges. Low slopes on river terraces and ridgetops.	Alluvial silt in valleys north of the Tanana River contains extensive permafrost within a few feet of the surface; upon disturbing the ground surface differential settlement and locally complete loss of bearing strength can result from thawing. Eolian silt on hill slopes contains permafrost at depths greater than 10 ft if at all; silt is generally stable but subject to rapid gullying and locally to frost heave; downslope movement could be significant where pipeline parallels slope. Foundations good in bedrock on ridgetops and on moraines and alluvium. Gravel plentiful along and south of Tanana River, but scarce to the north.	Seismic zone 3. Local seismic epicentral area; landslides, sand boils, ground cracks, and high water near Salcha Bluff reported following 1937 earthquake (ref. 3).	Tanana and Salcha River crossings subject to flooding.	------------------------------	3, 18, 29, 30, 31
Fairbanks C-1	Low slopes on river terraces.	Alluvial silt contains extensive permafrost up to a few feet of the surface; sand and gravel may be present at variable depth; differential settlement and locally complete loss of bearing strength result from thawing.	Seismic zone 3. Seismically active area during historic time; within 3 miles of pipeline ground cracks, sand boils, and high water reported following 1937 earthquake (ref. 3). Faults that break surface not known.	No floods anticipated.	------------------------------	3, 25, 29
Fairbanks D-1	Moderate to low slopes; hills underlain by bedrock. Low slopes on river terraces. 	Alluvial silt contains extensive permafrost within a few feet of the surface in swales, deeper elsewhere; sand and gravel present at variable depth; differential settlement and locally complete loss of bearing strength result from thawing. Eolian silt on hill slopes contains permafrost at depths greater than 10 ft if at all; silt is generally stable when dry but subject to rapid gullying; locally subject to frost heave where poorly drained. Foundations good in bedrock on ridgetops. Gravel sources quite limited.	Seismic zone 3. Seismically active during historic time; 1967 earthquake epicentral area within 4 miles of pipeline; earthslides and broken water pipes reported (ref. 13).	Chena River subject to flooding (ref. 4).	------------------------------	4, 13, 29, 32
Fairbanks D-2	Moderate to low slopes; hills underlain by bedrock.	Eolian silt on hill slopes contains permafrost at depths greater than 10 ft if at all; silt is generally stable when dry but subject to rapid gullying; locally subject to frost heave where poorly drained. Foundations good in bedrock on ridgetops. Gravel available in Goldstream Creek valley.	Seismic zone 3. Seismically active during historic time; 1967 earthquake epicentral area within 6 miles of pipeline; earthslides and broken water pipes reported (ref. 13). No faults mapped near pipeline.	No floods anticipated.	------------------------------	13, 21, 29

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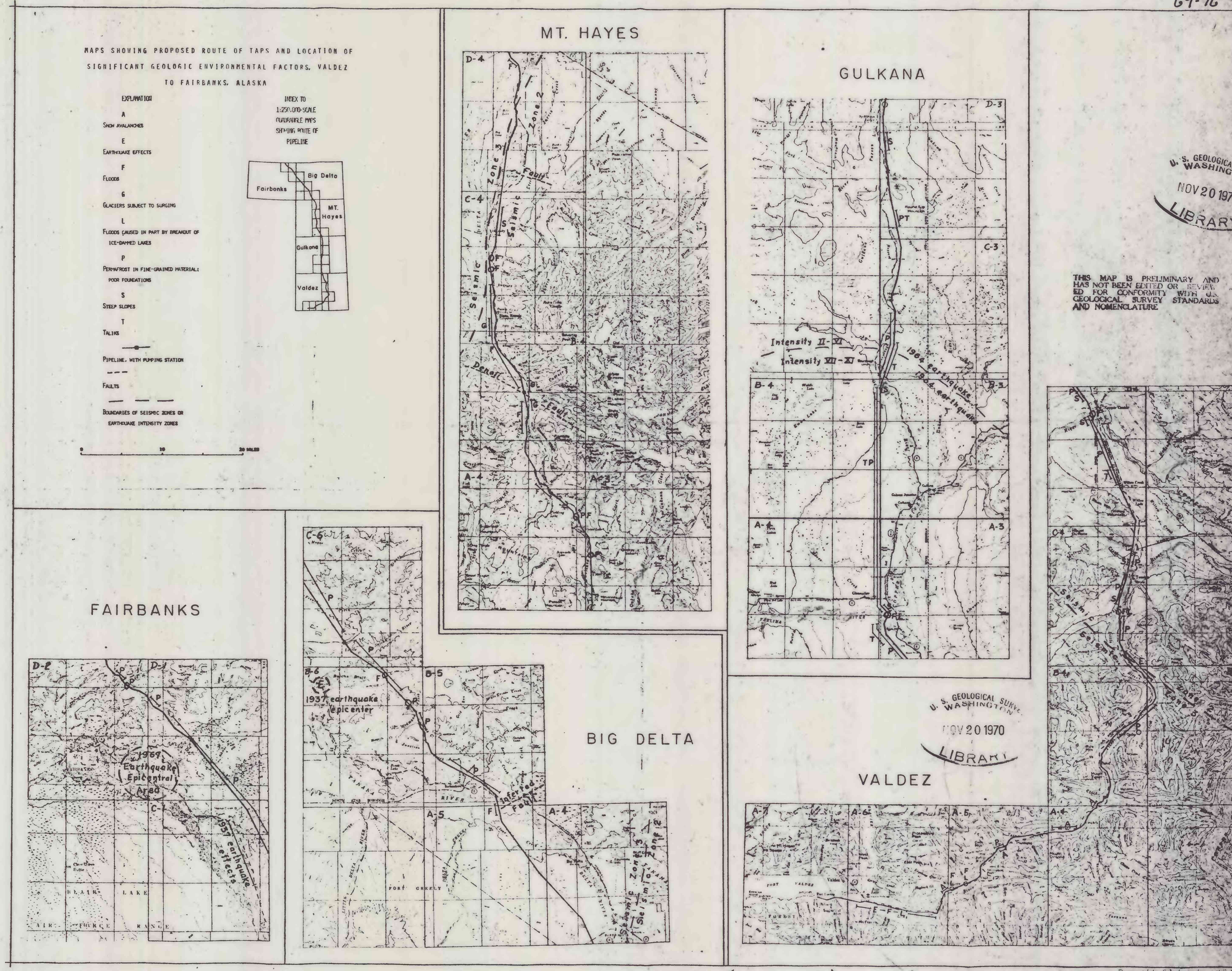

MAPS SHOWING PROPOSED ROUTE OF TAPS AND LOCATION OF SIGNIFICANT GEOLOGIC ENVIRONMENTAL FACTORS, VALDEZ TO FAIRBANKS, ALASKA
EXPLANATION
A
Snow avalanches
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Earthquake effects
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Floods
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Glaciers subject to surging
L
Floods caused in part by breakout of ice-dammed lakes
P
Permafrost in fine-grained material: poor foundations
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Steep slopes
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Pipeline, with pumping station
Faults
Boundaries of seismic zones or earthquake intensity zones
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10
20 MILES
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Valdez
MT. HAYES
GULKANA
FAIRBANKS
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VALDEZ
Intensity II-VI
Intensity VII-XI
1964 earthquake
1937 earthquake epicenter
1967 Earthquake Epicentral Area
1937 earthquake effects
Inferred Fault
BLAIR LAKE
AIR FORCE RANGE
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