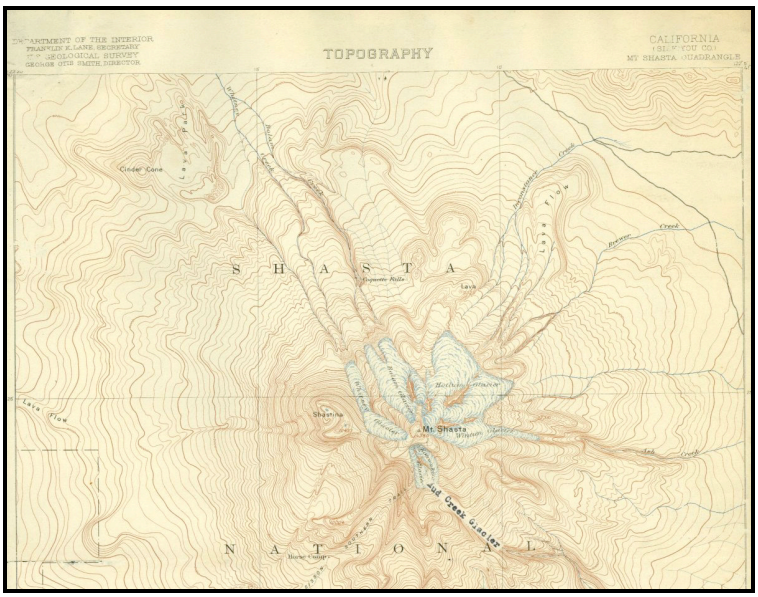
APPENDIX A

HISTORIC PHOTOS OF THE 1924 MUD CREEK LAHAR

This set of historic photos is part of the Mount Shasta Collection available at the College of the Siskiyous Library in Weed, California. The collection, established and developed by Dennis Freeman and Bill Miesse is the largest repository of information and documents about Mount Shasta. The collection consists of thousands of books, articles, manuscripts, photographs, maps, prints, and audiovisual materials about the Mount Shasta volcano and surrounding area. The photos shown here were made available online courtesy of the McCloud Fly Fishing Club at http://www.siskiyous.edu/shasta/env/mudflow/. The album is copyrighted (1924) by Morton & Co. of San Francisco. It shows photographs of the 1924 Mud Creek debris flow with original annotations. At the time, Mount Shasta City had the name Sisson, after Justin Hinckley Sisson, who arrived in 1853 and established the town. This photo collection is a good primary source for reconstructing the series of events which led to the mudflows of 1924 near McCloud, California.

APPENDIX A: HISTORIC PHOTOS OF THE 1924 MUD CREEK LAHAR

Photo 1: Mount Shasta from Sisson



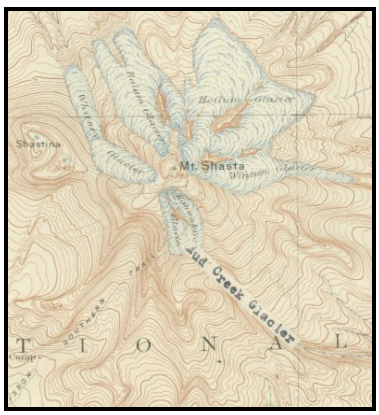
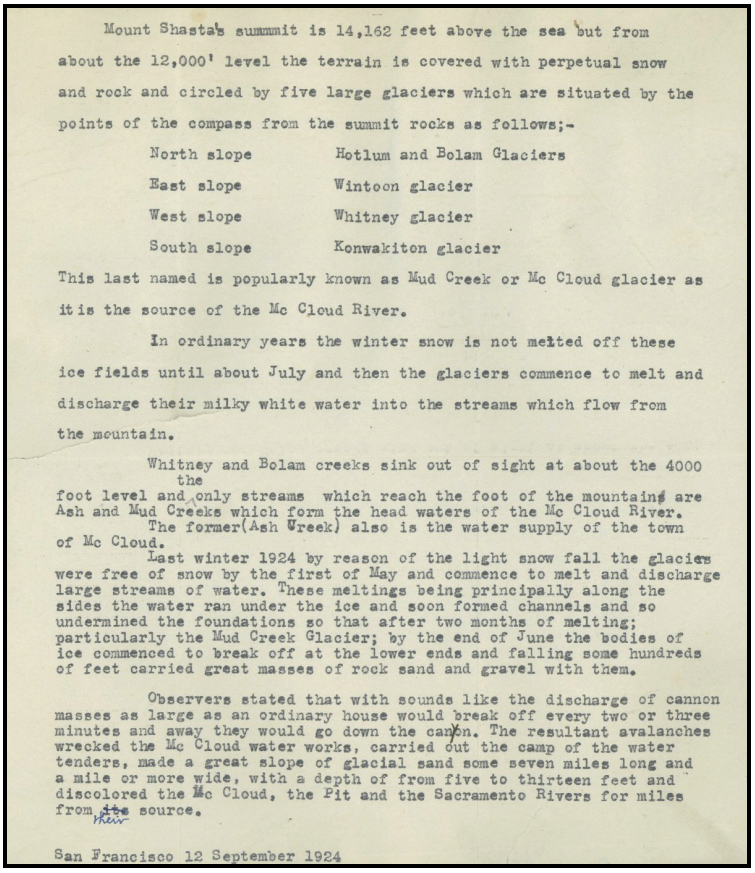


Photo 2: Mount Shasta Topographic Map with glaciers close-up



Mount Shasta's summit is 14,162 feet above the sea but from about the 12,000' level the terrain is covered with perpetual snow and rock and circled by five large glaciers which are situated by the points of the compass from the summit rocks as follows;-

North slope	Hotlum and Bolam Glaciers
East slope	Wintoon glacier
West slope	Whitney glacier
South slope	Konwakiton glacier

This last named is popularly known as Mud Creek or Mc Cloud glacier as it is the source of the Mc Cloud River.

In ordinary years the winter snow is not melted off these ice fields until about July and then the glaciers commence to melt and discharge their milky white water into the streams which flow from the mountain.

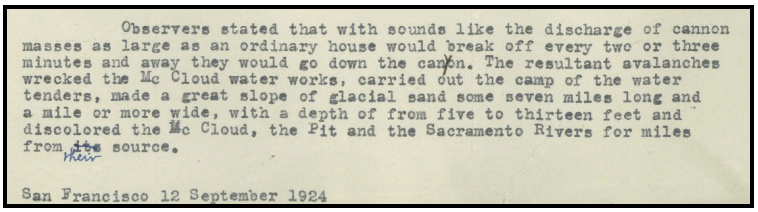
Whitney and Bolam creeks sink out of sight at about the 4000 foot level and only streams which reach the foot of the mountains are Ash and Mud Creeks which form the head waters of the Mc Cloud River. The former(Ash Creek) also is the water supply of the town of Mc Cloud.

Last winter 1924 by reason of the light snow fall the glaciers were free of snow by the first of May and commence to melt and discharge large streams of water. These meltings being principally along the sides the water ran under the ice and soon formed channels and so undermined the foundations so that after two months of melting; particularly the Mud Creek Glacier; by the end of June the bodies of ice commenced to break off at the lower ends and falling some hundreds of feet carried great masses of rock sand and gravel with them.

Observers stated that with sounds like the discharge of cannon masses as large as an ordinary house would break off every two or three minutes and away they would go down the canon. The resultant avalanches wrecked the Mc Cloud water works, carried out the camp of the water tenders, made a great slope of glacial sand some seven miles long and a mile or more wide, with a depth of from five to thirteen feet and discolored the Mc Cloud, the Pit and the Sacramento Rivers for miles from ~~its~~ their source.

San Francisco 12 September 1924

Photo 3: Introduction



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San Francisco 12 September 1924

Photo 4: Introduction, part 2

Photo 5: Overhanging Mud Creek Glacier Terminus

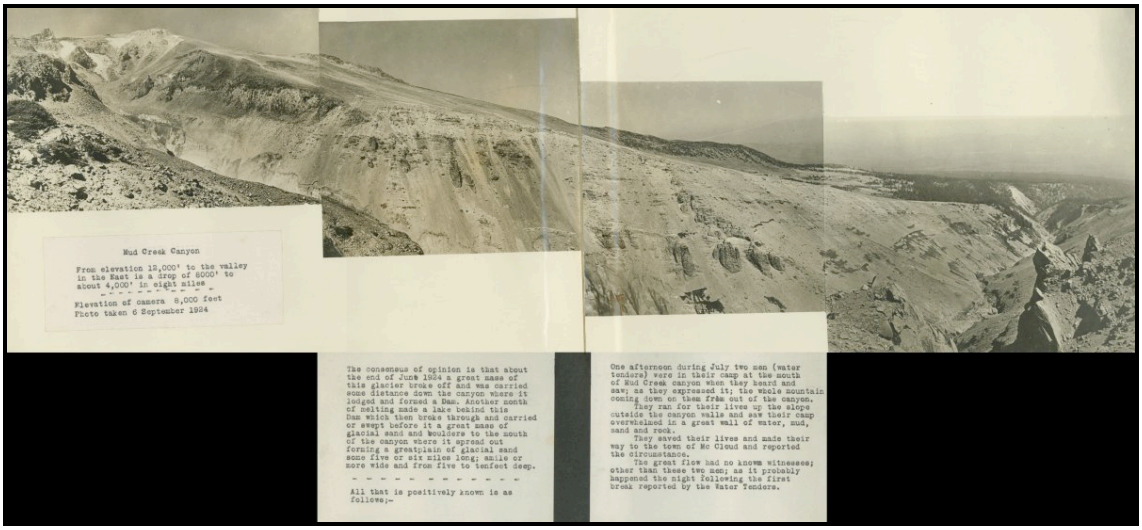

Photo 6: Panorama of debris source area: Mud Creek Canyon

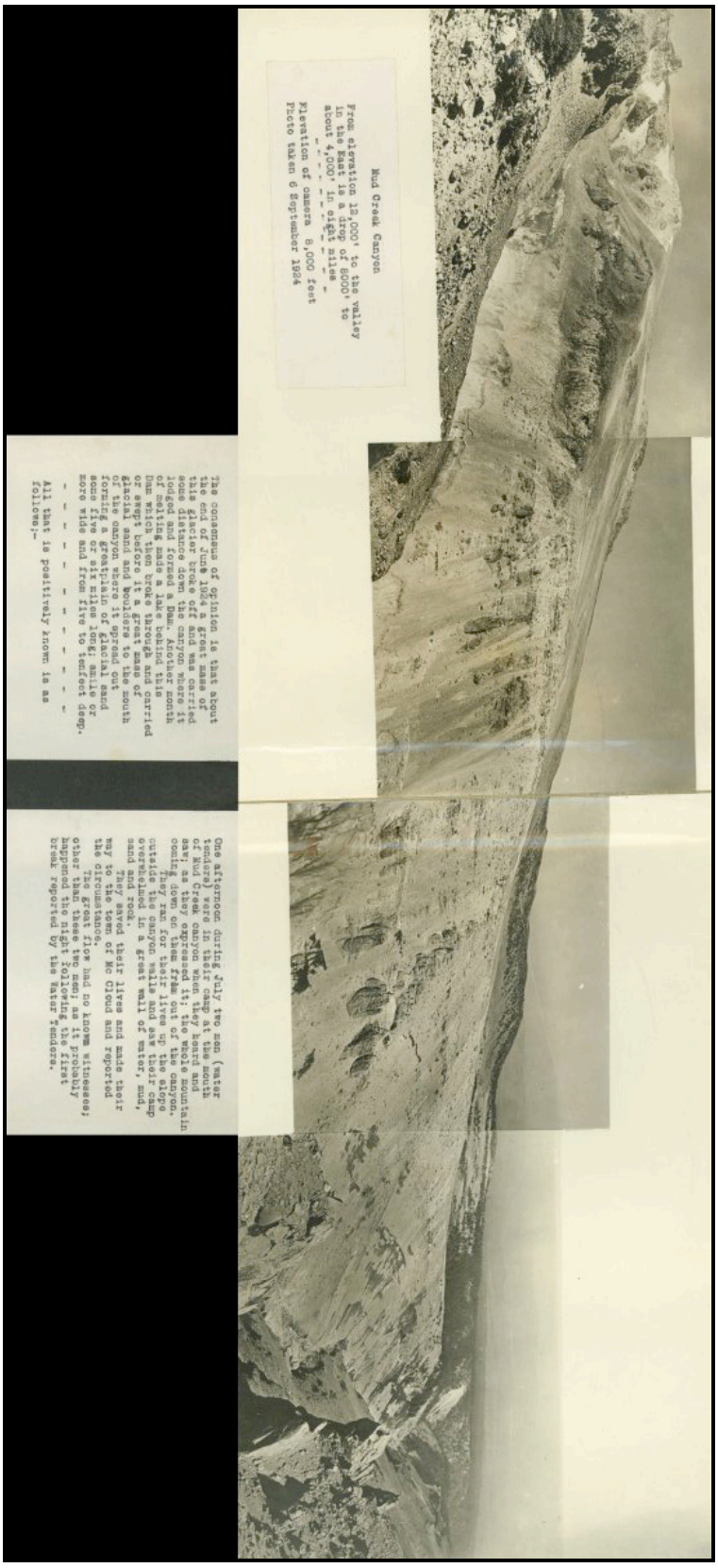

Photo 6a (enlarged): Panorama of debris source area: Mud Creek Canyon

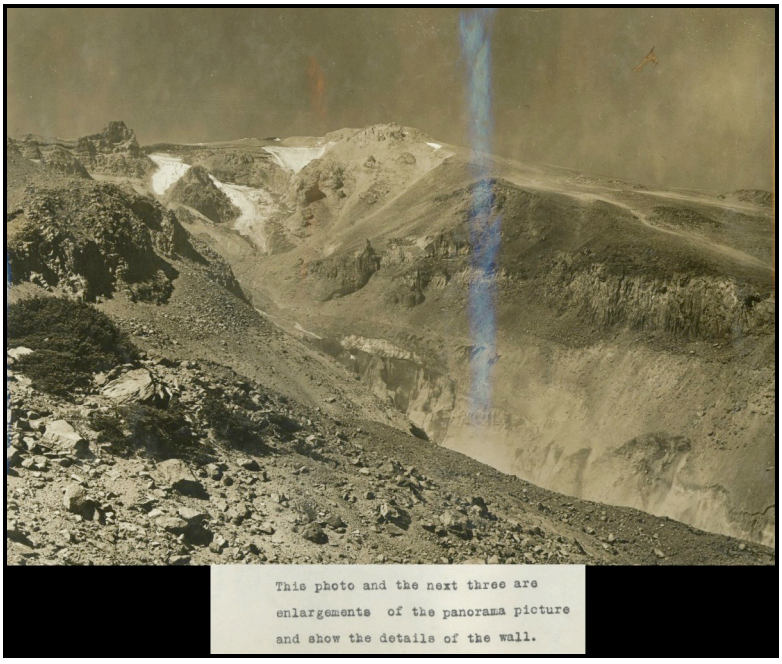

Photo 7: Part 1 of Mud Creek Canyon

Photo 8: Part 2 of Mud Creek Canyon

Photo 9: Part 3 of Mud Creek Canyon

Photo 10: Part 4 of Mud Creek Canyon

Photo 11: Terminus of the Mud Creek Glacier

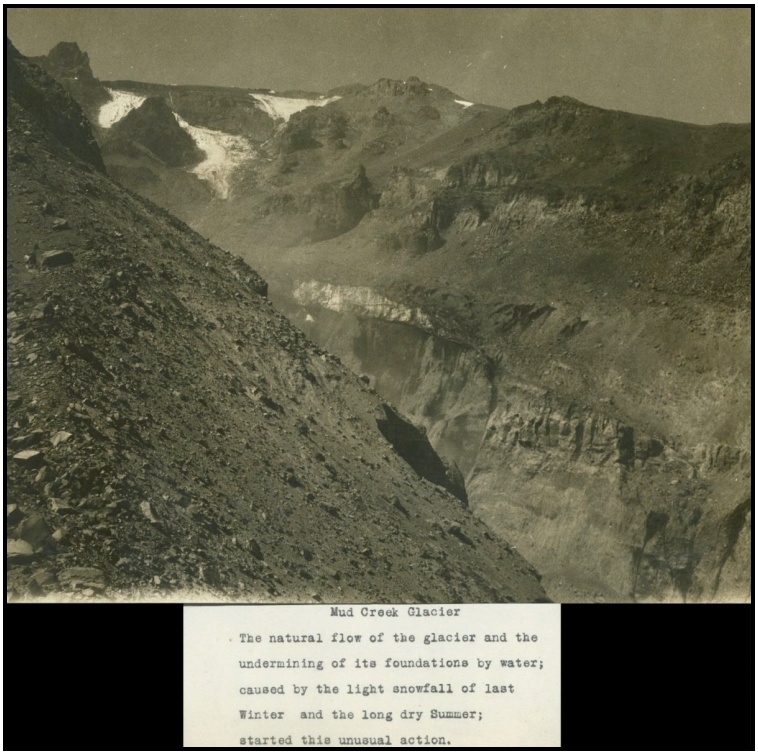

Photo 12: The Mud Creek Glacier from below the canyon wall

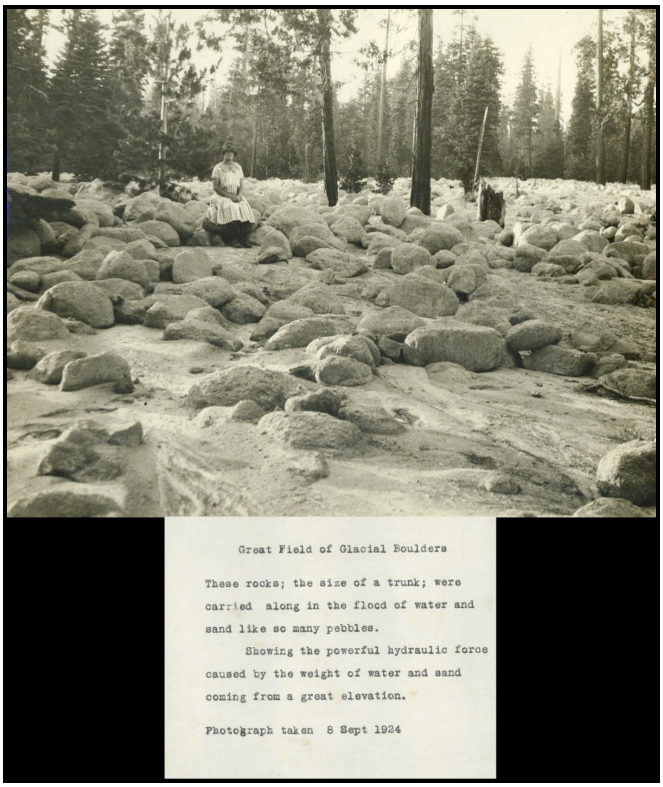

Photo 13: Field of boulders left along Mud Creek

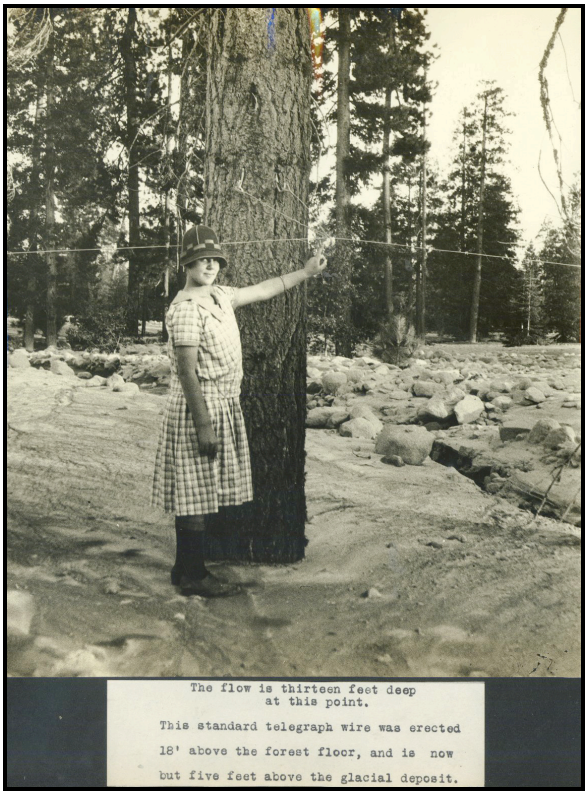

Photo 14: Indicators of the flow depth

Photo 15: Aftermath of the debris flow in the stream channel

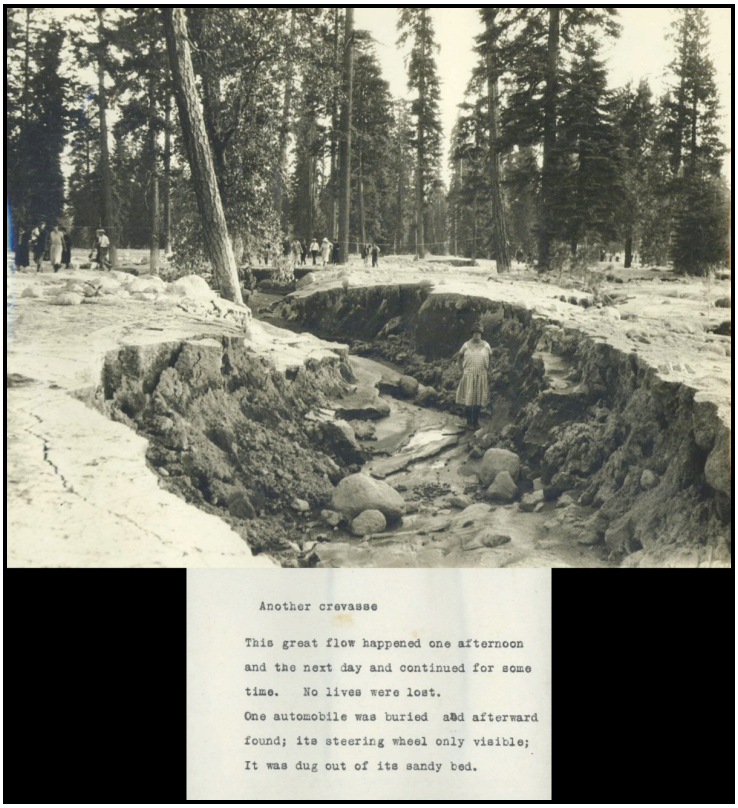

Photo 16: Depth of deposited material incised by stream flow

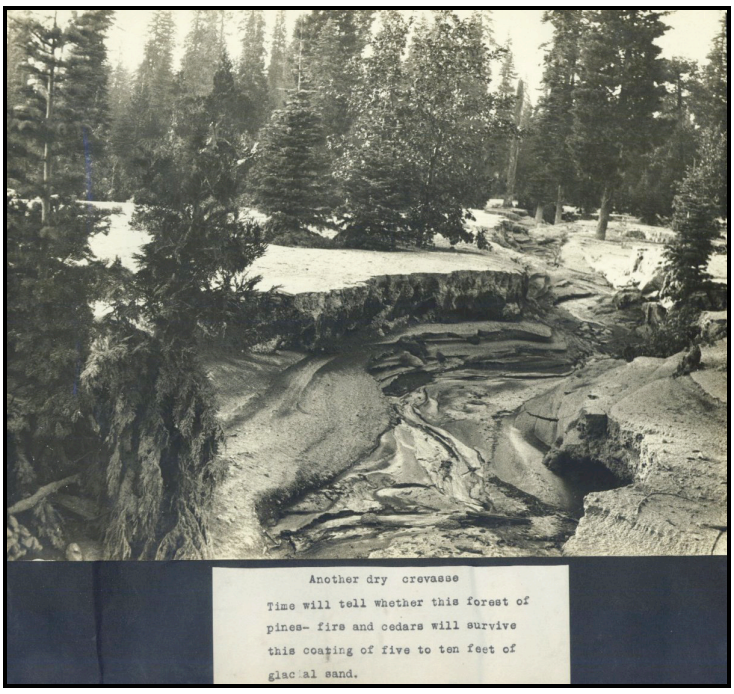

Photo 17: Mud Creek in the most heavily affected area

Photo 18: Mud Creek in the most heavily affected area

APPENDIX B

AERIAL PHOTOGRAPHY USED: WHITNEY CREEK 2003 AND MUD CREEK 1944

The following samples of air photos used in the study of Mud and Whitney Creek lahars were obtained from the USFS McCloud Ranger District Manager's office in McCloud, California. The first set of 12 Whitney Creek 2003 air photos were scanned from prints at a scale of 1:15,840. These photos were useful in the comparison of mapped 1935 lahar deposits with the extent of the 1997 flow (Fig. 6) and in a volume estimation for the 1997 lahar. The 1944 Mud Creek air photo shows the affected area 13 yr after the 1921-1931 series.

WHITNEY CREEK AND JUNIPER FLAT SERIES, 2000 AND 2001

Courtesy of Peter Van Susteren, USFS McCloud Ranger Station

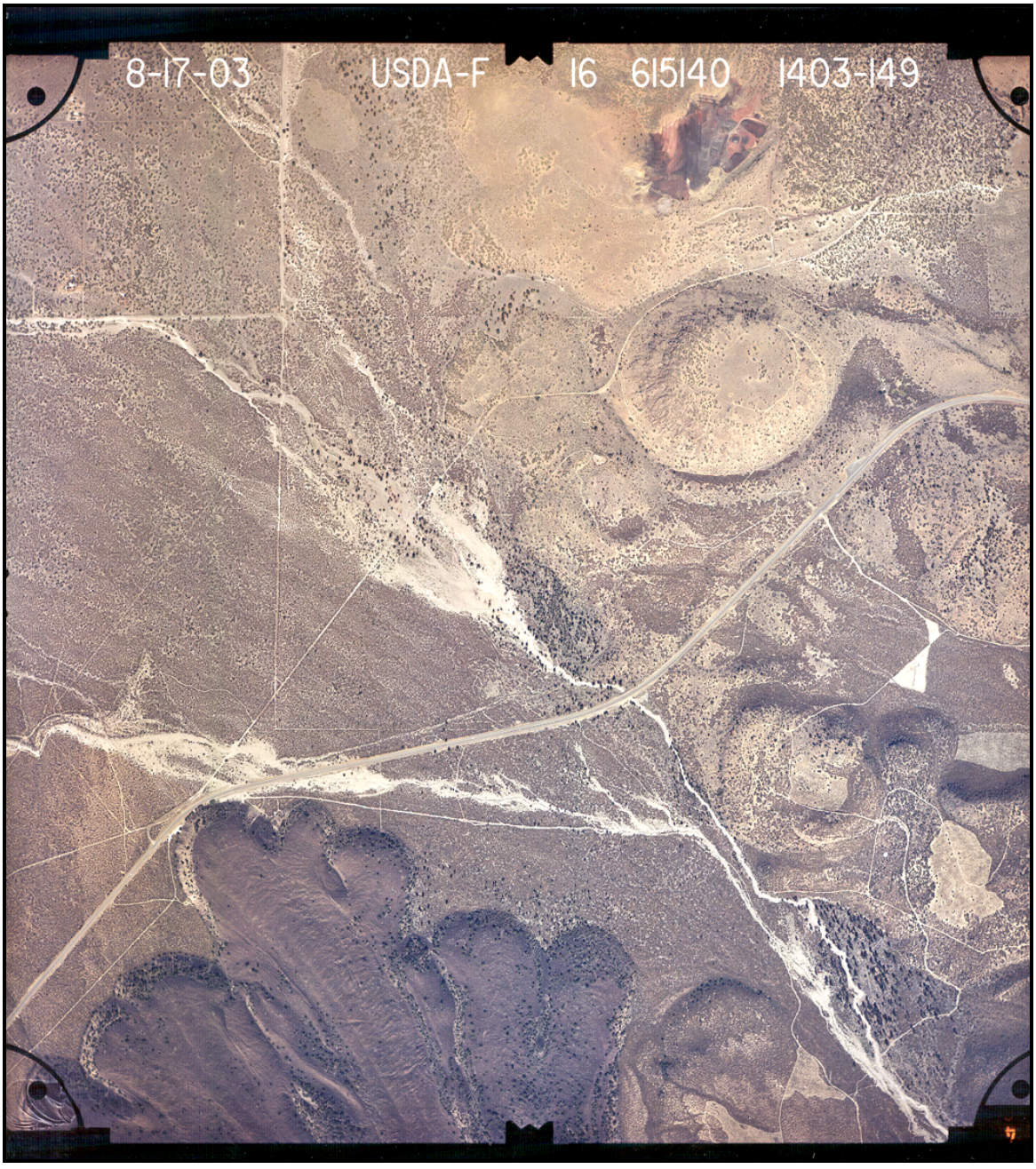

Figure B1: Whitney Creek at the intersection with U.S.97

MUD CREEK 1944 AIR PHOTO

Courtesy of Peter Van Susteren, USFS McCloud Ranger Station

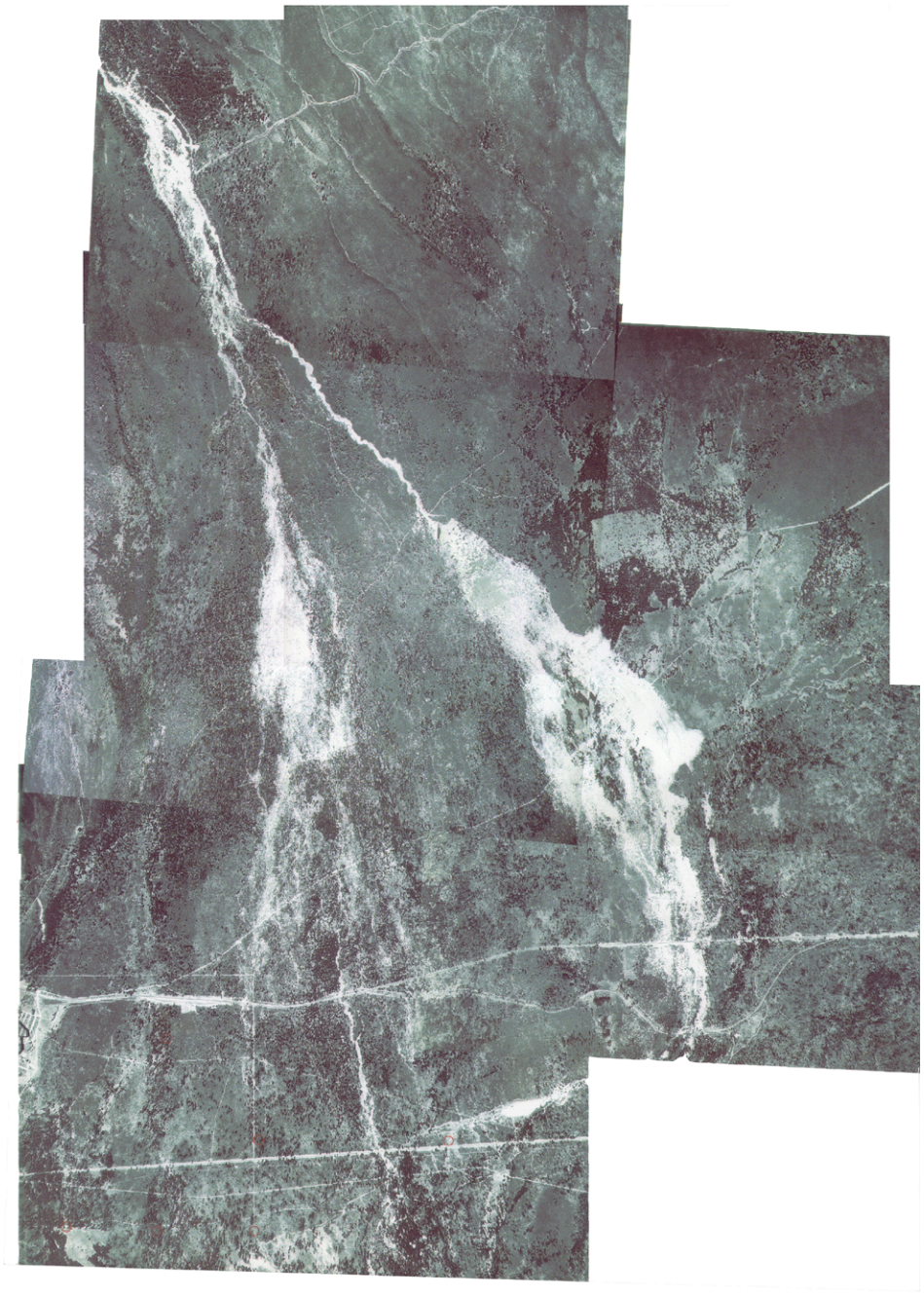

Figure B2: Entire length of the 1924-1931 Mud Creek debris flow series as it crosses Highway 89.

APPENDIX C

PREVIOUS LAHAR HAZARD MAPS OF MOUNT SHASTA, CA.

1980 LAHAR HAZARD MAP BY D. MILLER

The 1980 lahar hazard map by D. Miller includes three hazard zones ranging from (A) areas that are most likely to be affected by lahars to (C), areas that are likely to be affected the least. As the hazard decreases everywhere within the zones with greater height above stream channels and with greater distance from Mount Shasta, no lahar hazard exists on high areas within or beyond the zones. The northeastward tendency of the high hazard zones is a reflection of the presence of glaciers on that side of the volcano.

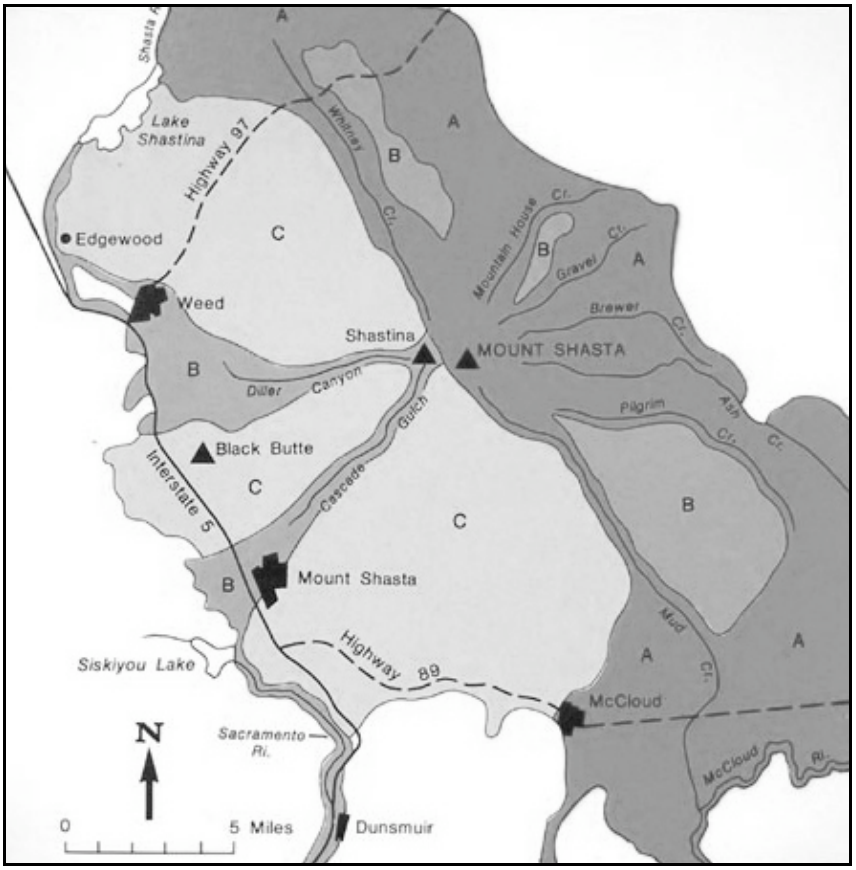

Figure C1: Mount Shata mudflow hazard map by Miller (1980)

1986 DEBRIS FLOW HAZARD ZONES FOR WHITNEY AND MUD CREEK BY W. OSTERKAMP

Scanned from Osterkamp et al. (1986), the hazard gradations shown in shades of pink correspond to the probability that a given area will be affected by debris flow activity within the next 100 yr. The high risk areas of most frequent activity are shown in darker shades and the risk decreases progressively to lighter shades. The hazard zones are based on geological and dendrogeomorphic field evidence from Osterkamp, W. R., Hupp, C. R., and Blodgett, J. C. (1986).

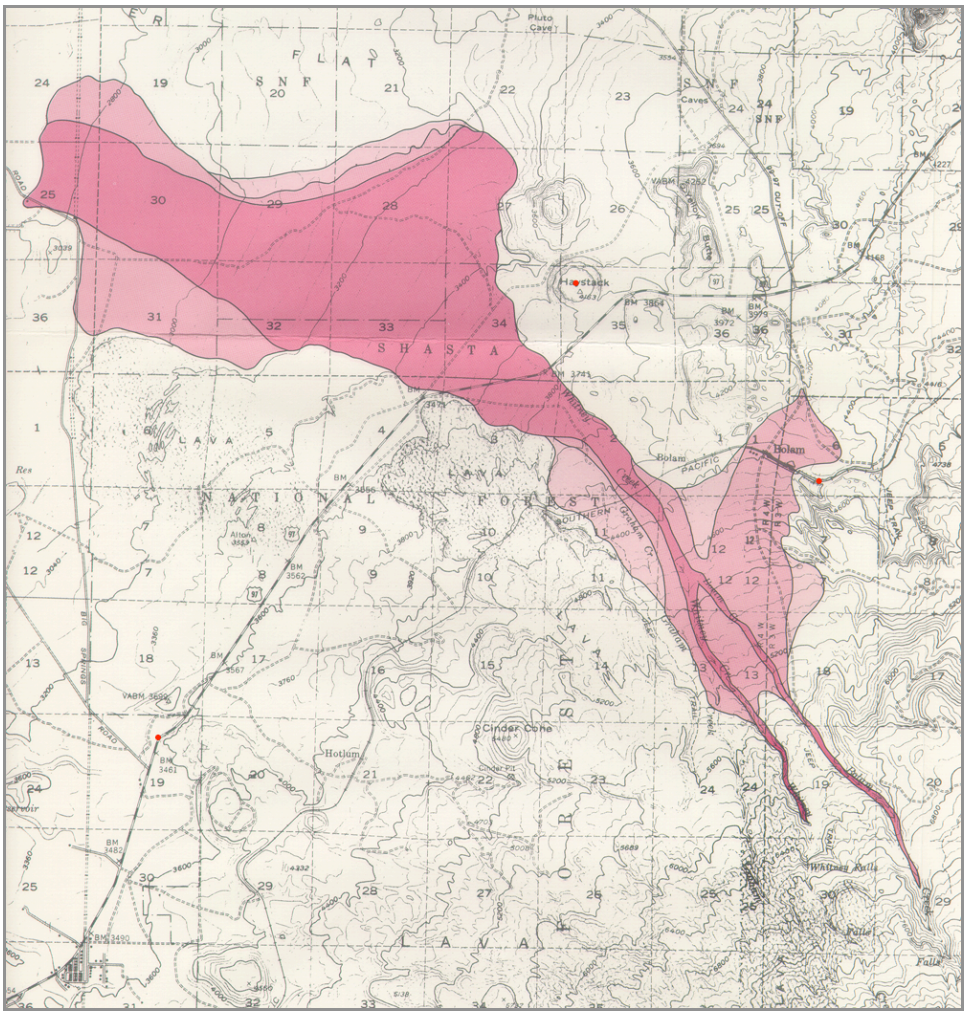

Figure C2: Scanned debris flow hazard map for the Whitney Creek drainage from Osterkamp et al. (1986)

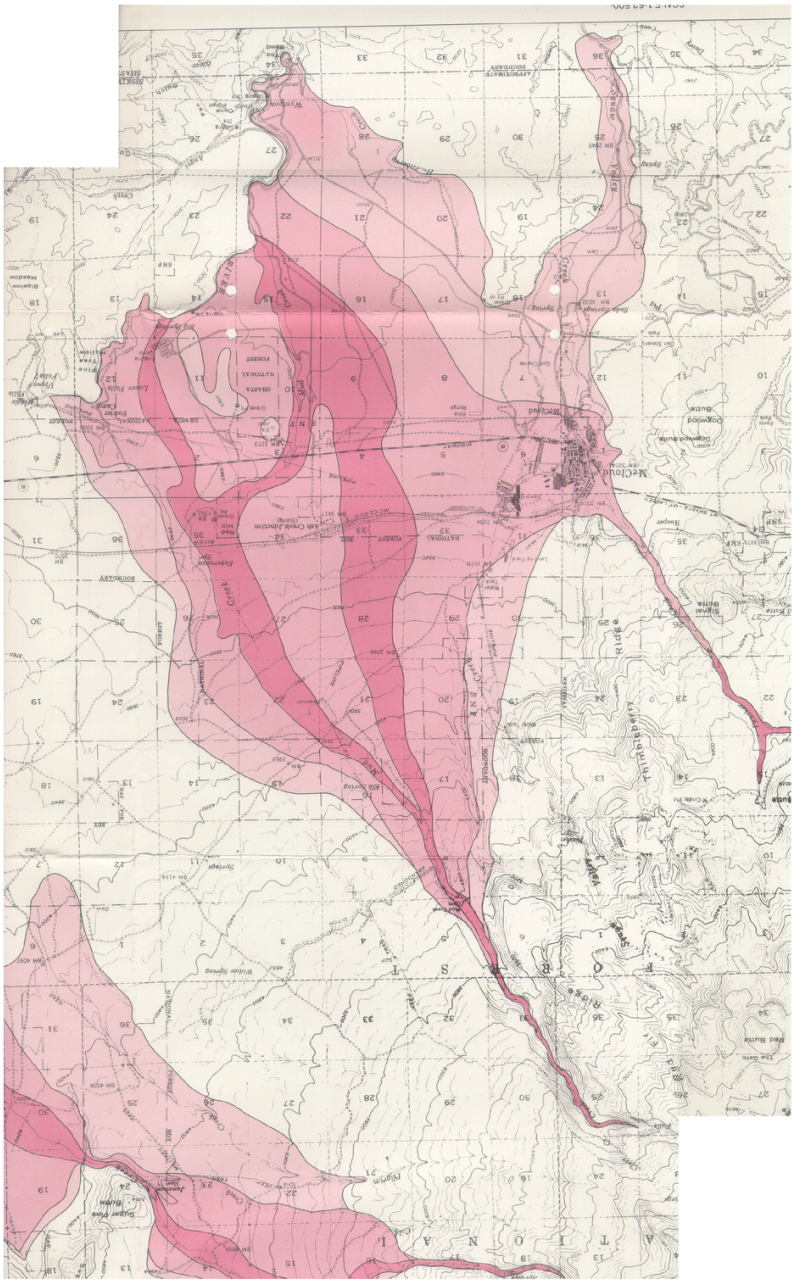

Figure C3: Scanned debris flow hazard map for the Mud Creek drainage from Osterkamp et al. (1986)

APPENDIX D

LAHARZ PROCESSING SEQUENCE AND ALGORYTHM

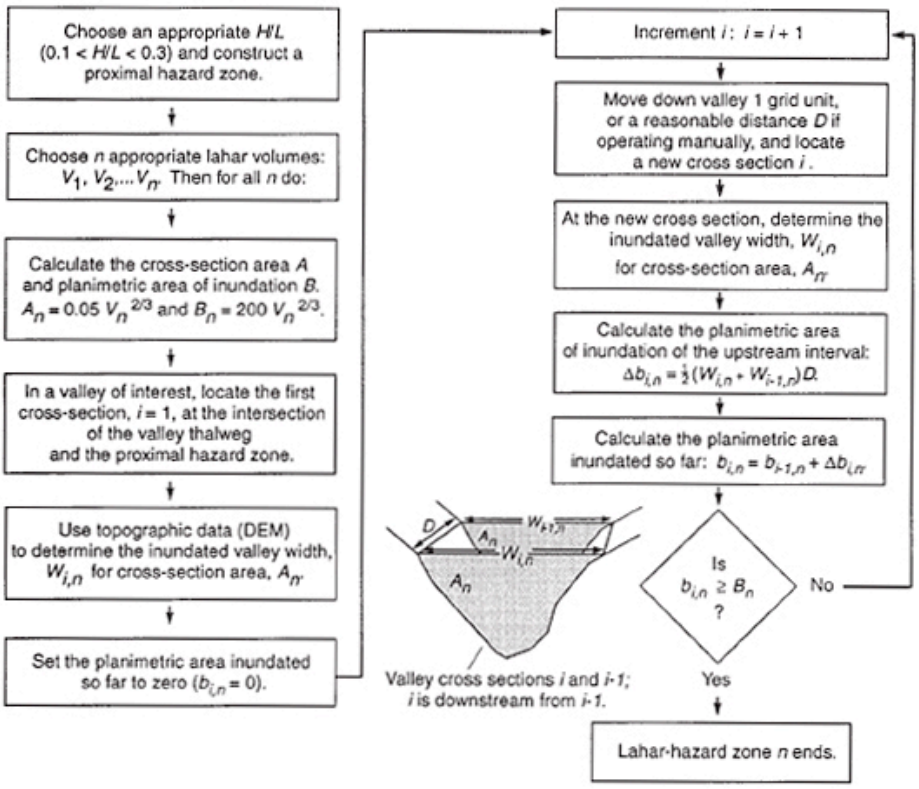

Figure D1: Flow chart of the algorithm used to implement hazard zone delineation. Modified from Iverson et al. (1998).

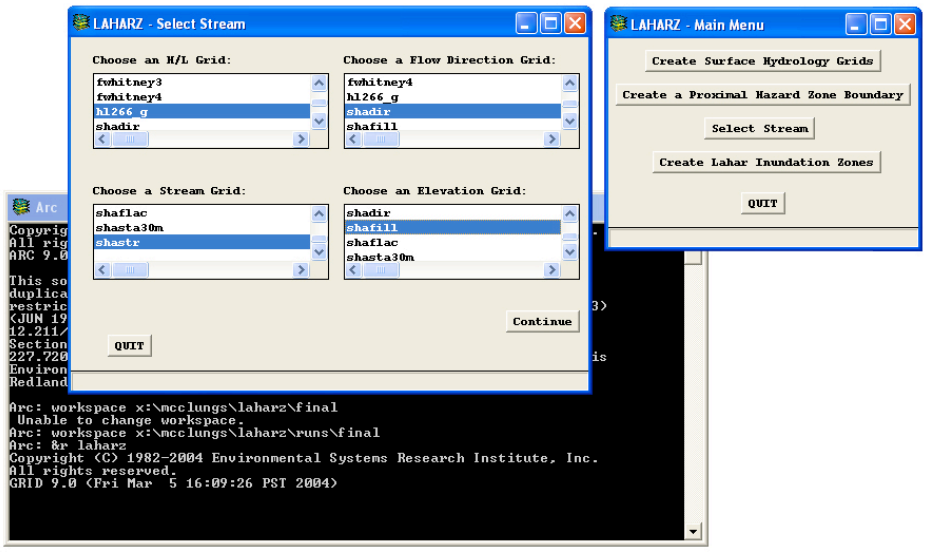

Figure D2: Screen capture of LAHARZ AML menus in action: stream selection

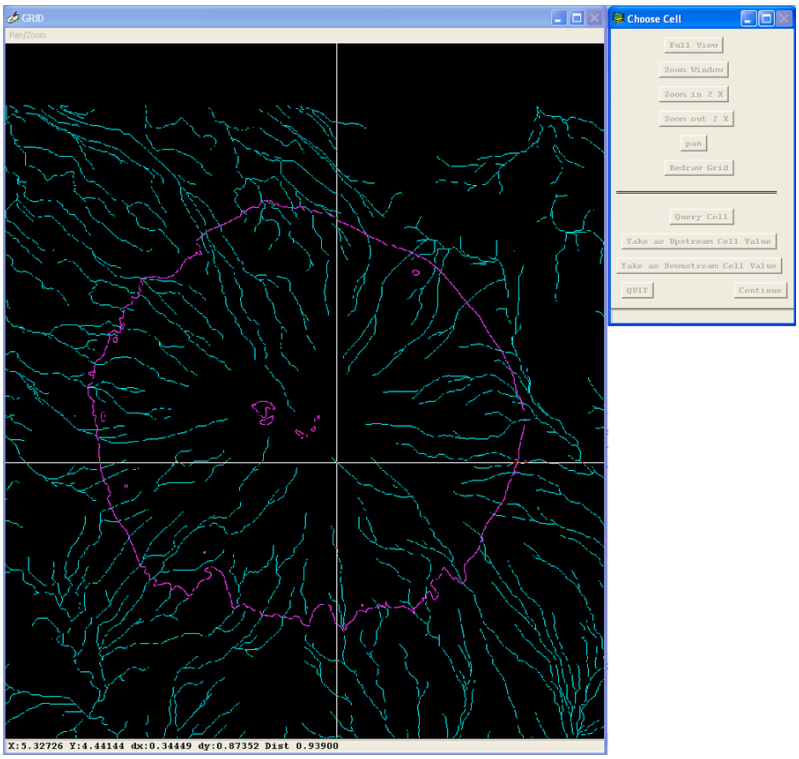

Figure D3: Screen capture of LAHARZ stream selection grid display. The crossbar is located over the initiation point for Mud Creek lahars. LAHARZ processes cell by cell downstream until it has found the proximal Hazard boundary line at which point it begins filling valley cross-sections to create inundation zones.

APPENDIX E

HAZARD ZONATION MAP FOR MUD AND WHITNEY CREEK BASINS