

# Blending Historical Mapping with Lidar: Barker-Hughesville Site Example

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**CDM  
Smith**



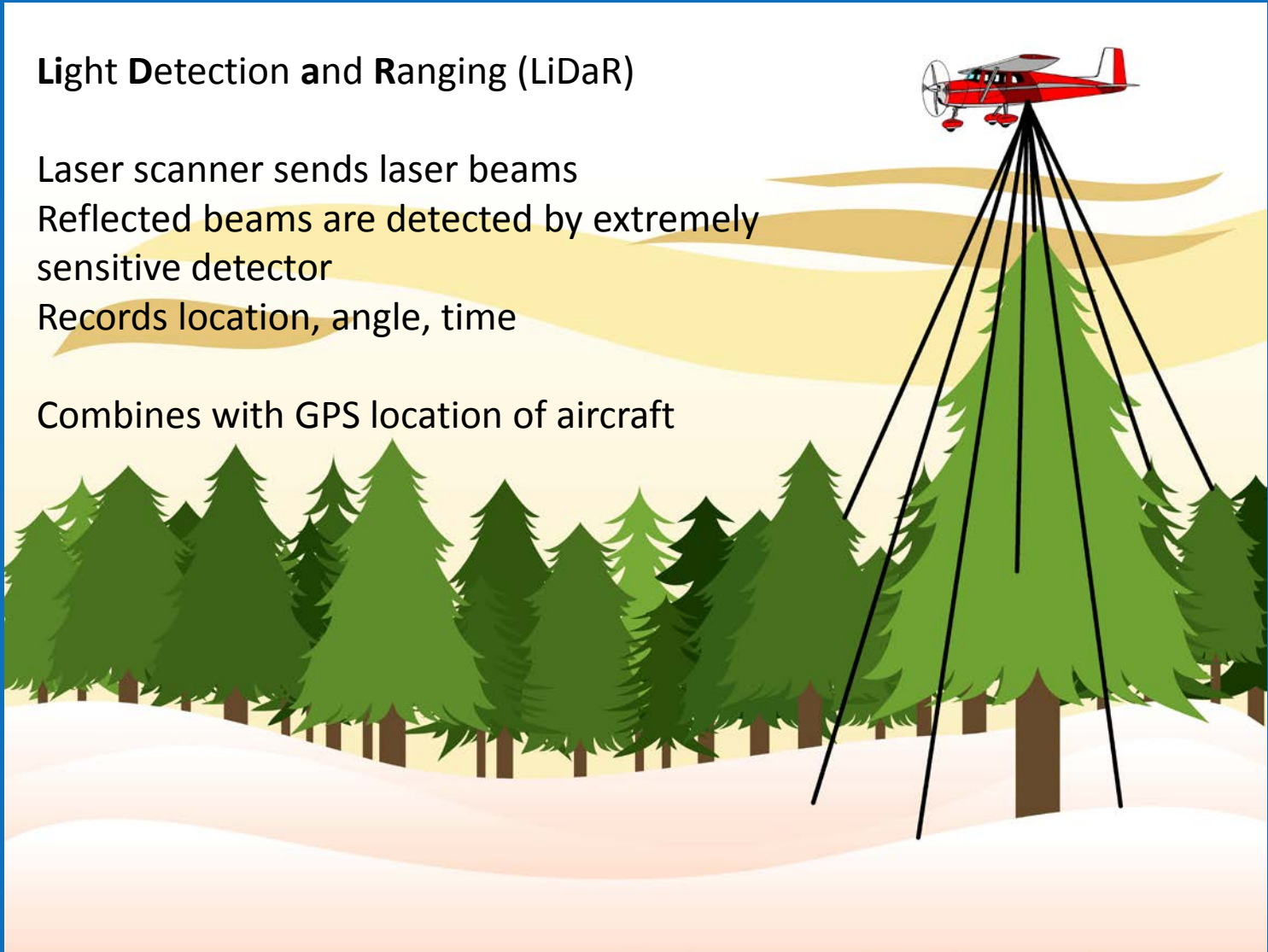
# Overview of Lidar

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## Light Detection and Ranging (LiDaR)

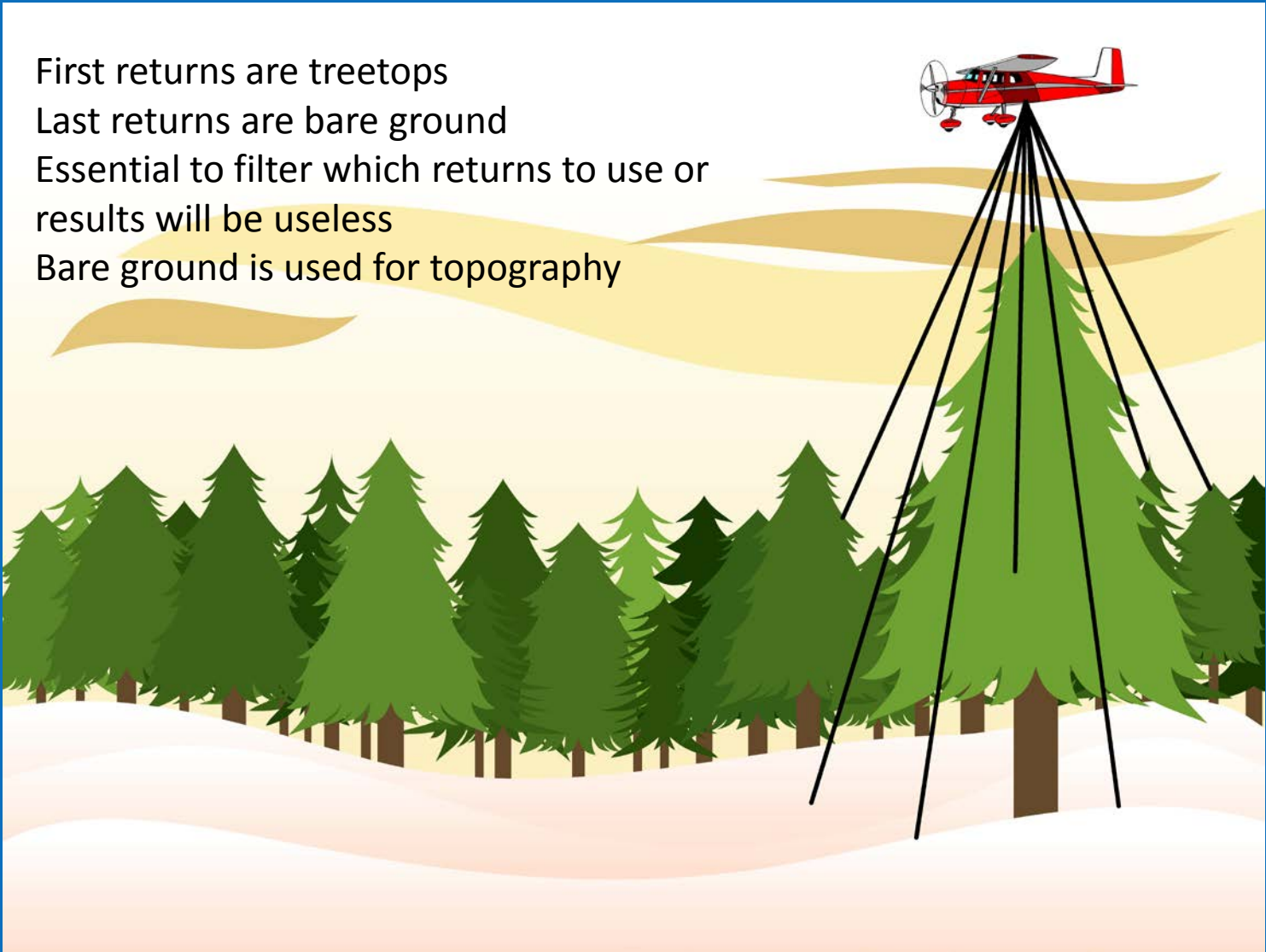
Laser scanner sends laser beams  
Reflected beams are detected by extremely  
sensitive detector  
Records location, angle, time

Combines with GPS location of aircraft



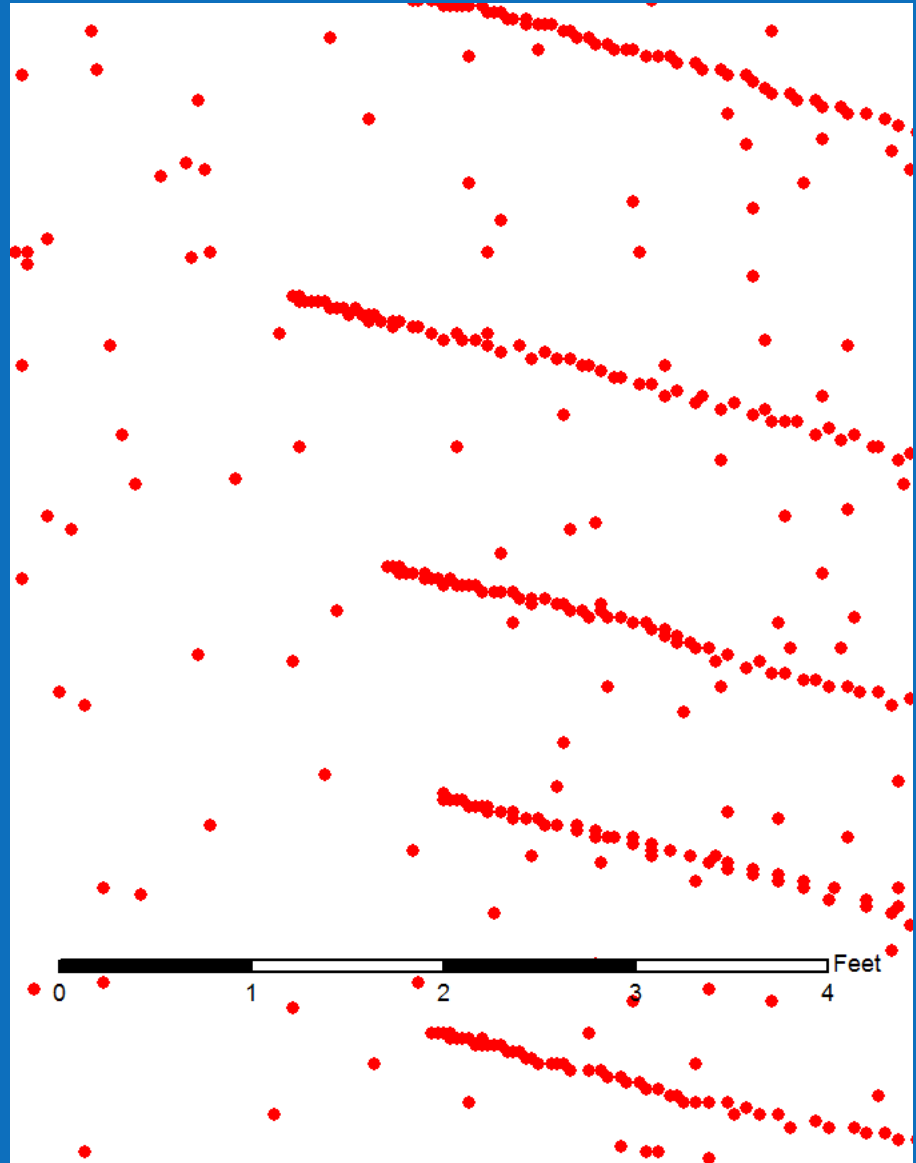
# Overview of Lidar

First returns are treetops  
Last returns are bare ground  
Essential to filter which returns to use or  
results will be useless  
Bare ground is used for topography

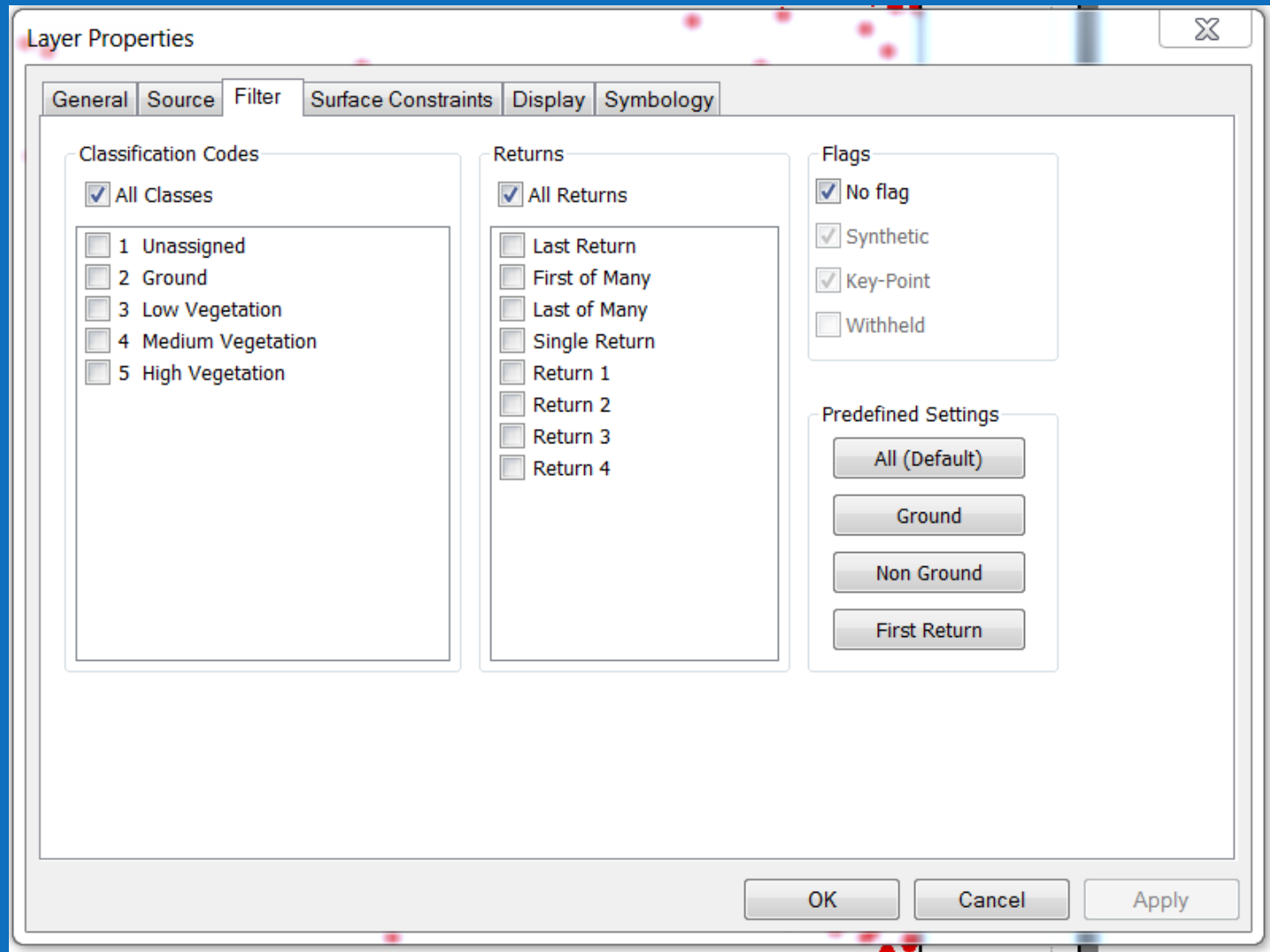


# Products Delivered

- Depends on Contractor and contract
- May include point file
- Usually includes contours
- May include raw files
- .las or MKP
- Orthophotography is optional



# Points, .las or MKP need analysis by GIS or CAD



# Primary product is DEM and contours

Digital Elevation Model (DEM) is used for designs, calculation of volumes, and local hydrology

Contours are for visual presentation

Heavy demands on computer and software

Lots of spinning orb time





# Barker Hughesville Site

# Barker Hughesville Mining District Site, Montana

Numerous abandoned underground mines

Mill and tailings pond

Open adits and shafts

Waste Rock piles

Discovery 1879 – sporadic mining through 1960s

Primarily lead and silver



# Barker Hughesville Mining District Site, Montana

Steep topography  
Heavy timber

Mixed ownership  
Limited access



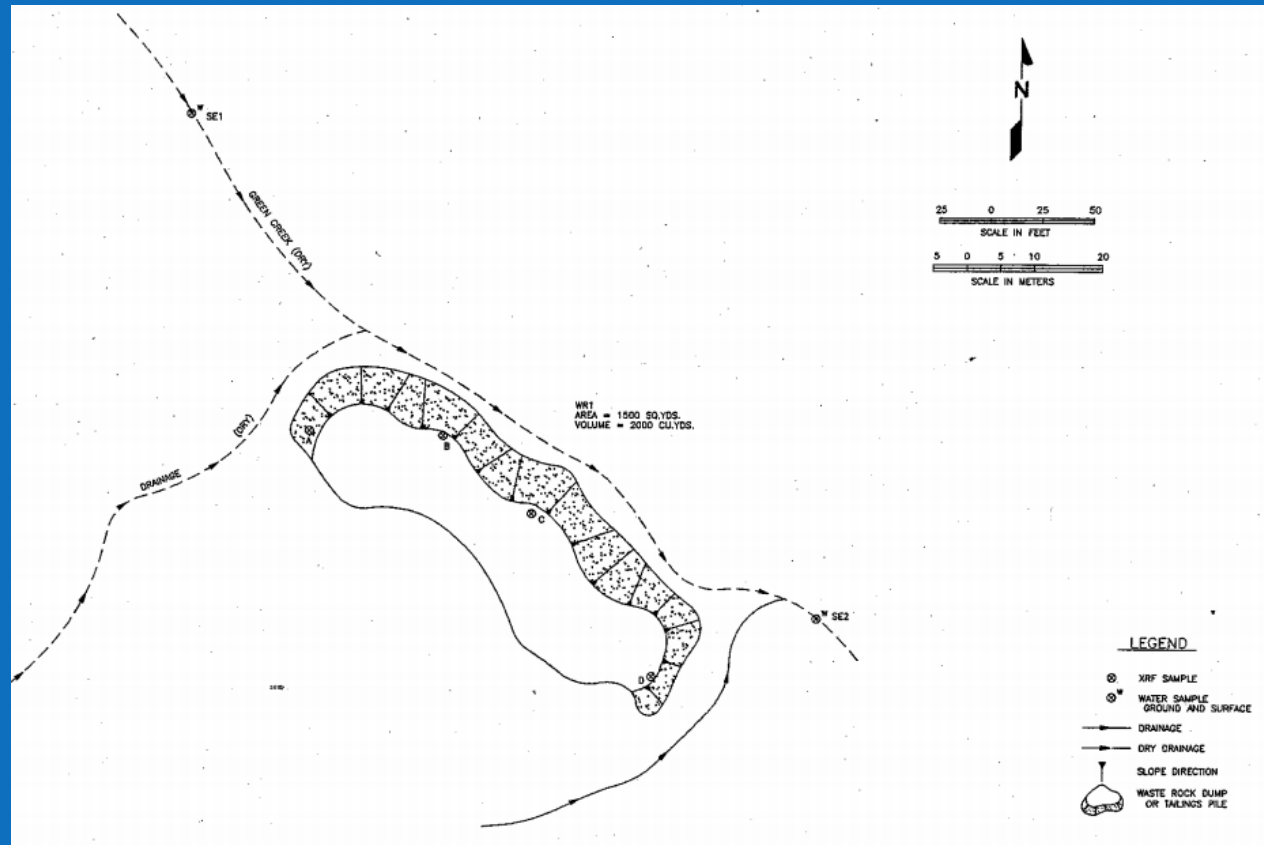
# Barker Hughesville Mining District Site, Montana

Previous  
investigations 1990s

Mixed quality

Some incorrect sites

Very incomplete



# NPL Listing and Remedial Investigation

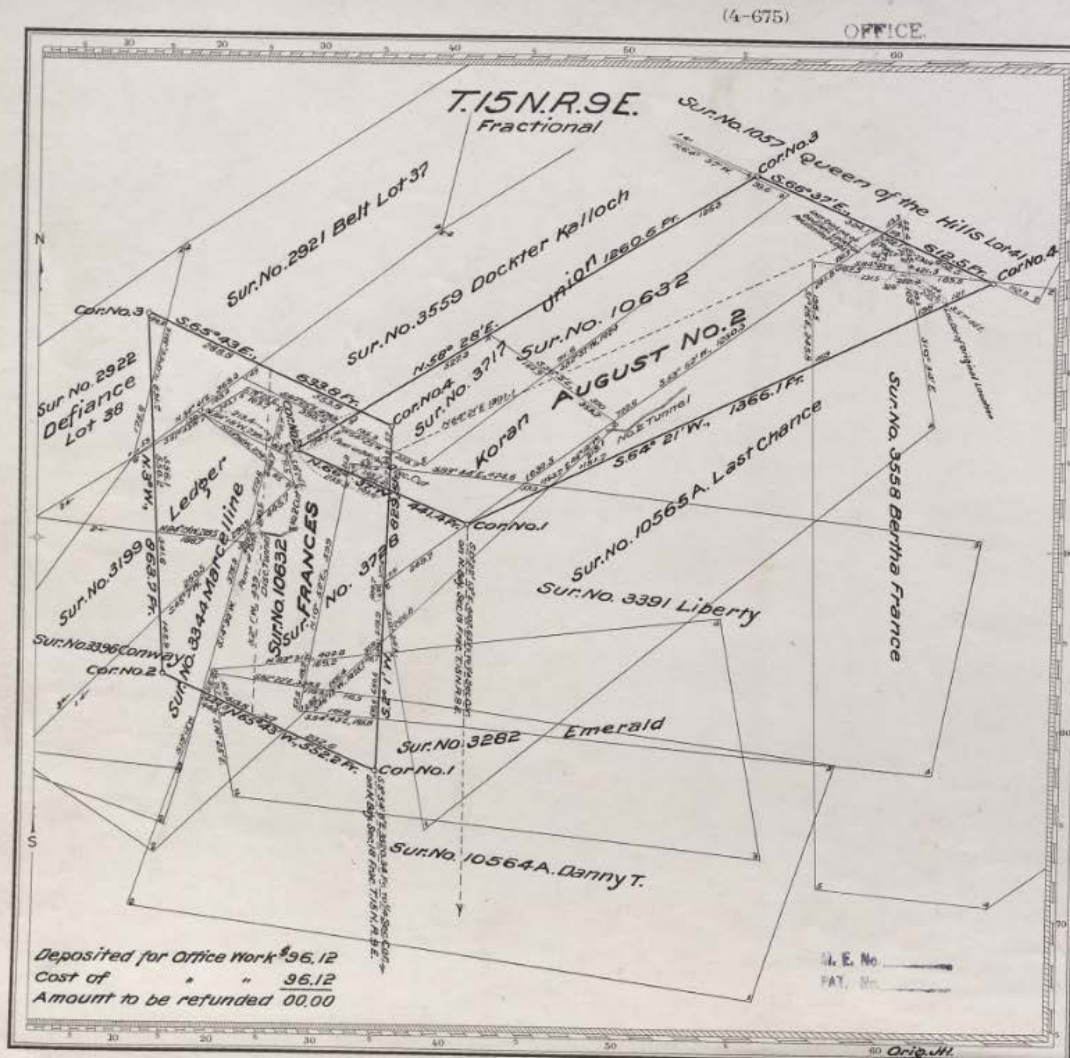
## Needs

- Full inventory of sites
- Sample all significant sites
- Generate areas and volumes for FS

## Research for Sites

- EPA and State files
- Geologic reports
- Historical Society library
- BLM GLO records
- Defense Minerals Agency
- National Mine Map Repository
- County records
- Aerial photography

# GLO Mine Survey



Mineral Survey No. 10632

Great Falls Land District.

**PLAT**

OF THE CLAIM OF

Faith Mining Company  
KNOWN AS THE

**AUGUST NO. 2 AND  
FRANCES LODES**

IN Barter (unary) MINING DISTRICT,  
Judith Basin COUNTY, Montana

Scale of 200 Feet to the inch.  
Variation 2° 30' East  
SURVEYED Feb 10 1930 to March 30 1930 BY  
James L. Sinclair  
U.S. Mineral Surveyor.

The Original Field Notes of the Survey of the Mining Claim from which this plat has been made under my direction, have been examined and approved, and are on file in this Office, and I hereby certify that they furnish such an accurate description of said Mining Claim as will, if incorporated into a patent, serve fully to identify the premises, and that such reference is made therein to natural objects or permanent monuments as will perpetuate and fix the locus thereof.

Further certify that Five Hundred Dollars worth of labor has been expended or improvements made upon, or for the benefit of, each location embraced in said mining claim by claimant

or  
its  
grantees and  
that said improvements consist of Disc. cut, disc.  
tunnel, tunnel and cut, valued at  
\$3708.22

that the location of said improvements is correctly shown upon this plat, and that no portion of said labor or improvements has been included in the estimate of expenditures upon any other claim.

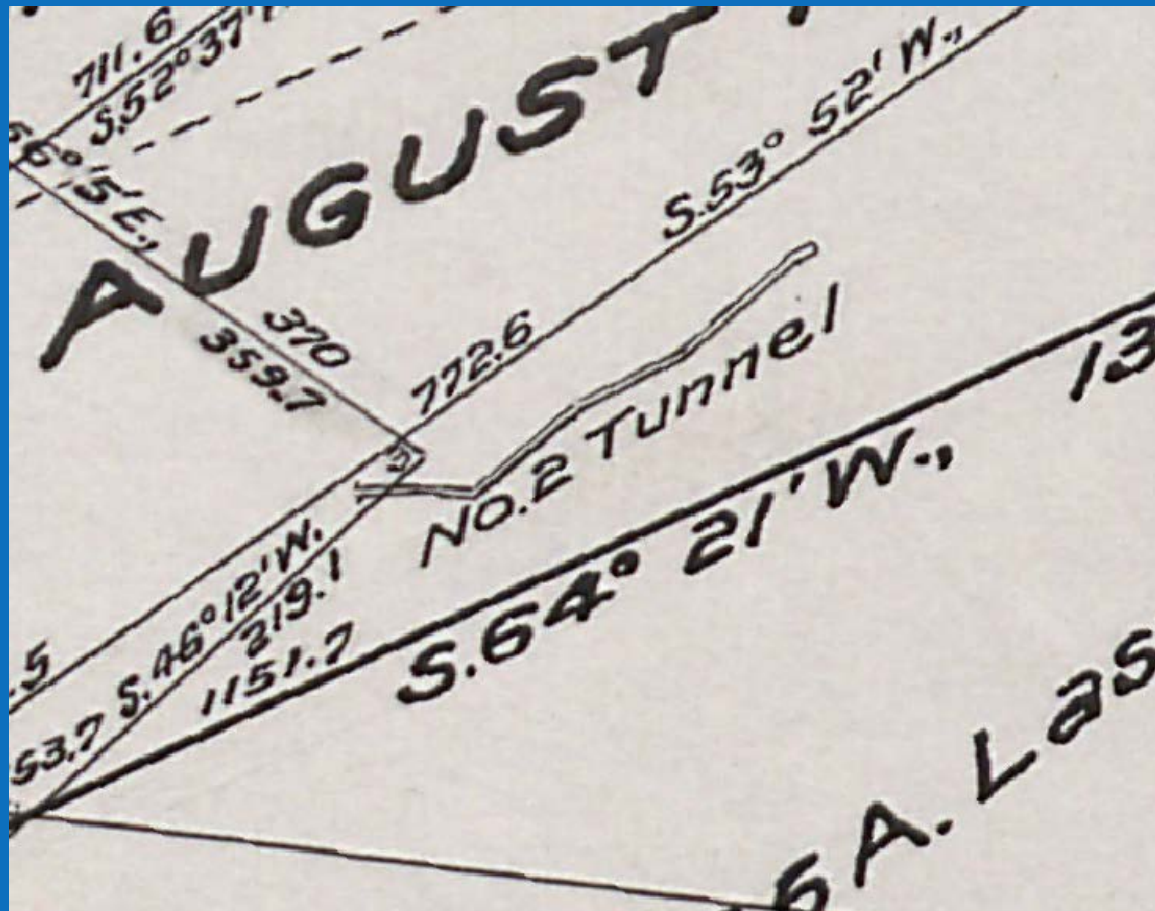
And I further certify that this is a correct plat of said Mining Claim made in conformity with said original field notes of the survey thereof, and the same is hereby approved.

Public Survey Office  
Helena Montana  
August 5<sup>th</sup> 1930  
Office Geological Engineer for  
Montana

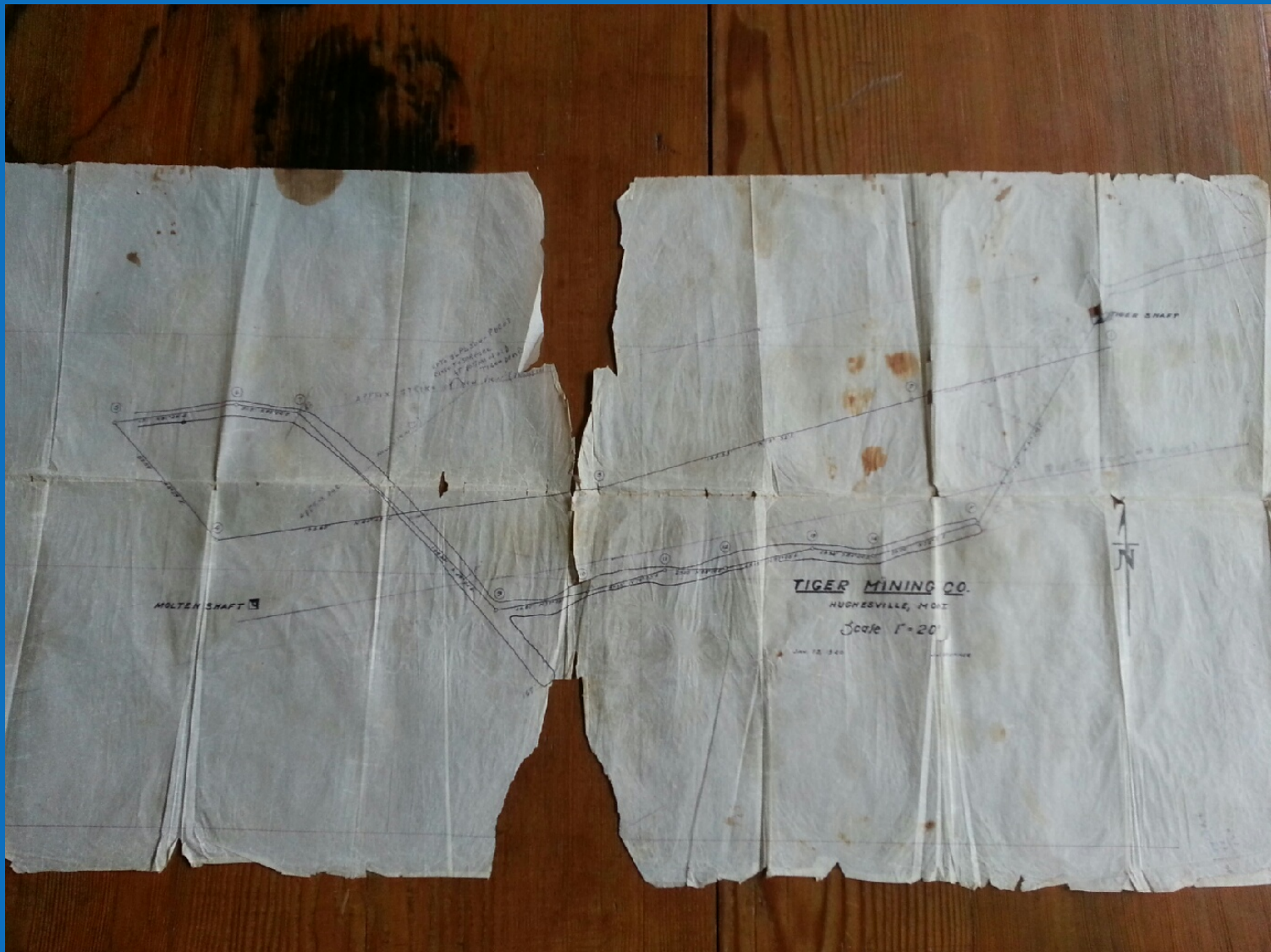
10632

# Some workings on Mine Surveys

- Discovery cut, shaft or tunnel
- Sometimes extent of tunnels
- Uncertain accuracy



# Mine Maps of varying quality and condition



# Narrative Reports from Mine Inspectors

## HUGHESVILLE.

The Carter mine, at Hughesville, is worked by the Carter Mining Company. A two compartment shaft was sunk to the depth of 90 feet. Were going to cross-cut the ledge at the 100-foot level. They were putting up a hoist and were preparing to put in hoisting machinery. Employ 8 men around the mine. J. Barker, Superintendent, and David O'Neill, Foreman.

May and Edna Mine, worked by the May and Edna Mining Company. The first work was done on this property about three years ago. The lower tunnel is driven in about 700 feet, and is timbered with sets. About 195 feet in this tunnel an uprise was driven to surface, and the face of the workings was ventilated by means of a box connected with this uprise, which gives a return to the air. Above this tunnel, on the hill, two more tunnels were driven a short dis-

# How to Resolve Locations?

## The Good

- Claim names are mostly consistent
- Patented claims are inholdings
- Cadastral records retain claim names and outer shapes

## Not So Good

- Mining companies and mine names come and go
- Mining reports are somewhat secretive and exaggerate ore and workings
- Difficult to find mining reports
- Aerial photography is just trees



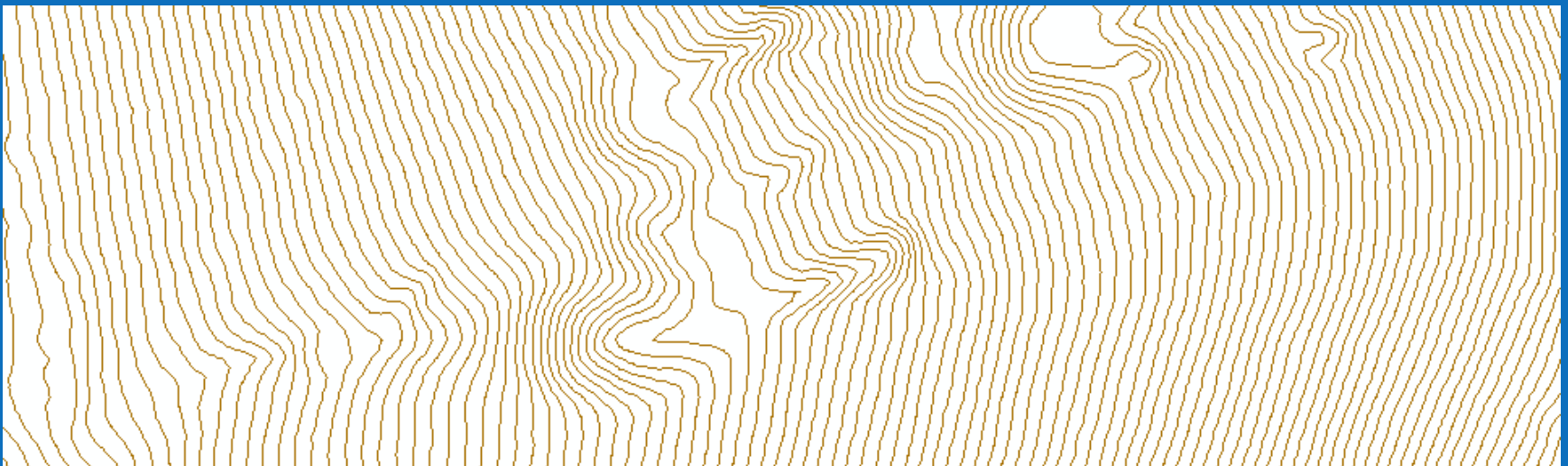
# Lidar to the Rescue

# High Quality Topography Illuminates Workings

Vegetation is removed and anthropogenic disturbances are easy to see

- Roads
- Waste rock piles
- Shafts

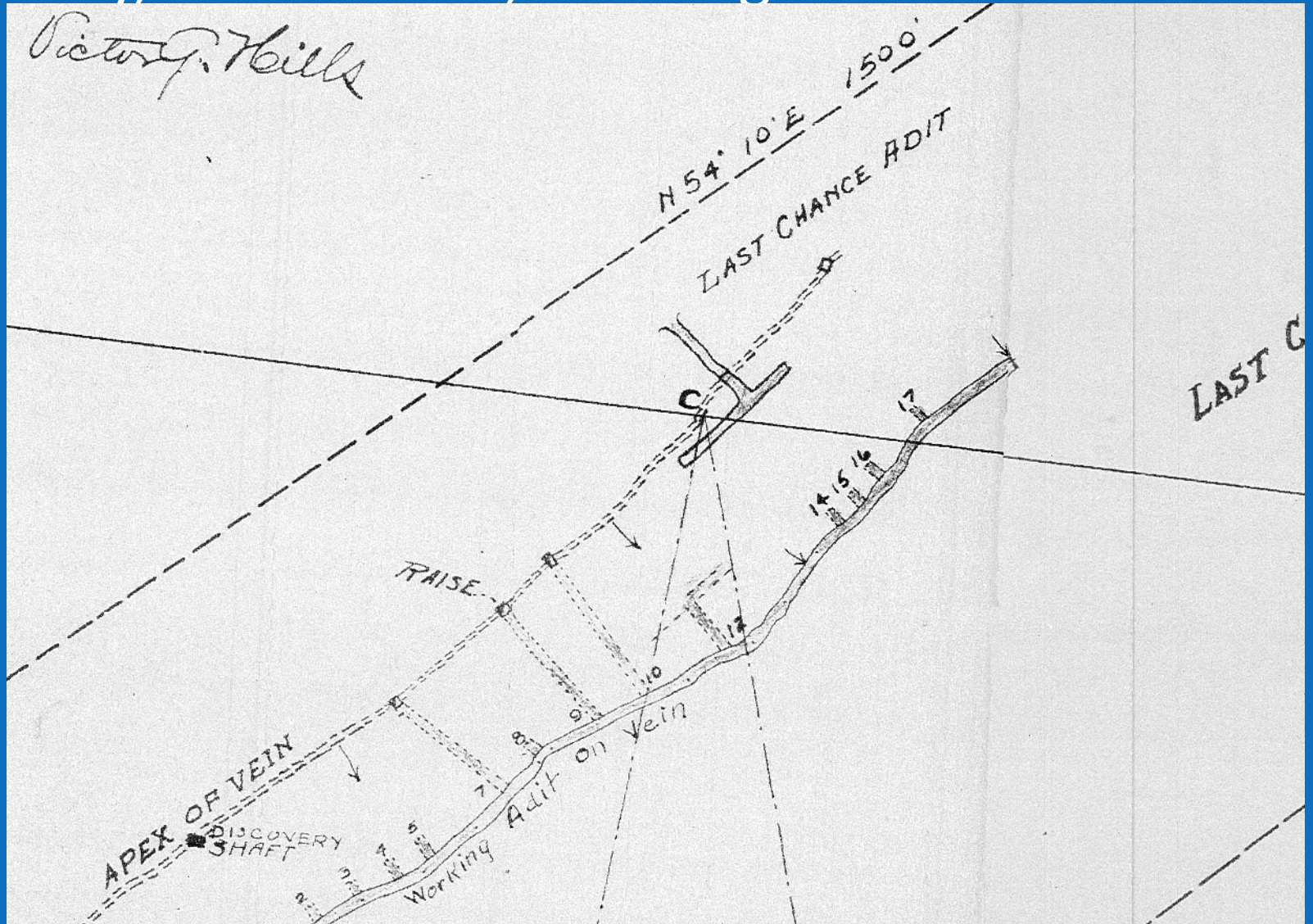
# Virtual clear cut reveals adits and waste rock piles



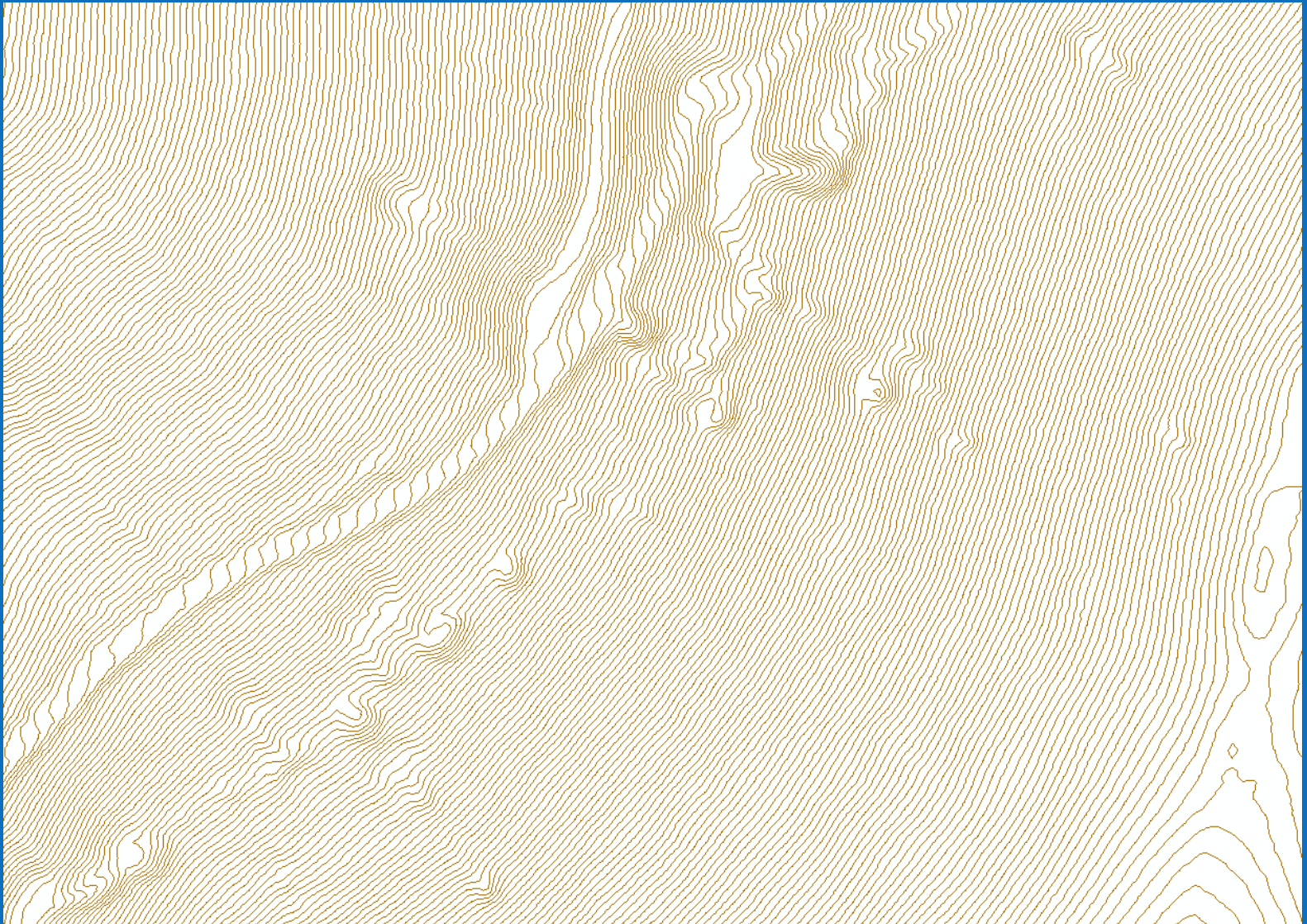
# Liberty, Last Chance, and August No. 2 Mines



# Liberty, Last Chance, and August No. 2 Mines



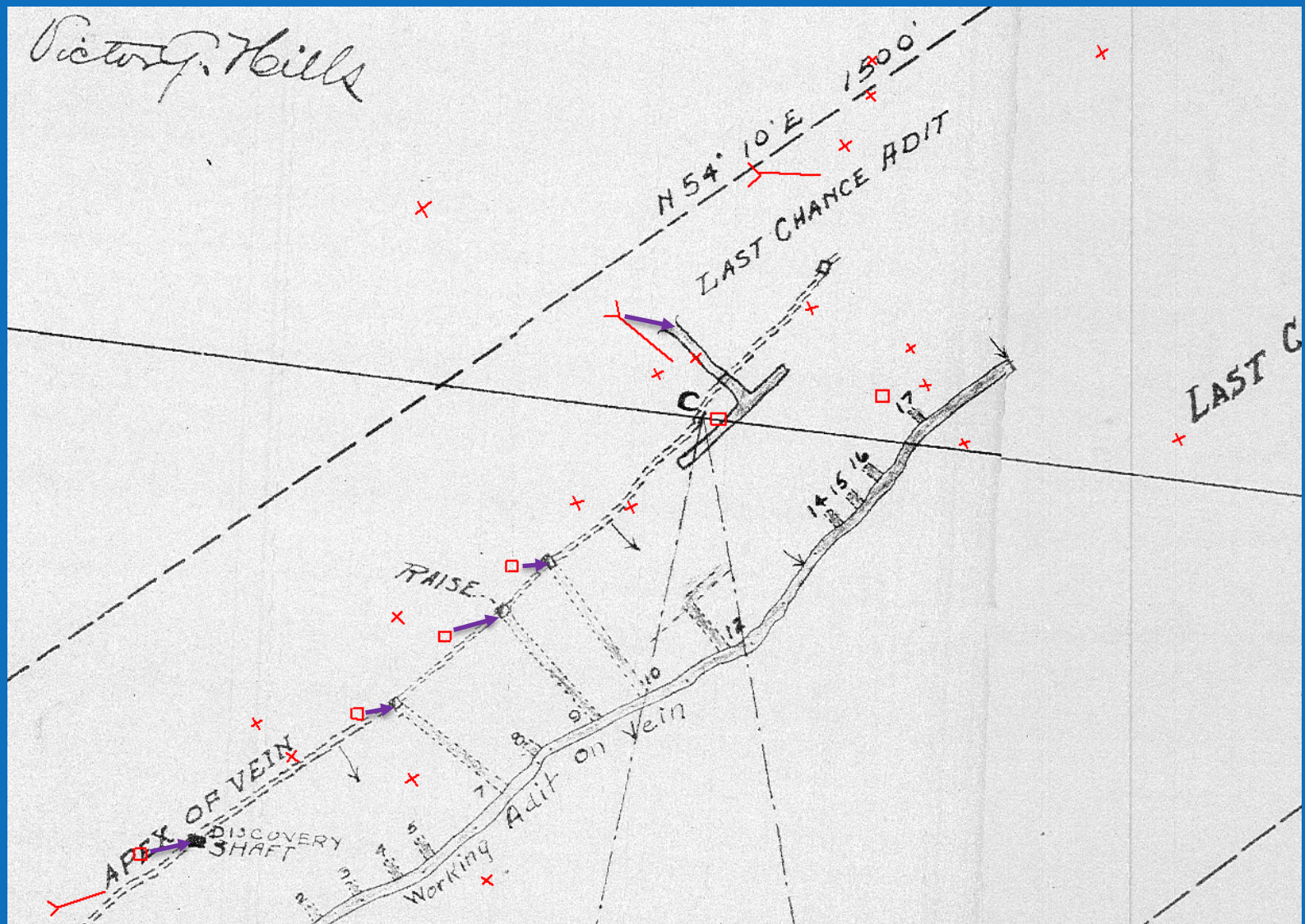
# Liberty, Last Chance, and August No. 2 Mines



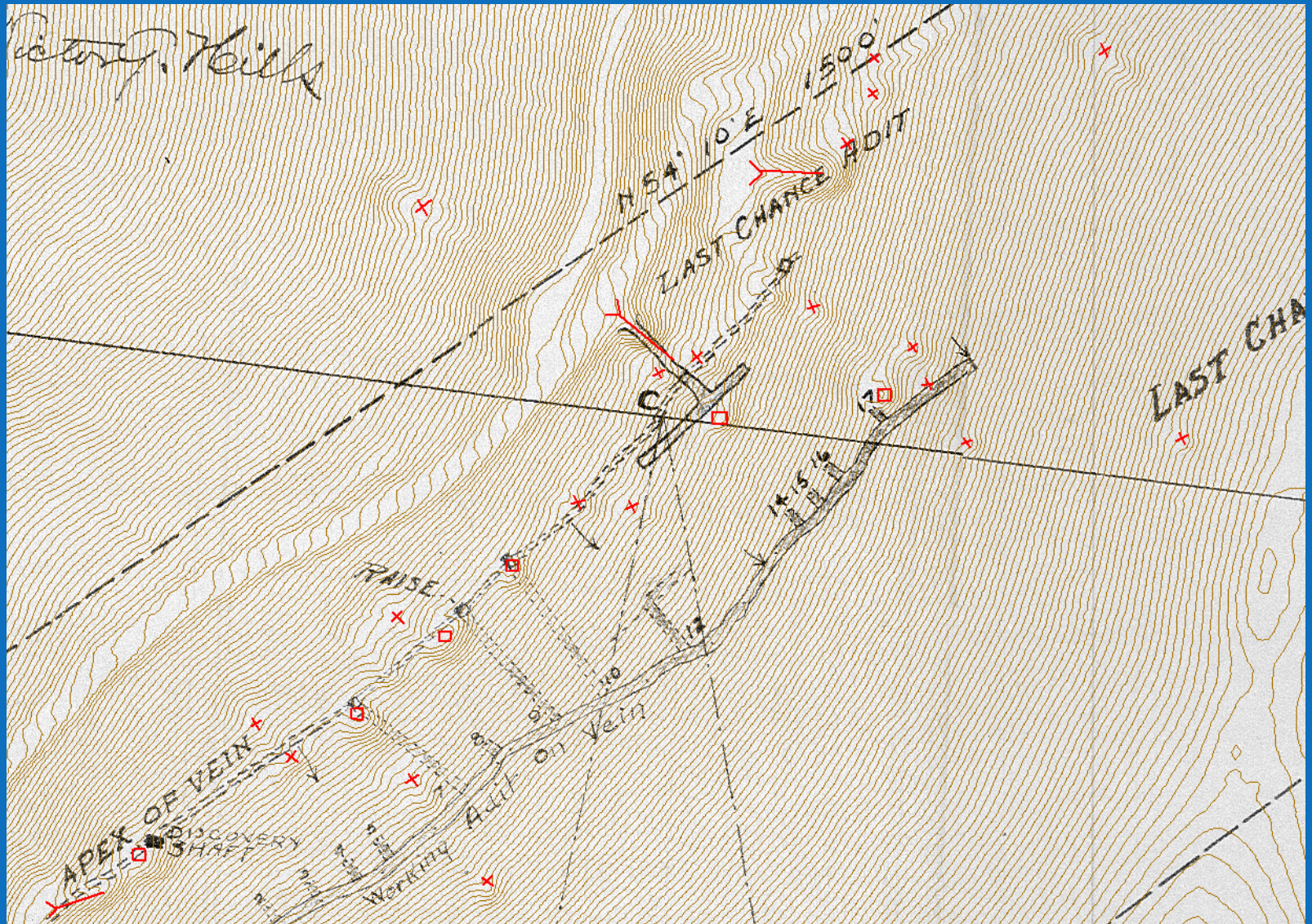
# Liberty, Last Chance, and August No. 2 Mines



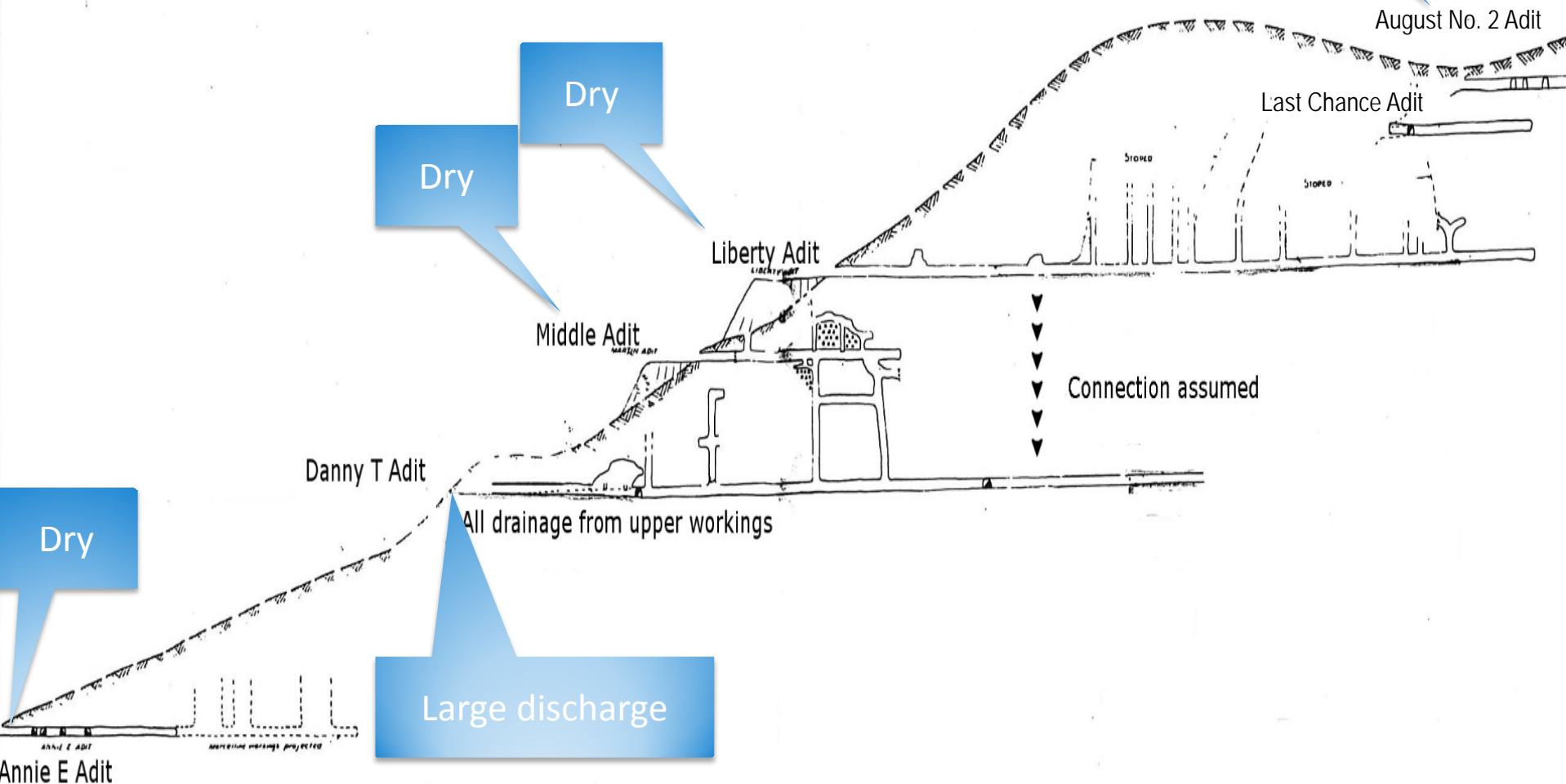
# Liberty, Last Chance, and August No. 2 Mines



# Liberty, Last Chance, and August No. 2 Mines



# Benefit of accurate mapping



# Moulton Mine

- Discovered 1886
- Large waste rock pile
- Discharging adit
- No workings map



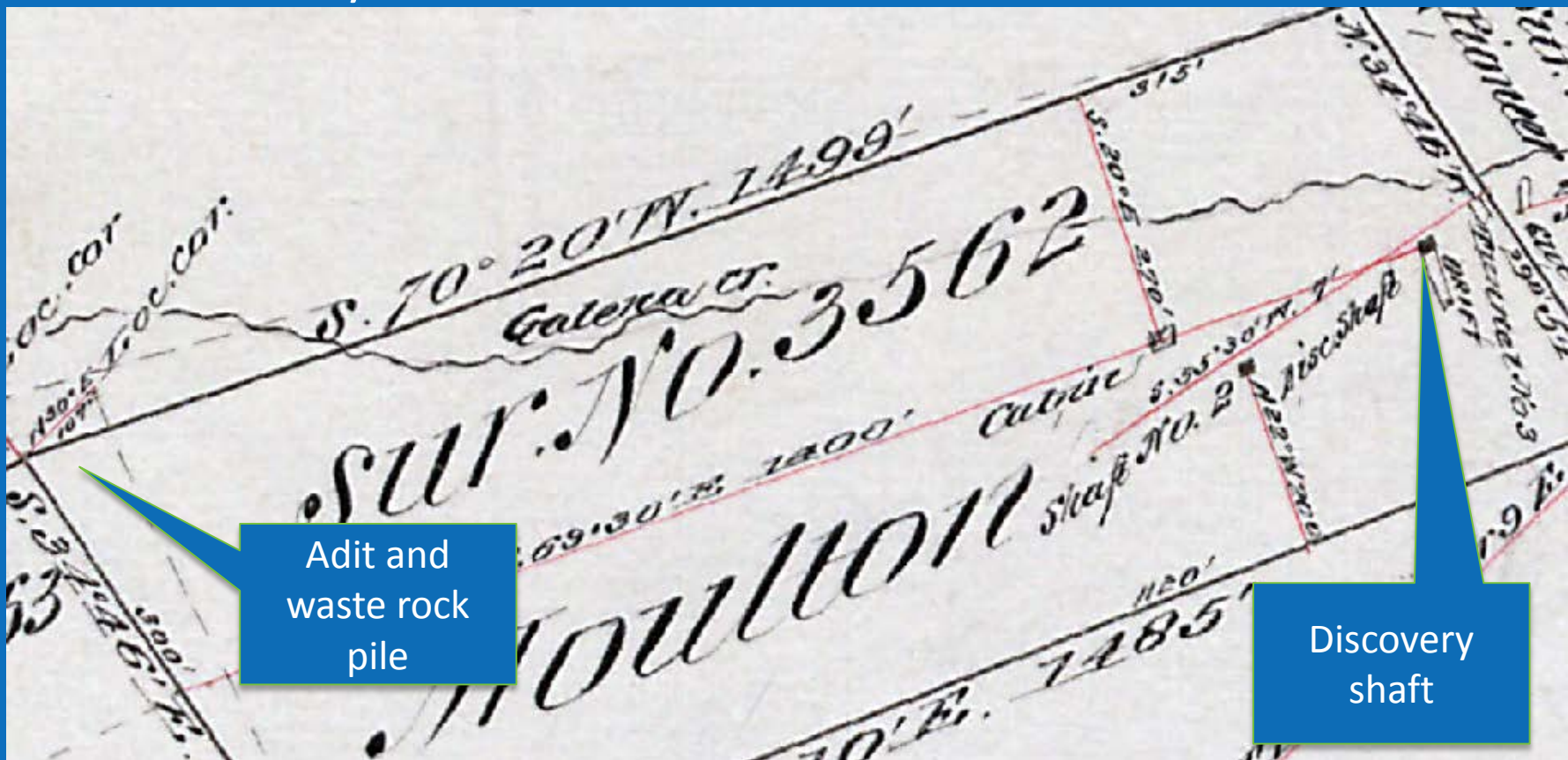
# Moulton Mine

- Very little information available



# Moulton Mine

- 1890s Mine Survey
- Discharging adit and waste rock to west
- Discovery shaft to east



# Moulton Mine

- Lidar revealed discovery shaft
- Change in slope is geologic contact and vein

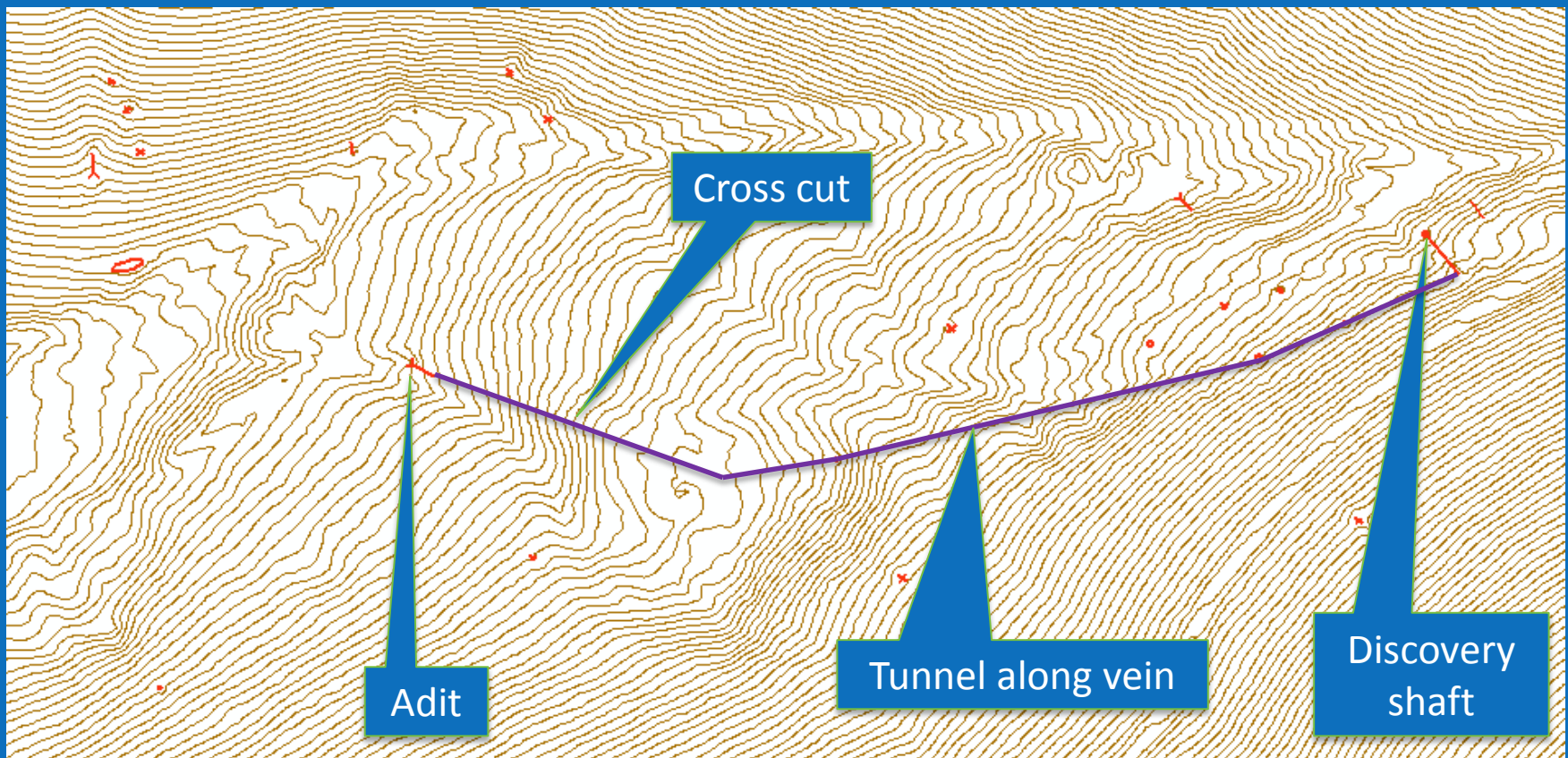


# Moulton Mine

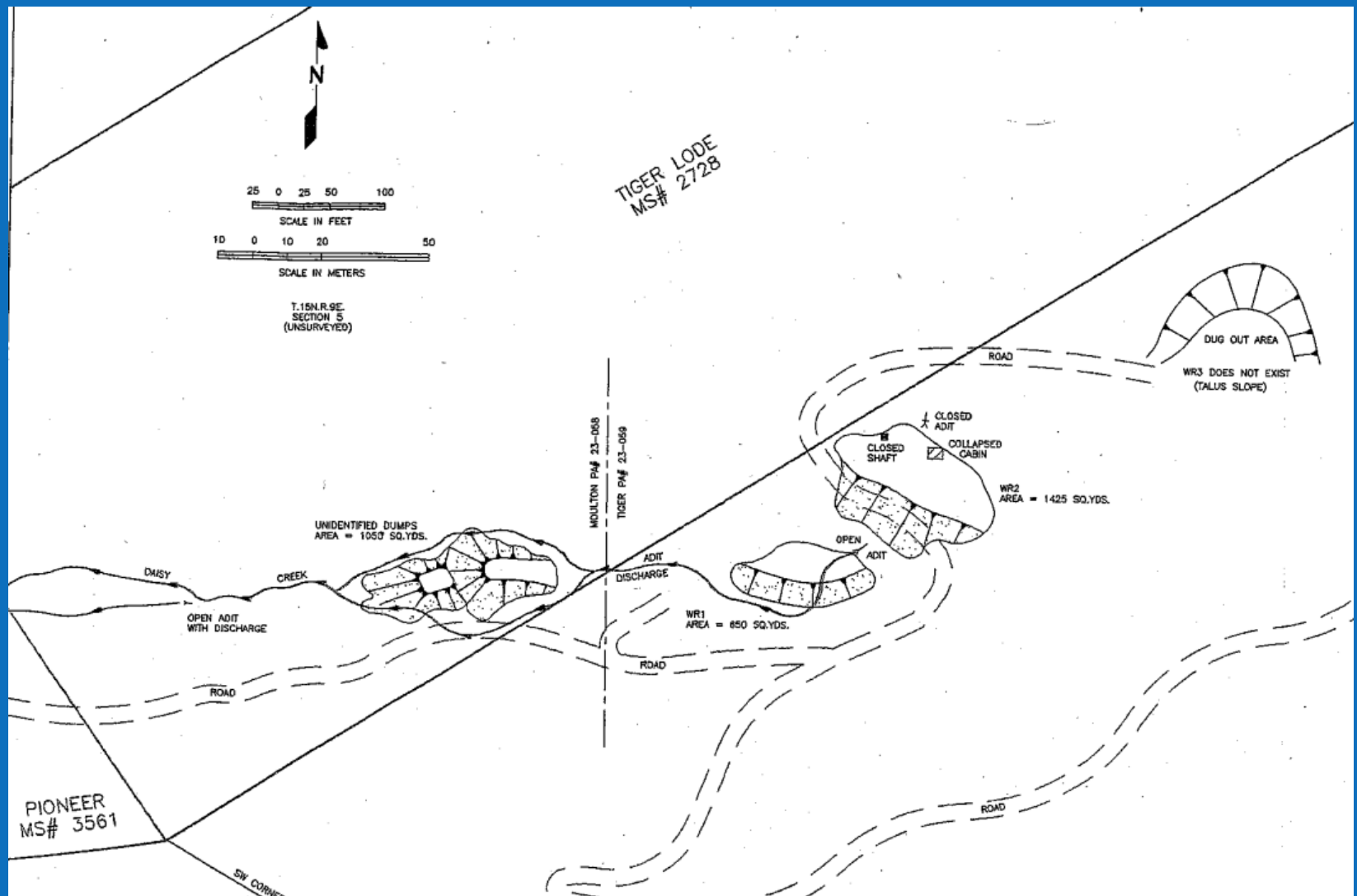
- 1894 mine inspector report described a shaft 100 feet deep
- 1897 mineral survey shows two shafts and a drift
- 1899 mine inspector report described a shaft 110 feet deep and a tunnel was to be dug 1200 feet long and 350 feet deep
- 1900 USGS report indicated that the target depth was 356 feet with a tunnel 1232 feet long
- 1951 mine inspector report indicated that the tunnel included a 356 foot crosscut to the vein

# Moulton Mine Assumed Workings

- Cross cut assumed 356 feet
- Shaft estimated depth 274 feet
- Tunnel length approximately 1165 feet to shaft
- 1235 feet to claim boundary



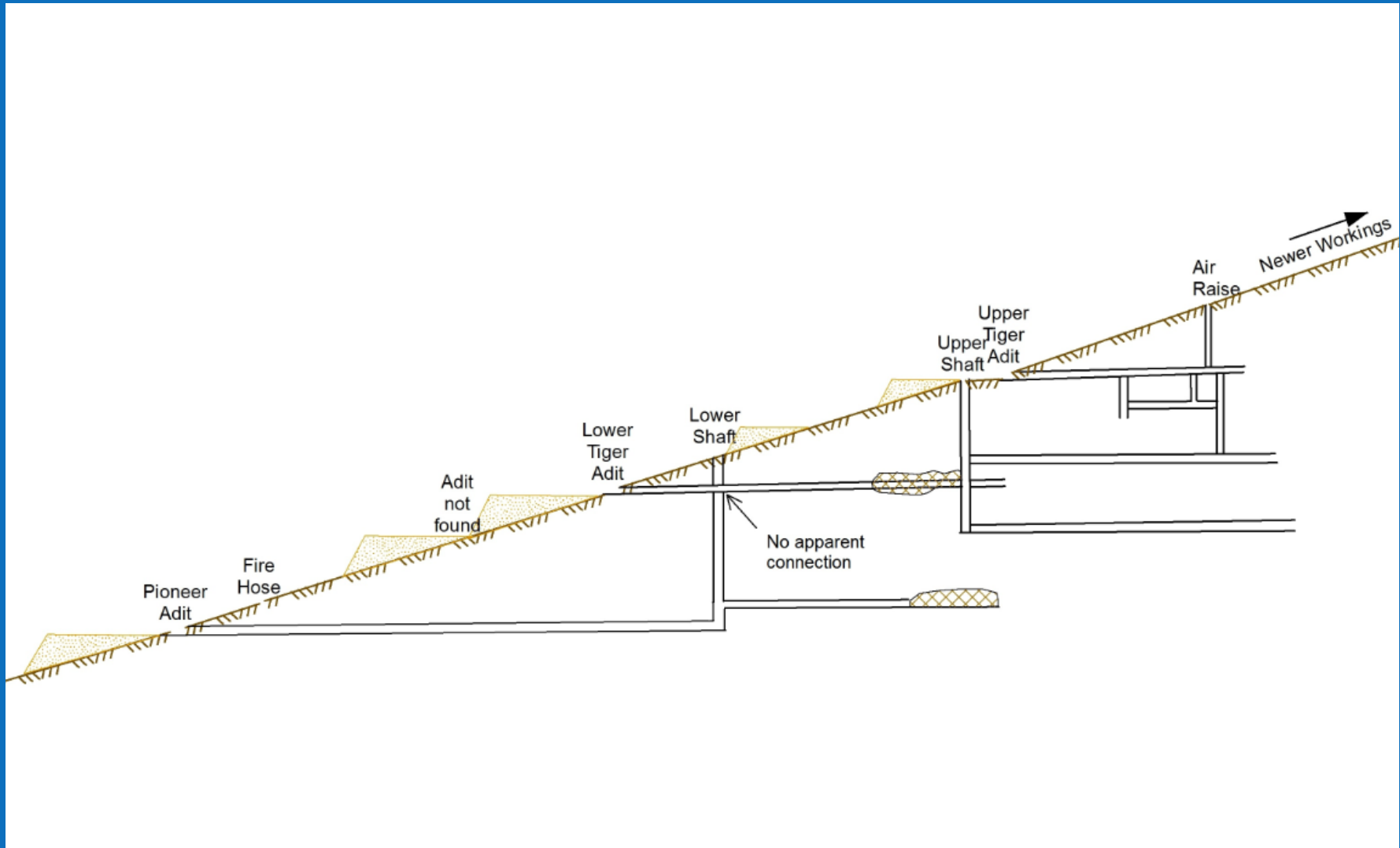
# Tiger Mine – 1990s information



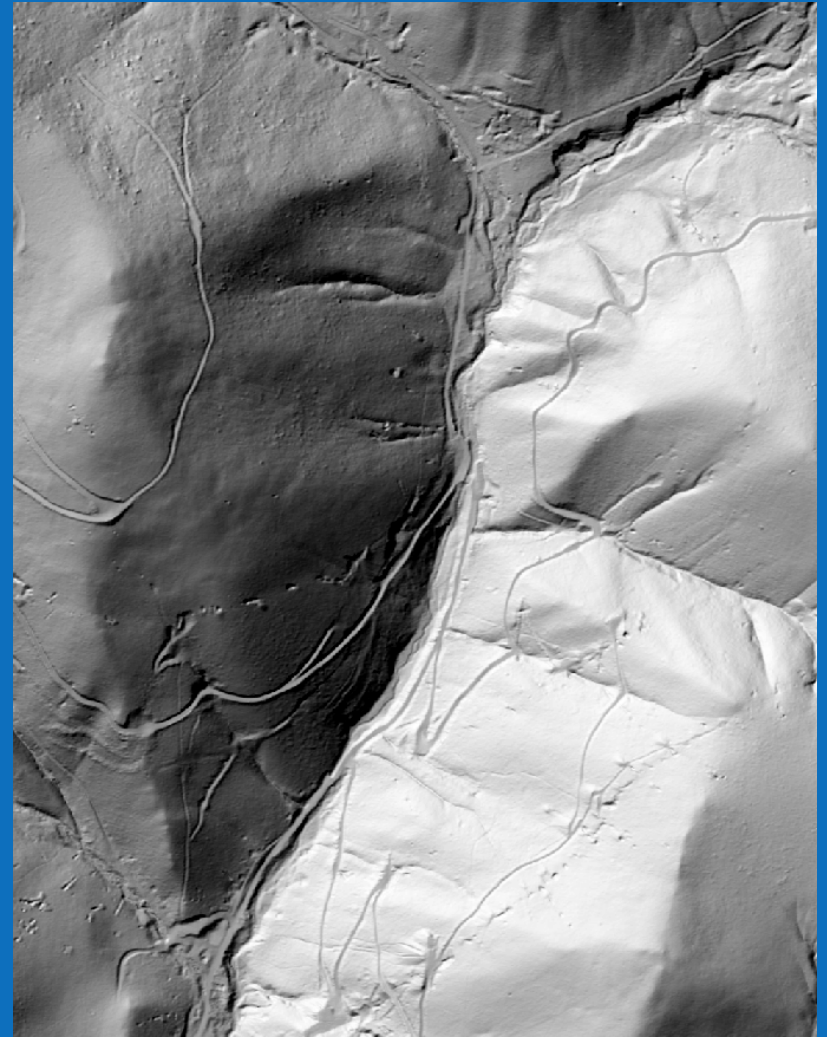
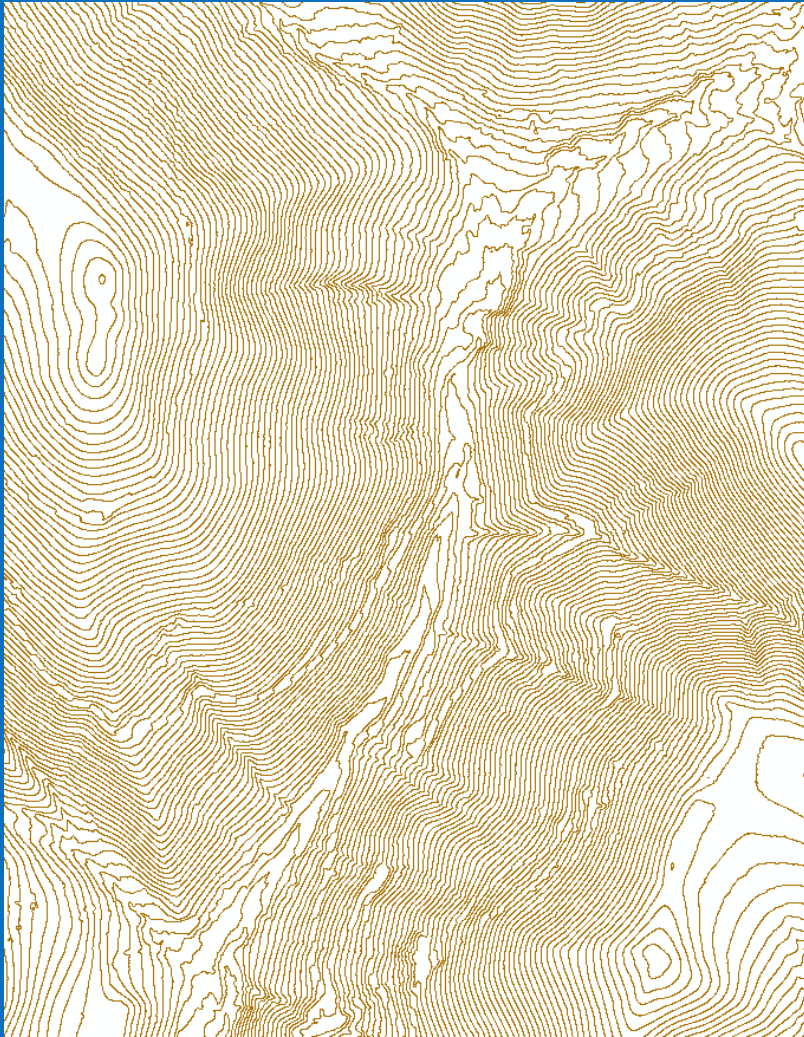
# Tiger Mine – Combined historic and current info



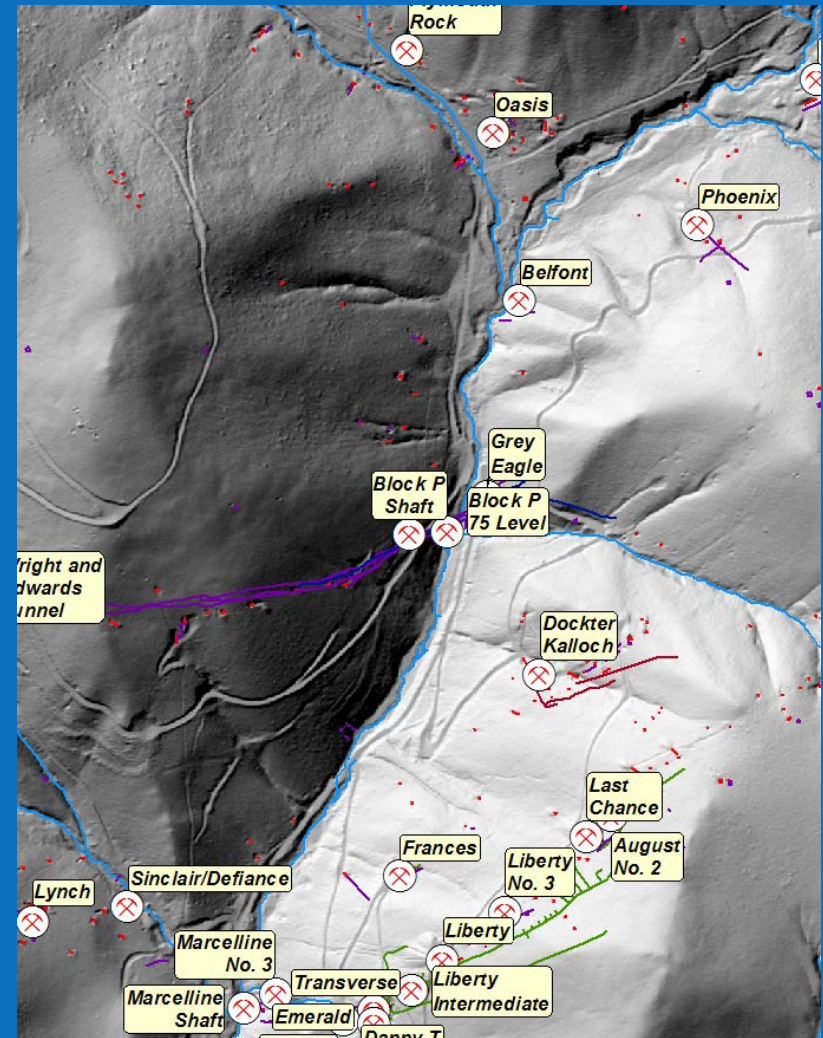
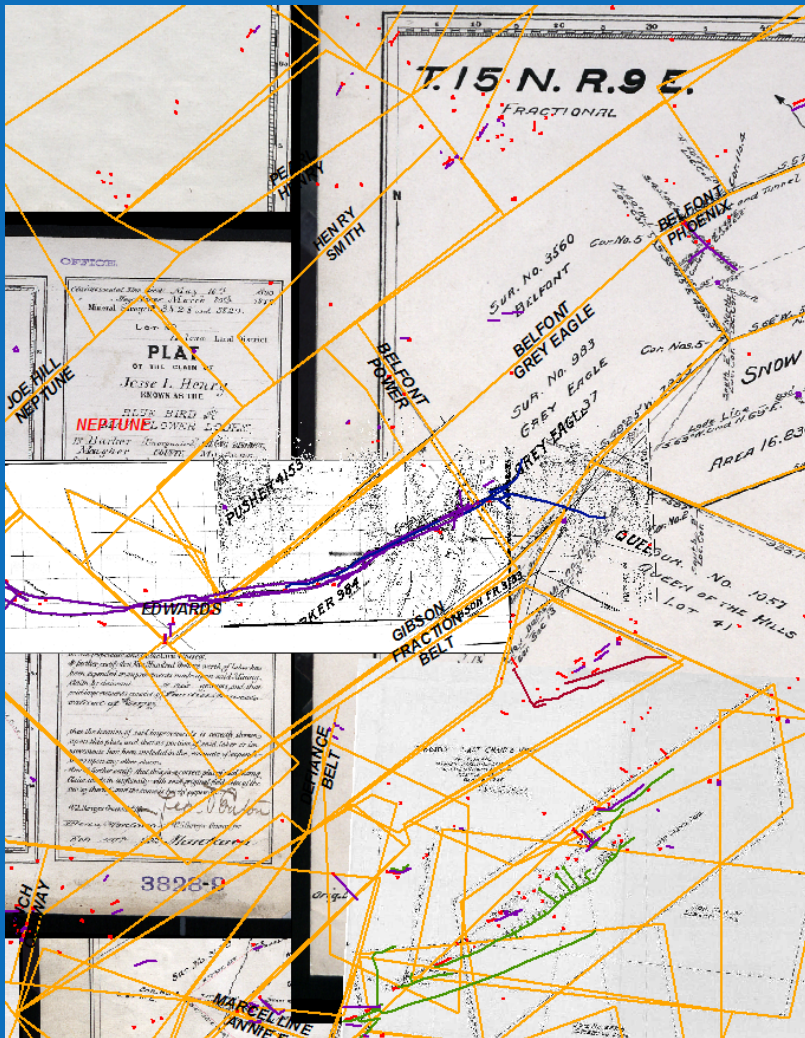
# Interpretation of workings



# Hillshade can Help with Visualization



# Blend all available data and simplify



# Barker Hughesville Summary

- Pre-listing information identified 46 mine sites of which 16 were potential sources
- Research of historic information and Lidar mapping identified 64 mine sites and many, many small shafts and pits
- We believe all significant sites have been visited and sampled including discharging adits
- Knowledge of workings will help during RD/RA for source control



# Lidar Cost

# Costs

## Tenmile Creek Deliverables

- Orthophotography
- 2-foot contours
- Point files
- Approximately 34 square miles
- \$110,000 (\$3200/sq mi)
- Combined with other sites to reduce costs

## Barker Deliverables

- Point Files (.las and MKP)
- No photography
- Approximately 7 square miles
- \$36,500 (\$5200/sq mi)
- Combined with other sites to reduce costs

## Tenmile Photogrammetry

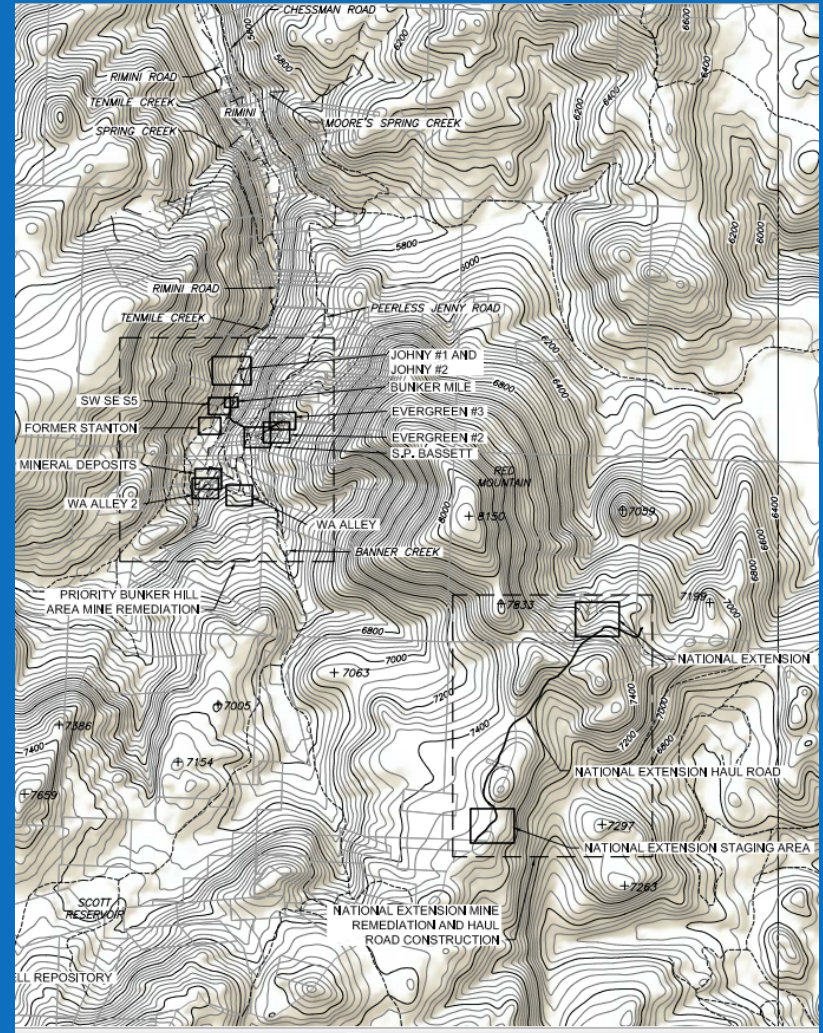
- Point Files
- Contours
- B&W photography
- Approximately 0.28 square miles
- \$17,000 (\$61,000/sq mi)
- Combined with ground survey to reduce costs



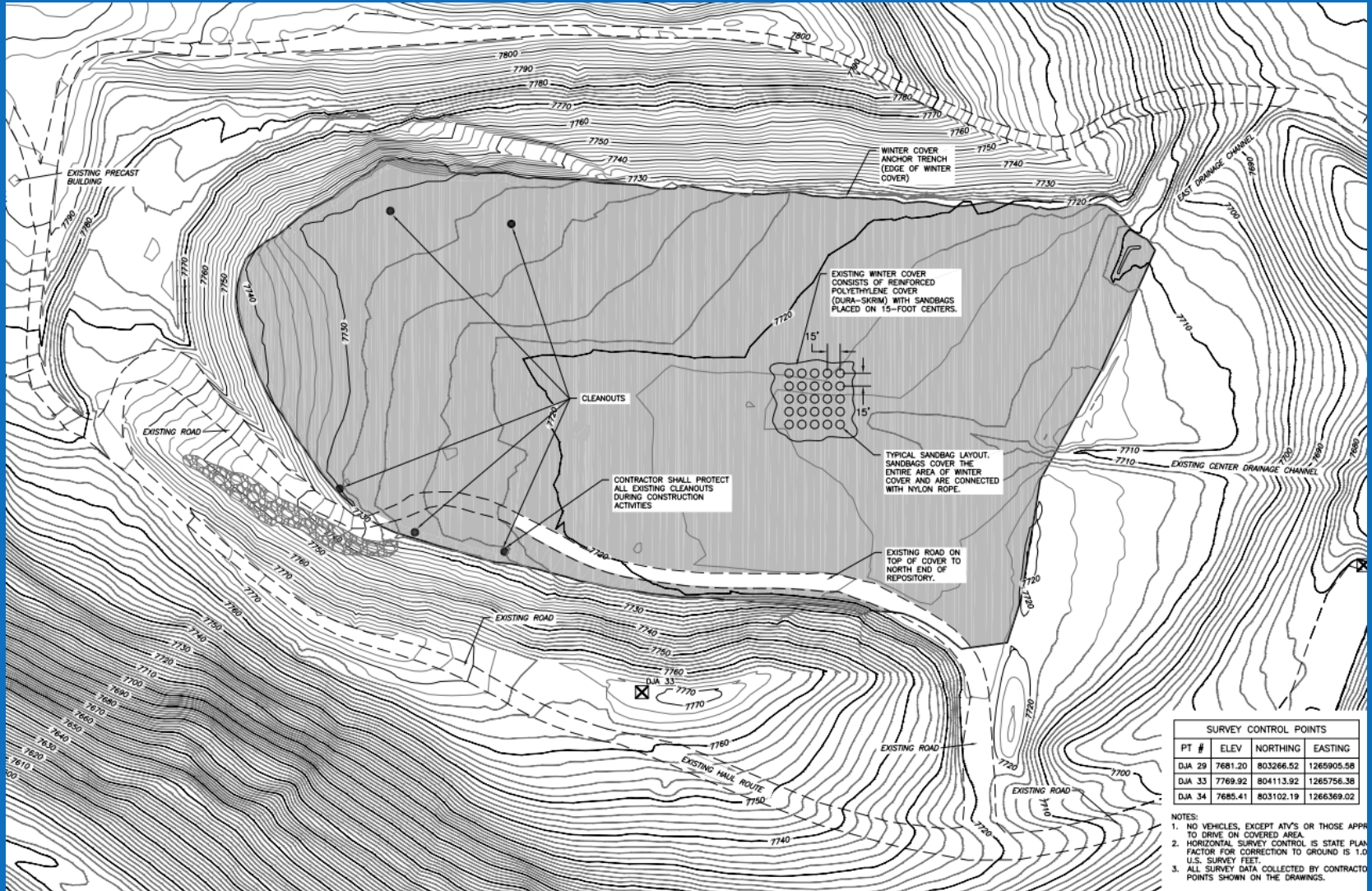
# Upper Tenmile Site

# Upper Tenmile Creek Mining Area Site

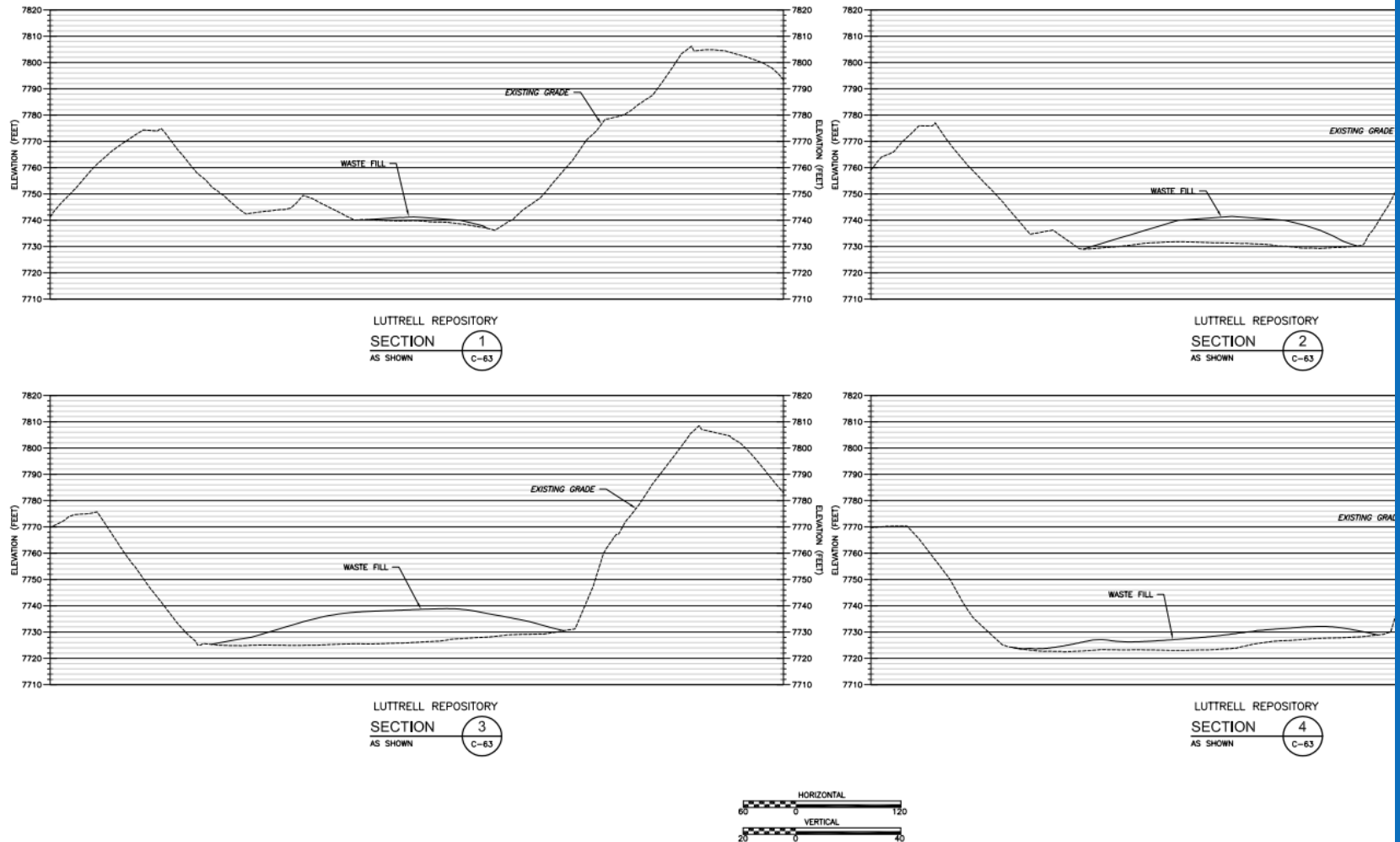
- NPL listing in 1999
- RI/FS 2000-2002
- ROD 2002
- Initial focus on residential yards with photogrammetric topography
- Shift to mine sites in 2011
- Lidar collected for entire site for mine site designs



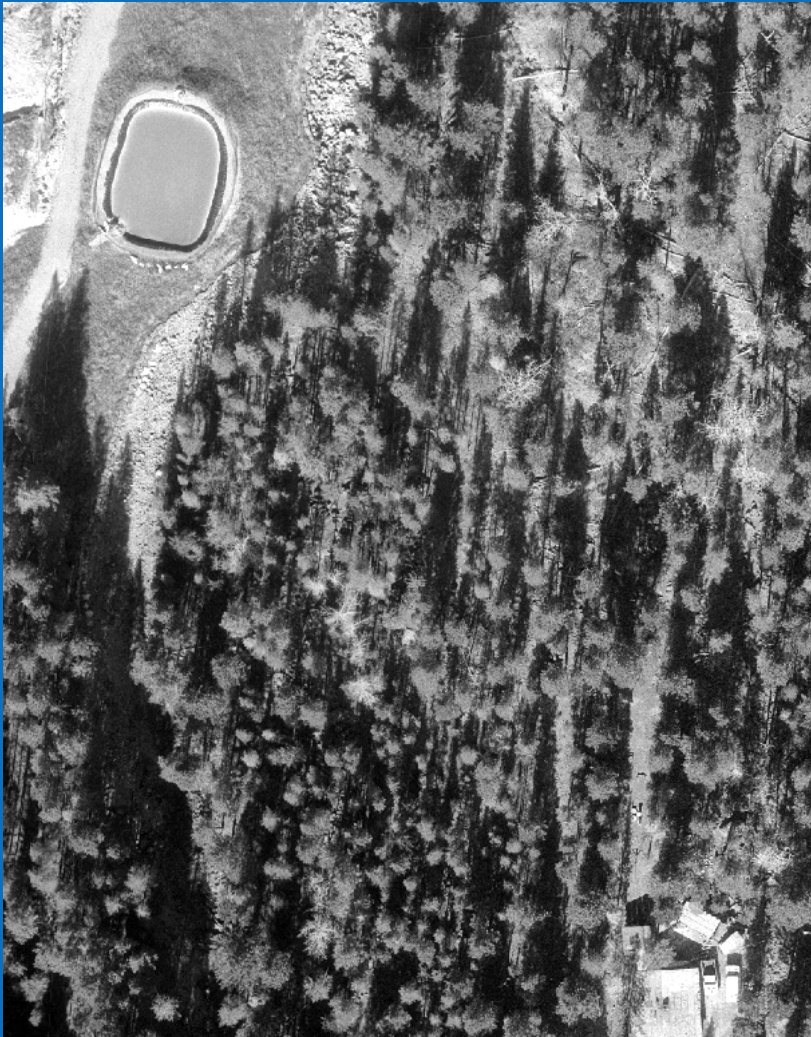
# Upper Tenmile Creek Remedial Design



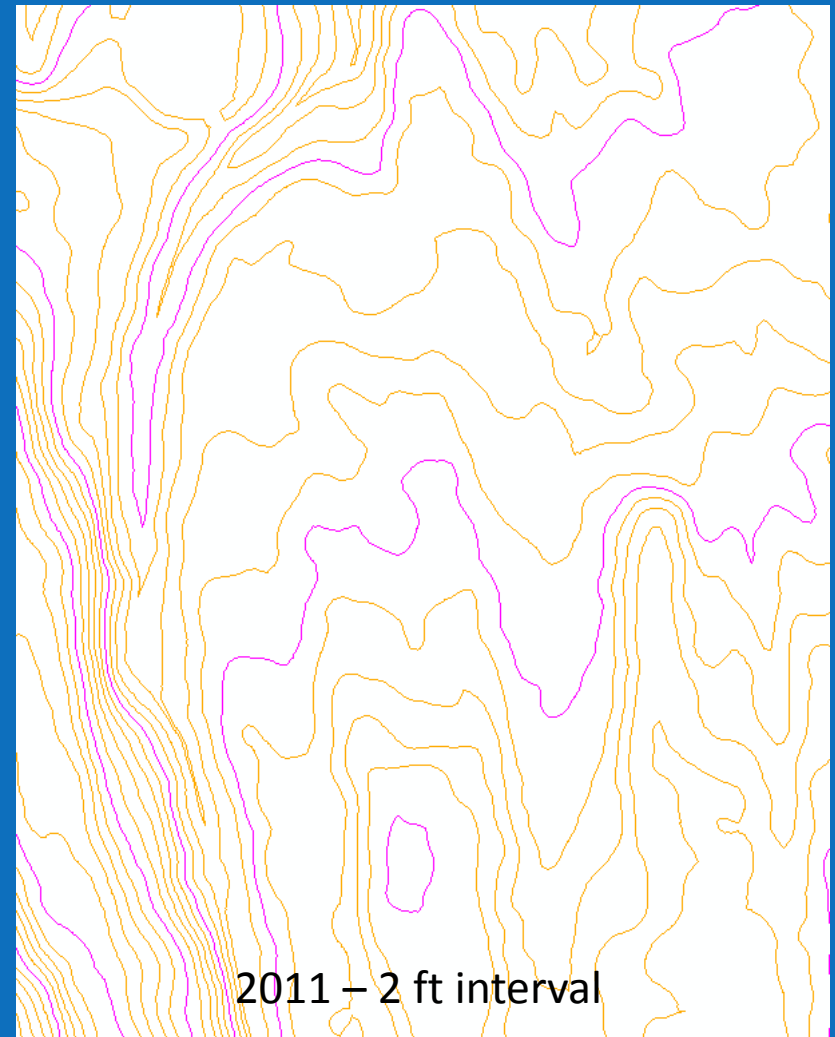
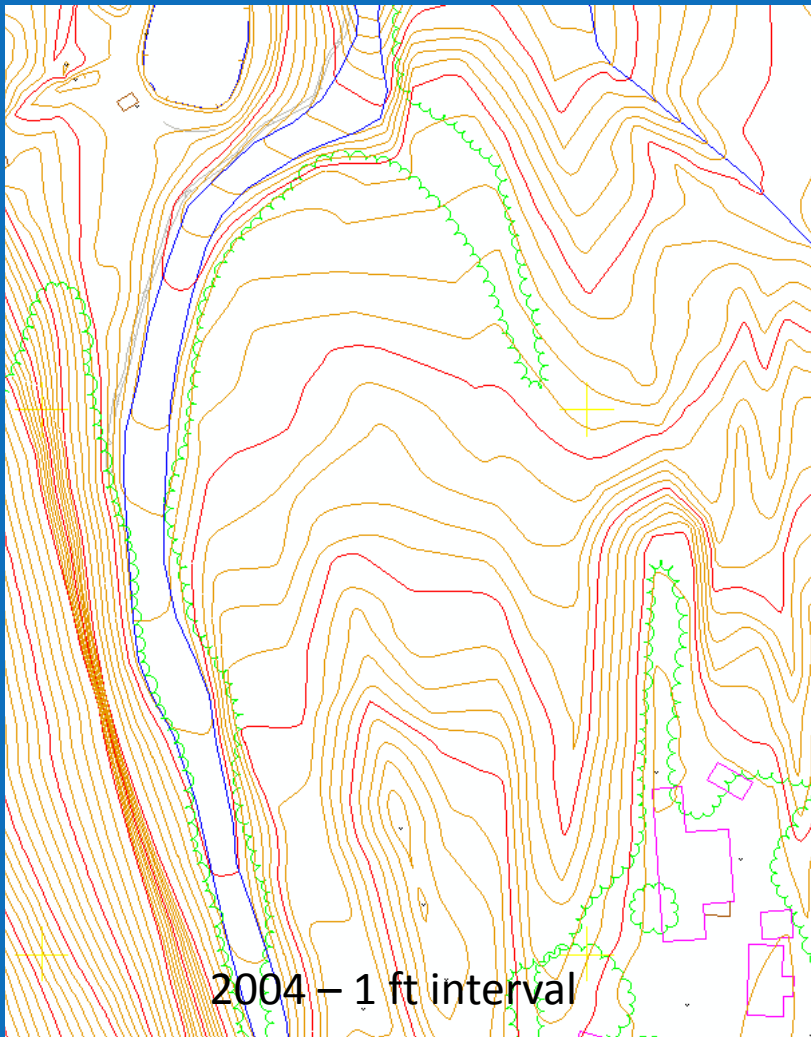
# Upper Tenmile Creek Remedial Design



# Rimini Comparison to Photogrammetry



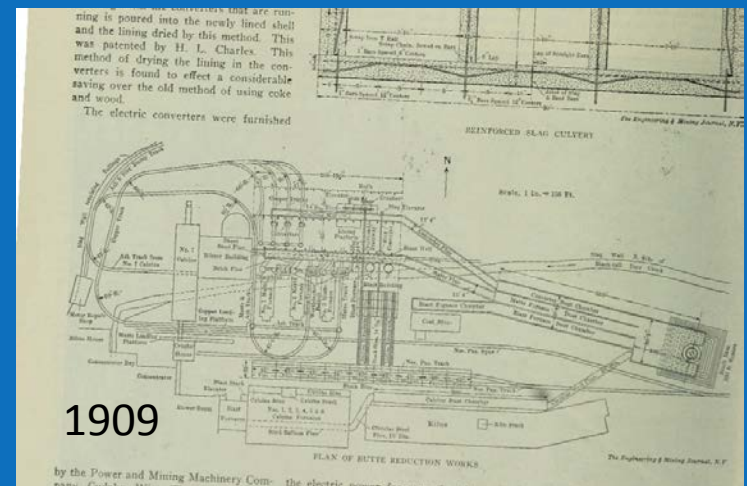
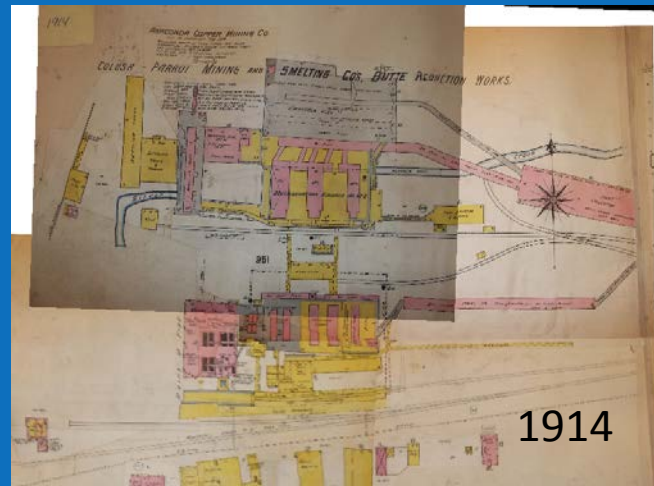
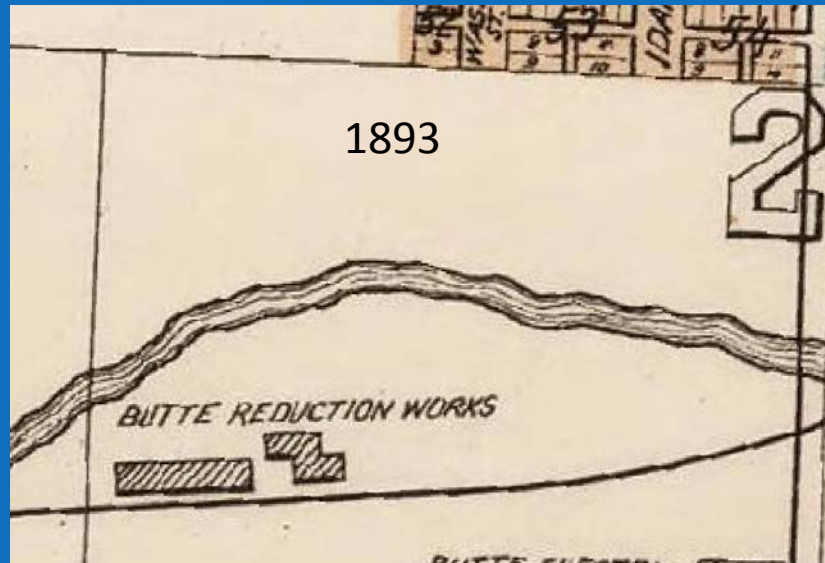
# 2004 Photogrammetry and 2011 Lidar





# Butte Reduction Works

# Butte Reduction Works, Montana



# Butte Reduction Works, Montana



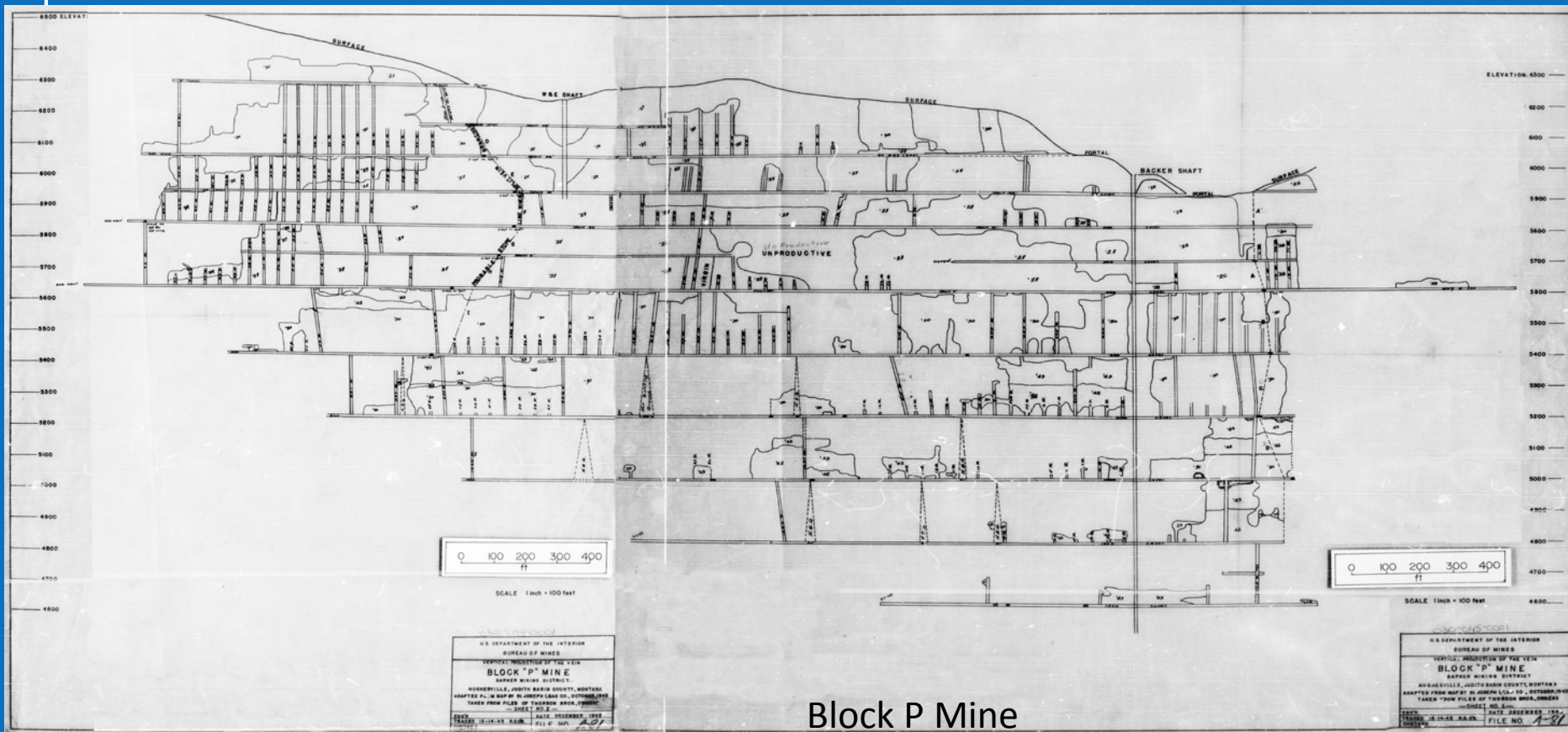
# Butte Reductions Works Smelter



- Tunnel accurately located and mapped
- 305 foot smelter stack foundation located
- Poured slag walls more accurately mapped
- Will be used for design



# Questions?



Block P Mine