FINAL REPORT

HISTORIC/ARCHAEOLOGICAL MAPPING AND TESTING
ELIZABETH MINE SITE
VOLUME I

Strafford and Thetford, Vermont

CONTRACT NO. DACW33-02-M-0187

Principal Investigator/Contributing Author:
Suzanne G. Cherau

Project Supervisor/Primary Author:
Ben Ford

Industrial Historian/Secondary Author:
Matthew Kierstead

Prepared for:
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742-2751

Prepared by:
PAL
210 Lonsdale Avenue
Pawtucket, Rhode Island 02860

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6. AUTHOR(S) Suzanne G. Cherau, Ben Ford, and Matthew Kierstead

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PAL, 210 Lonsdale Avenue, Pawtucket,
Rhode Island 02860

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13. ABSTRACT *(Maximum 200 words)*

PAL, under contract with the U.S. Army Corps of Engineers, New England District, conducted historic/archaeological mapping and testing at the Elizabeth Mine Site in Strafford and Thetford, Orange County Vermont. The investigations included background research and field investigations. The background research focused on collecting information needed to develop historic contexts for the project Area of Potential Effect (APE) and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort; 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. No prehistoric period resources were identified in the project APE, although sensitive areas were identified in other parts of the overall site, outside of the project APE. The field investigations did result in the identification of numerous industrial and domestic resources related to the historic mine operations during the nineteenth and early-to-mid twentieth century. The resources consist of visible structural remains and features along with a representative artifact assemblage recovered from the ground surface and in 50-x-50 centimeter test pits at select resource areas. Technical report recommendations included the documentation of the mine landscape (to be undertaken in the spring of 2003 as part of the mitigation efforts for the project) for the project APE and other major landscape features.

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EXECUTIVE SUMMARY

Introduction

Elizabeth Mine is a designated National Priorities List (Superfund) site, and as such, the Environmental Protection Agency (EPA) is coordinating the hazardous material cleanup of the site to protect human health and the environment. This report presents the results of an historic/archaeological mapping and testing survey of the Elizabeth Mine Site (Vermont Archaeological Inventory VT-OR-28) in Strafford and Thetford, Orange County, Vermont (see Figure 1-1 of the technical report). The currently defined site encompasses approximately 800 acres of land within the Ompompanoosuc River drainage, a major tributary of the Connecticut River. The majority of the mine site is located in South Strafford in the southern part of the town of Strafford, with an eastern portion in Thetford and small portions at its southern extremity in Sharon and Norwich, which are located in Windsor County. The site is focused on the core area of historic mining activity, although the total land area historically associated with the mine reached 8,000 acres where the mining company(s) had mining rights only. PAL conducted the archaeological investigations for the Department of the Army, New England District, Corps of Engineers (NAE).

Prior to the current investigations, the site had been studied as part of the EPA's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800. The initial cultural resources study, titled *Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Vermont,* was prepared by Hartgen Archaeological Associates, Inc. (Hartgen 2000). The supplemental report, titled *Historical Context and Preliminary Resource Evaluation, Elizabeth Mine Site, South Strafford, Orange County, Vermont* (PAL 2001), and an addendum report, titled *Addendum to Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont* (PAL 2001), were both prepared by PAL under contract with Arthur D. Little, Inc. on behalf of the EPA. The goal of the current investigations was to locate, identify, photograph, map, and in some cases draw visible structural, artifactual, and landscape features associated with the Elizabeth Mine Site. Limited subsurface testing was also conducted to locate and identify prehistoric and historic period resources within the preliminary Area of Direct Potential Effect (APE). The current APE covers an estimated 170 acres characterized by Tailing and Mine Waste Piles 1, 2, and 3 (TPs), and surrounding lands. The total current study area for the site encompasses approximately 460 acres.

The fieldwork, report, and database will assist the EPA in complying with Section 106 of the National Historic Preservation Act of 1966, as amended, for the proposed undertaking at the Elizabeth Mine Site. The report is a scholarly document that not only fulfills the mandated legal requirements, but also serves as a scientific reference for future professional studies and as a framework for possible future interpretive programs. All archaeological survey work was undertaken in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, 1983), the Advisory Council on Historic Preservation's handbook "Treatment of Archaeological Properties" (1980), and the Vermont State Historic Preservation Office's (VTSHPO) *Guidelines for Conducting Archeology in Vermont* (2002).

The Elizabeth Mine was established in the early nineteenth century and operated until the mid-twentieth century. It lies approximately one-half mile south of the West Branch of the Ompompanoosuc River, in the rugged uplands of east-central Vermont (Figure 1-2). This section of Orange County hosted mining activity in the approximately 20-mile long Copper Belt, and by the late nineteenth century was the location of several other mining operations, including the Ely Mine in Vershire (VT-OR-14) and Pike Hill Mines (Eureka and Union) (VT-OR-27) in the town of Corinth. Today, Elizabeth Mine contains major mining landscape features, numerous standing structures, and the aboveground and buried remains of structures and features

related to several periods of mining operations at the site. There are also a number of non-mining historic period farmstead sites within the approximately 800-acre mine site.

Survey Methodology

The current investigations of the Elizabeth Mine Site included additional background research and field investigations. The background research focused on collecting information needed to develop prehistoric and pre-/non-mining historic period contexts for the APE and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort (included as Appendix H of the technical report); 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. These investigations resulted in the identification of historic period resources for which there is physical evidence and the preparation of archaeological sensitivity maps for prehistoric and historic archaeological resources within the entire site.

The goal of the archaeological survey was to locate, identify, photograph, map, and in some cases draw visible structural and landscape features and artifacts associated with the Elizabeth Mine Site. These activities were conducted in the APE where cleanup activities will take place and outside the APE within documented activity areas. To accomplish this objective, three research strategies were used:

- additional archival research and local informant interviews;
- field investigations, consisting of a comprehensive site walkover/GPS survey, limited subsurface testing in the APE, and detailed drawings of select cultural features; and
- laboratory processing and analyses of recovered cultural materials.

Background research was conducted to assist in the development of prehistoric and pre-/non-mining historic period contexts. Historical contexts are needed to interpret and evaluate the significance of any Native American and Euro-American (non-mining) resources that may be identified during the field investigations. The background research for prehistoric sites primarily consisted of a review of archaeological site files and cultural resource management reports and studies maintained at the Vermont Division for Historic Preservation (VDHP) for up-to-date information about known prehistoric sites within and/or near the site. Interviews with the Native American Abenaki representatives also provided information relating to culturally sensitive locations within the site.

Additional historic research focused on examining primary and secondary documentary sources (town histories, maps, etc.), including those previously collected by PAL and others, to identify potential Euro-American (non-mining) archaeological sites within or adjacent to the project area. Interviews with local persons knowledgeable about the non-mining history of the area, including Gwenda Smith, historian/curator of the Strafford Historical Society, were conducted to assist in the development of the pre-mining historic context. An interview with mining historian Collamer Abbott regarding the industrial use of the site was also conducted, along with a review of his archival collection at the University of Vermont for preliminary information relating to its contents and potential contribution to the site's mining period history.

The first field survey task was to produce a comprehensive site plan that depicts the spatial configuration of visible features and landscape elements. This site plan is linked to the GIS cultural resources database for the site (see Appendix H of the technical report). For the purposes of this survey, the Elizabeth Mine Site includes known and documented habitation and mining activity areas at TPs 1, 2, and 3, Old South Mine, South Open Cut, Sargent Brook Smelter Site, Furnace Flat South Smelter Site, and Furnace Flat North Smelter Site.

Initially, a walkover survey with close ground inspection was conducted to locate and identify visible features and landscape elements across the site. The survey encompassed 460 acres that extended from the cemetery in the south to Furnace Flat North and from the Sargent Brook Smelter Site in the west to east of TP 1 (see Appendix B of the technical report). The types of resources that were recorded as part of the site mapping include structural features, area features, linear features, and isolates (see Table 2-1 of the technical report). The walkover survey was designed to maximize coverage of open and wooded areas, using pedestrian transects at 30-meter (m) intervals. The transects were oriented along predetermined compass headings across roughly 460 acres of the historic mining landscape.

Visible features and landscape elements identified during the walkover survey were recorded using a GPS unit. A Trimble GeoExplorer 3, containing PAL's custom historic resource GPS database, with an external antenna, set to collect from a minimum of four satellites achieving a maximum PDOP (percent dilution of precision) of seven was used to collect geographic and attribute data for all identified features. With these settings a minimum accuracy of 5 m was achieved. Linear features such as roads, trenches, and stone walls were recorded as lines, while finite objects like building corners, exploratory drill casings, and discrete artifact scatters were recorded as points, and larger more amorphous features such as large artifact scatters and mine openings were recorded as polygons. Representative photographs were taken of all recorded visible features and landscape elements.

Areas not subjected to GPS survey, because of a lack of landowner permission at the time of the field investigations, include: 1) the majority of the area along the strike of the ore north of the North Open Cut and the West Branch on the Ompompanoosuc River; 2) Lower Bailey Road east of TP 1 (the haul road near Gove Hill); and 3) two house foundations near the intersection of Furnace Flat Road and Route 132. The documented historic period resources in these areas provide information as to their archaeological sensitivity in relation to the overall Elizabeth Mine Site (see Chapter 7 of the technical report).

The information collected during the walkover of accessible site areas was transferred from the GPS unit to the project map utilizing both ESRI ArcView 3.2 and 8.1 GIS. This data was instrumental in determining where subsurface testing would occur within the project APE. Additionally, the GIS data permitted a more sophisticated analysis of the landscape and visualization of the historic spatial arrangement of the project area.

Information collected during background research and the walkover survey was used to develop a predictive model to assess the potential for the presence of Native American and Euro-American resources, the types of sites that might be found, and their cultural and temporal affiliation. The development of predictive models for locating cultural resources has become an increasingly important aspect of CRM and planning.

The predictive sensitivity model used criteria to rank the potential for the project area to contain Native American or Euro-American sites. The general criteria used to assess the Elizabeth Mine project area were proximity of known and documented cultural resources, local land use patterns, environmental characteristics, and the area's physical condition. The prehistoric period Native American archaeological sensitivity of the Elizabeth Mine Site was based on the VDHP's environmental predictive model for pre-contact settlement sites and information collected during the walkover survey on current project area conditions. The predictive

model alone was not sufficient because it provides only a rough approximation of an area's sensitivity while the walkover survey took into account the relative importance of resources and natural barriers to their procurement. Because of the size of the APE and the diversity of environments contained within it, it was necessary to divide the Native American archaeological sensitivity assessments into eight regions based on an environmentally derived parsing of the landscape.

The likelihood of Euro-American archaeological resources was a foregone conclusion based on the intensive mining use of the site during the historic period and the previous historic and archaeological studies conducted by PAL and others. However, based on historic maps and the comprehensive walkover survey it was possible to identify areas of intensive Euro-American utilization, areas of sporadic Euro-American use, and areas where there were little or no Euro-American resources. Furthermore, by georeferencing, or "rubber-sheeting," historic maps of the mine on top of the modern project map it was possible to ascertain which historic resources had been buried or destroyed by subsequent mining campaigns. Based on the GPS survey and archival research a number of Euro-American industrial and domestic occupation areas were identified within/adjacent to and outside of the project APE at the Elizabeth Mine Site. The large majority of these areas were grouped collectively within designated subsites, or vicinities of intensive occupation.

Limited subsurface testing was conducted in moderate and high archaeologically sensitive portions of the project APE to locate and identify any potentially important archaeological resources. A total of 73 test pits were excavated for historic period resources within the project APE. These test pits, 50-x-50 centimeters (cm) in size, were excavated at 8-m intervals along 14 judgmental linear transects and as 28 judgmentally placed test pits. Specific subareas subjected to subsurface testing include: the World War I Era Smelter Site, the Tyson Mill Site (specifically the blacksmith shop), the Preston Farm, the Blaisdell Farm, the Farm, North Village, South Village, and TP3 (cob shop, Upper Copperas Factory). Subsurface testing was conducted at a representative sample of visible historic period resources within the project APE. This testing was designed to collect archaeological data on the temporal affiliation, possible function(s), and subsurface soil matrices for individual resource areas (or subsites) where this information was not readily discernable based on visual characteristics alone.

In addition to the above testing, 44 test pits were placed in areas of the project APE determined to be archaeologically sensitive for prehistoric period resources based on the results of the predictive model, walkover survey, and consultation with representatives of the Abenaki Tribe. An additional four test pits were placed in the area northeast of TP1 in proximity to a culverted branch of Copperas Brook. All of these test pits, 50-x-50 cm in size, were excavated at 8-m intervals along nine judgmental transects and as six judgmentally placed test pits.

Furnace Flat North, Furnace Flat South, Tyson Mill Site, Sargent Brook Smelter Site, Blaisdell Farm, the Farm, North Village, TP3, South Village, the Twin Foundations, East Village, and the Lower Copperas Factory contain visible structures and landscape features that were subjected to detailed plan and cross-section line drawings. Plan maps, which show the spatial relationship of the various features of a resource, were created at either a scale of 1 inch equals 2 m or 1 inch equals 5 m, depending on the size of the resource. Similarly, cross sections were employed to depict the topographic relationships between the various features as well as aspects of wall construction.

Cross sections were completed at a scale of 1 inch equals 2 m. In general the transit was used to establish a baseline and measurements were taken relative to the transit along a tape measure to create the cross sections. However, a number of the shorter wall profiles were drafted using a tape measure across the top of the wall with measurements taken down from the top of the wall. In general the plan maps were created using a hand compass and tape measure to establish the angles and distances between points within a resource. However, in

the case of TP3 where the exceedingly steep slope of the area prohibited the effective use of a tape measure, the transit was used to measure both angle and distance. The field maps were digitized using AutoCAD 2000i and were then exported into the GIS database. Besides adding more detail to the GIS map the field drawings permitted the data collected during the GPS survey to be corrected for greater accuracy.

All cultural materials recovered from the project APE during subsurface testing and representative industrial-related artifacts collected from the entire site during the field mapping were organized by subsite and provenience, and recorded and logged in on a daily basis. Cultural materials were sorted by type and either dry brushed or cleaned with tap water depending on the material or artifact type and condition. Following the laboratory processing and cataloging activities, all recovered cultural materials were stored in acid-free Hollinger boxes with box content lists and labels printed on acid-free paper. These boxes are being *temporarily* stored at the PAL facilities in Pawtucket, Rhode Island according to curation guidelines established by the U.S. Army Corps of Engineers.

Results

No prehistoric period cultural resources were encountered during the archaeological mapping and testing at the Elizabeth Mine Site. While upland cultural adaptations have been recorded in northern New England, especially during the Late Archaic and Late Woodland periods, the focus of Native American activity in the region appears to have been concentrated in the major river valleys. With the Connecticut River only a few miles to the east, there may have been only sporadic prehistoric period settlement and land use in the vicinity of the West Branch of the Ompompanoosuc River and Copperas Brook. The rugged, upland topography would not have been particularly attractive for the types of long-term habitation activities (e.g., structures, food processing/storage/disposal pits, hearths, lithic workshops) that would have left readily discernable cultural deposits in the archaeological record at the site. There are only limited settings within the site study area that are relatively flat and contain sources of raw materials and perennial water sources where potentially important prehistoric period resources could be present. These settings include the terrace overlooking the West Branch of the Ompompanoosuc River in the northeast portion of the study area, north of TP1; and quartz outcrops in the west-central portion of the study area, west of the North Open Cut.

A total of 545 distinct historic period features was recorded during the GPS component of the fieldwork. Identified artifact, feature, and structure concentrations were collectively organized into 18 spatially distinct historic period industrial and domestic subsites related to the nineteenth and twentieth-century operations of the Elizabeth Mine. The historic and archaeological mapping and testing program identified 11 industrial archaeological subsites, seven domestic archaeological subsites; and 43 architectural resources including 31 buildings, nine structures, one individual object, and a multiple object artifact scatter. Thirteen of the industrial and domestic archaeological subsites are located in the project APE. Twenty-eight of the architectural resources are located within the APE. All of the identified archaeological and architectural resources were interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address salient research questions, The following three tables summarize the identified cultural resources by type, time period, major visible physical remains, integrity, and historical research value (documentary data, archaeological sensitivity).

The identified historic period architectural and archaeological resources at the Elizabeth Mine Site are all components of a larger, complex, integrated cultural landscape. The Elizabeth Mine can be considered a single megasite composed of numerous temporally, functionally, historically and physically related industrial, agricultural, domestic and administrative subsites. The natural and man-made environments provide the most

Executive Summary-Table 1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
World War I Smelter	1916	- Concrete platform (floor); - Piles of brick and rebar; - Iron scraps and slag	Eight test pits - yielded construction materials including a handmade brick	Poor	Poor	Low
Tyson Mill	1899 to 1930	- Section of stone foundation - Concrete pads and piers; - Angle iron bases; - Timber arrangements	Twelve test pits in blacksmith shop area - yielded fire-reddened earth, coke, slag, charcoal, and window glass	Fair to Good?	Fair	High
Tailings Pile 1	1940s to 1950s	415-m-x-490-m flat, triangular plateau of mine waste; visible launder trestle supports	N/A	Excellent	Good	Low
Tyson Smelter (buried under west toe)	ca. 1900-1902	None	N/A	Unknown	Fair	High
Heckscher Smelter (partially buried Copperas Brook dam and slag heap - north toe)	ca. 1907-1909	- Burnt ore and slag; - Dam remains (altered topography)	N/A	Unknown	Fair	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Tailings Pile 2	1940s to 1950s	150-m-x-140-m triangular flat-top pile of mine waste	N/A	Excellent	Good	Low
Buried ephemeral Tyson Mill Period outbuildings/sheds and waste rock piles. (See Preston Farm, Table 7-2)	ca. 1900-1902	None	N/A	Unknown	Poor	Low
Tailings Pile 3 (contains visible remains of 19th c. and early 20th c. resources)	1809-1958	See below	See below	See below	See below	See below
North Open Cut	1809-1958	Open excavation	N/A	Excellent	Good	Low
Tyson Mining Zone	ca. 1880s	- Manway; - Shafts 1 and 2; - Clinker pile; - Waste rock	No subsurface testing conducted	Fair	Fair	Moderate
Water Reservoir and Dam	19th century	- Dam - Reservoir	No subsurface testing conducted	Good	Low	Low
Leaching and Roasting Beds	1809-1882	- Scaffolding : wood planks and timber features; - Brick-lined channel; - Ore corrals - Piles of roasted ore, - Piles of burnt fused ore - Piles of waste rock	Four test pits - yielded construction materials and industrial waste	Fair	Fair	High
Blacksmith Shop	ca. 1874	- Stone foundation; - Iron plates and implements	See above	Fair to Good?	Poor	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Cob Shop	ca. 1874	- Stone foundation	See above	Fair to Good?	Moderate	High
Upper Adit	ca. 1830	- Possible stone foundation - Collapsed mouth	See above	Fair	Poor	Low
Lower Adit (Deep)	ca. 1854	-collapsed mouth -wasterock pile	No subsurface testing required	Fair	Poor	High
Evaporators	ca. 1874	- Possibly one of 3 visible as stone wall protruding from yellow waste-rock	No subsurface testing conducted	Poor	Poor	High
Upper Copperas Factory	19th century	- Interior and exterior stone foundations, stanchions, and wood wall posts	Five test pits - yielded construction materials and industrial waste; three ceramic sherds	Good	Poor	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Lower Copperas Factory	19th century	- Interior and exterior stone foundations; iron chutes and plats; platforms; stanchions, brick piles; earth berms	No subsurface testing conducted - fire brick and iron bracket (wood supports) surface collected; iron chutes and arch noted.	Excellent	Poor	High
Outside of the APE:						
Furnace Flats North	1854-1884	- Dam embankment - Saw mill foundation - Cooper shop foundation and turbine shaft - Wheel pit - Furnace area - Two paint factories - Bath house foundation - Bridge abutment - Domestic component: two house and one barn foundations	No subsurface testing conducted	Excellent	Poor	High
Furnace Flats South	ca. 1830	- Bridge abutment - Haul road (1830s) - Furnace debris including salamanders, slag piles, and refractory material - Charcoal storage platform	No subsurface testing conducted	Excellent to unknown	Poor	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Sargent Brook Smelter	1882-1890	- Haul road - Foundation - Stalls - Reservoir - Dam - Charging ramp - Furnace floor - Furnace hood and binder rods - Slag dump	No subsurface testing conducted	Good	Fair	High
Old South Mine	early 19th century	- Two large excavated trenches - Waste rock piles - Exploratory trenches - Adit mouth - Domestic foundation	N/A	Good	Poor	Moderate
South Open Cut	1950	- 500-m-x-40-m excavated trench; - Various logging and haul roads; - Tunnel leading to North Open Cut; - Drill steels in bedrock. - Waste rock pile	N/A	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address research questions relating to the mine technology and the lifeways of mine workers.

Executive Summary Table 2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Completely or Partially Within the APE:						
Blasdell Farm	19th century	House and barn foundations/cellar holes; well	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
The Farm	19th century	House foundation/cellar hole and stone retaining wall	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
Preston Farm (buried beneath southeast toe of TP2)	ca. 1828-1890	Stone-lined roadway leading into TP2 (buried foundations are suspected)	Ten test pits - yielded low density of nondescript bottle glass and brick	Unknown	Good	High
North Village	19th century	Two (mine agent?, mine family?) house/cellar hole foundations and two terraces associated with barn foundations	Eight test pits - yielded moderate density of19th c. and early 20th c. domestic and construction debris.	Fair to Poor	Poor	High
Office	19th century	One cellar hole/foundation, and related platform	Six test pits - yielded moderate density of mid-19th c. to early 29th c. domestic and construction debris	Fair to Poor	Fair	High
South Village	ca. 1809-1880	Seven house cellar hole/foundations, two barn foundations	Eight test pits - yielded a relatively high density of 19th c. to early 20th c. domestic and construction debris. Of note, only domestic site with a faunal assemblage	Excellent	Poor	High

Executive Summary Table 2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Twin Foundations	19th century	Two nearly identical stone foundations with cellar holes; possibly well or privy depression	No testing conducted; dense surface scatter of 19th c. to early 20th c. domestic debris.	Excellent	Poor	High
East Village	ca. 1809-1942	Three (boarding?) house foundations and possibly well/privy depressions on south side of Mine Road; connected house and barn foundation with intact agricultural landscape on north side of Mine Road	No subsurface testing; surface collection of representative 19th c. domestic materials; farm machinery observed in woods	Good	Poor	High
Outside of the APE: see Table 7-1 - Furnace Flats North contains remains of several domestic structures; TP1 is documented to encompass a late 19th/early 20th c. boardinghouse.						
Teamster's Foundation	mid-19th century	drylaid fieldstone and earth berm foundation	No subsurface testing conducted	Good	Good	Low
Unnamed Foundation	unknown	drylaid stonewall corner section	No subsurface testing conducted	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address priority research questions for Vermont relating to the lifeways of workers and local farmers.

[3] based on expected available sources: land evidence and probate records, tax records etc; company records, anecdotal/travelers accounts historic photographs

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Copper Castle	B	Y	ca. 1840-1855	Excellent (inhabited dwelling)	High	High
Infirmary/Carpenter Shop	B	Y	ca. 1850	Excellent (inhabited dwelling)	High	High
Club House	B	Y	late 19th/early 20th c.	Fair (altered, inhabited dwelling)	High	High
Buena Vista House Buena Vista Barn Complex Buena Vista Ash House	B B B	N N N	1859 ca. 1859 ca. 1859	Excellent (inhabited dwelling) Excellent Excellent	High High High	High High High
Lower Water Tank Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
Laboratory/Assay Office	B	Y	1941-1958	Excellent (inhabited dwelling)	High	Moderate
Office/Warehouse	B	Y	1941-1958	Excellent	High	Moderate
Machine Shop	B	Y	1941-1958	Excellent	High	Moderate
Shed south of Machine Shop	B	Y	1941-1958	Fair	Moderate	Low
Compressor Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
1898 Adit	S	Y	1898 - rebuilt ca. 1942	Good	High	Low
Change House	B	Y	1941-1958	Excellent	High	Moderate
Shed behind Change House	B	Y	1941-1958	Fair	Moderate	Low
Shed northeast of Change House	B	Y	1941-1958	Poor	Moderate	Low
Artifact Scatter northeast of Change House	O	Y	1941-1958	N/A (various steel objects and machinery	High	High

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Mine Car Bridge	S	Y	1941-1958	Good	High	Low
Ore Bin	S	Y	1941-1958	Poor	High	Low
Storage Shed northwest of Crusher Building	B	Y	1941-1958	Fair	Moderate	Low
Crusher Building	B	Y	1941-1958	Poor (superstructure and machinery removed)	High	Low
Grinding/Flotation Mill	B	Y	1941-1958	Fair (roof partially collapsed, machinery removed)	High	Low
Thickener/Drier Building	B	Y	1941-1958	Fair (north section demolished, all equipment removed)	High	Low
5-Bay Garage	B	Y	1941-1958	Excellent	Moderate	Low
Heating Plant/Pipe Shop	B	Y	1941-1958	Excellent	High	Low
Flotation Cells	O	Y	1941-1958	Poor (not in situ - removed from Grinding/Flotation Mill, motors and agitators missing)	High	Low
Launder Trestle	S	Y	1941-1958	Poor (partially buried uprights)	High	Moderate
Upper Tailings Pumphouse	B	Y	1941-1958	Fair	High	Moderate
Lower Tailings Pumphouse	B	Y	1941-1958	Poor (ruin)	Moderate	Low
Warming Hut	B	Y	1941-1958	Fair (may not be in situ)	Moderate	Moderate
World War II Housing	(Site)	N	1941-1958	N/A (buildings demolished, but site terracing still visible)	N/A	High
Community Center	B	N	1941-1958	Fair (altered inhabited dwelling)	High	High
Upper Water Tank Building	B	Y	1941-1958	Poor (foundation only)	Moderate	Low

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
1948 Shaft Hoist House	B	N	1941-1958	Poor (foundation and machinery bases only)	Moderate	Low
1948 Shaft Idler Tower	S	N	1941-1958	Poor (tower demolished)	Moderate	Low
1948 Shaft Headframe	S	N	1941-1958	Poor (shaft capped, headframe demolished)	Moderate	Low
River Pumphouse (WW II)	B	N	1941-1958	Poor (collapsed)	High	Low
River Pumphouse (Heckscher)	B	N	ca. 1906-1916	Poor (concrete foundation and machinery footings only)	Moderate	Low
Air Shaft and Electrical Substation	S	N	1941-1958	Fair (shaft capped, transformers removed)	Moderate	Low
Air Vent	S	N	1941-1958	N/A (steel pipe)	Moderate	Low
Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	Mid-1800s	Excellent (inhabited dwelling)	Moderate	High
Copper Shed at Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	1941-1958	Fair (altered)	High	Low

B=building
S=structure
O=object

[1] Architectural Integrity = primarily based on the degree of alteration, however, condition is indicated where relevant.
[2] Historical Research Value = based on the potential to reveal information on the arrangement, architecture, construction, and technology of the historic mining system and lifeways of the mine workers, managers, and neighbors.
[3] Associated Archaeological Resource Potential = based on the likelihood for intact ground surfaces within the surrounding landscapes that could contain potentially significant belowground resources.

dramatic visual images of the mine, and are as important as the buildings, structures, features, and artifacts arranged within them. The cultural landscape at Elizabeth Mine provides insights into the technological advances of copperas production, copper mining and metallurgy, and informs about how the arrangement of features defines socioeconomic relations of the inhabitants.

Recommendations

No prehistoric period Native American resources were identified within the project APE. The results of subsurface testing conducted within the APE combined with unfavorable environmental factors and the extent of historic period industrial soil disturbances indicates an overall low potential for important prehistoric period resources to be present. No additional archaeological investigations for prehistoric period sites within the project APE are recommended.

The 13 APE historic mine period subsites and associated landscape features interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address priority research topics related to themes of industry and abandoned communities important to Vermont history (see VDHP 2002:22). The industrially-related research themes for the identified Elizabeth Mine resources within the project APE focus on the various mine technologies, spatial organization of industrial complexes, and the living conditions of the mine workers. These research themes have been identified as important to Vermont history, and as such should be important to a broad public, including the communities of Strafford and Thetford.

Prior to any earthmoving activities related to the site environmental characterization work, documentation of the mine landscape will be undertaken in the spring 2003 as part of the mitigation efforts for the project. These activities are likely to cause irrevocable changes to the landscape and important cultural features related to industrial and domestic subsites. The landscape documentation will encompass the project APE and other major landscape features including the South Open Cut. The landscape documentation will consist of aerial photographs of the TP1/2/3/North Open Cut/South Open Cut landscape, done in the most archivally stable color transparency film available with some additional black-and-white; and terrestrial large format (4" x 5" negative) color transparency and black-and-white photographs of the TP1/2/3/North Open Cut/South Open Cut landscape.

The current survey identified industrial and domestic archaeological resource areas within the project APE that have the potential to address important priority research topics in the state of Vermont (refer to Executive Summary Tables 1 and 2/Tables 7-1 and 7-2 in the technical report). The proposed trenching associated with the site environmental characterization work should take place with consideration for further investigating industrial archaeological resources as shown on Figure 8-1 and in Appendix B of the technical report. A collaborative effort between cultural resource specialists and the geotechnical team would be expected to provide some of the information identified as data gaps in the research priority topics discussed above. Pending the evaluation of archaeological data collected during the site characterization work, additional systematic archaeological investigations of targeted resources may be warranted as part of mitigation efforts for the project. However, the Corps and EPA have no plans to pursue additional archaeological investigations at this time either to further address the research questions or as possible mitigation. Domestic archaeological resource areas having high research potential should be avoided during site environmental characterization work and cleanup activities.

It is possible that additional areas of potential effect including borrow pits and access roads may be identified in archaeologically sensitive areas outside of the current APE, in which case archaeological survey may be warranted. The survey work would be designed to identify and evaluate any potentially important

belowground historic period resources. The need for and scope of additional archaeological investigations within project impact areas will be included in the project's Memorandum of Agreement (MOA).

There are no current plans to alter the WWII buildings in the project APE. However, given their relatively unstable condition and importance to the overall mine site, Historic American Engineering Record (HAER) documentation will be undertaken in the spring of 2003 as part of the mitigation efforts for the project. These buildings and structures include: the upper tier of administrative, maintenance, and operational buildings; the adit and mine car rail line and bridge; the lower tier of ore bin, crusher, grinding/flotation mill, thickener/drier building, tailings pump house and launder remains; the 1948 Shaft Site, TP1 and 2, the Ompompanoosuc River Pump House and Air Shaft, and any other miscellaneous associated resources. Standard HAER documentation will consist of recording the buildings with a set of measured drawings showing site plans, materials handling routes and process flow charts. Although the PAL Historic Context Report (PAL 2000) contains a general history of the Elizabeth Mine that could serve as a basis for the HAER narrative report component, that document will be updated to reflect new information discovered during the course of subsequent research and fieldwork, and edited to shift the focus primarily to the Elizabeth Mine. Since the HAER documentation concentrates strongly on process, the narrative and drawings will be created in consultation with an industrial historian knowledgeable about the Elizabeth Mine and the ore beneficiation processes used there. A set of photographs separate from the above-mentioned landscape documentation will be done in large format (4" x 5" negative) for the building exteriors (interiors if available) using mostly black-and-white with some color, and also including limited representative views of the TP1/2/3 and North/South Open Cuts landscapes as they were sources of ore during the World War II period.

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CHAPTER ONE

INTRODUCTION

Scope and Authority

Scope

This report presents the results of the historic/archaeological mapping and testing survey of the Elizabeth Mine Site (Vermont Archaeological Inventory VT-OR-28) in Strafford and Thetford, Orange County, Vermont (Figure 1-1). The currently defined site encompasses approximately 800 acres of land within the Ompompanoosuc River drainage, a major tributary of the Connecticut River. The majority of the mine site is located in South Strafford in the southern part of the town of Strafford, with an eastern portion in Thetford and small portions at its southern extremity in Sharon and Norwich, which are located in Windsor County. The site is focused on the core area of historic mining activity, although the total land area historically associated with the mine reached 8,000 acres where the mining company(s) had mining rights only. Elizabeth Mine is a designated National Priorities List (Superfund) site, and as such, the Environmental Protection Agency (EPA) is coordinating the hazardous material cleanup of the site to protect human health and the environment. PAL conducted the archaeological investigations for the Department of the Army, New England District, Corps of Engineers (NAE).

Prior to the current investigations, the site had been studied as part of the EPA's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800. The initial cultural resources study, titled *Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Vermont,* was prepared by Hartgen Archaeological Associates, Inc. (Hartgen 2000). The supplemental report, titled *Historical Context and Preliminary Resource Evaluation, Elizabeth Mine Site, South Strafford, Orange County, Vermont* (PAL 2001), and an addendum report, titled *Addendum to Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont* (PAL 2001), were both prepared by PAL under contract with Arthur
D. Little, Inc. on behalf of the EPA. The goal of the current investigations was to locate, identify, photograph, map, and in some cases draw visible structural, artifactual, and landscape features associated with the Elizabeth Mine Site. Limited subsurface testing was also conducted to locate and identify prehistoric and historic period resources within the preliminary Area of Direct Potential Effect (APE). The current APE covers an estimated 170 acres characterized by Tailing and Mine Waste Piles 1, 2, and 3 (TPs), and surrounding lands. The total current study area for the site encompasses approximately 460 acres.

The fieldwork, report, and database will assist the EPA in complying with Section 106 of the National Historic Preservation Act of 1966, as amended, for the proposed undertaking at the Elizabeth Mine Site. The report is a scholarly document that not only fulfills the mandated legal requirements, but also serves as a scientific reference for future professional studies and as a framework for possible future interpretive programs.

Authority

The archaeological investigations were conducted under the authority of the National Historic Preservation Act of 1966, (P.L. 89-665; 80 Stat. 915) as amended (16 U.S.C. 470 et seq.); the Comprehensive

Environmental Response, Compensation, and Liability Act (CERCLA–U.S. Code–Title 42); the American Indian Religious

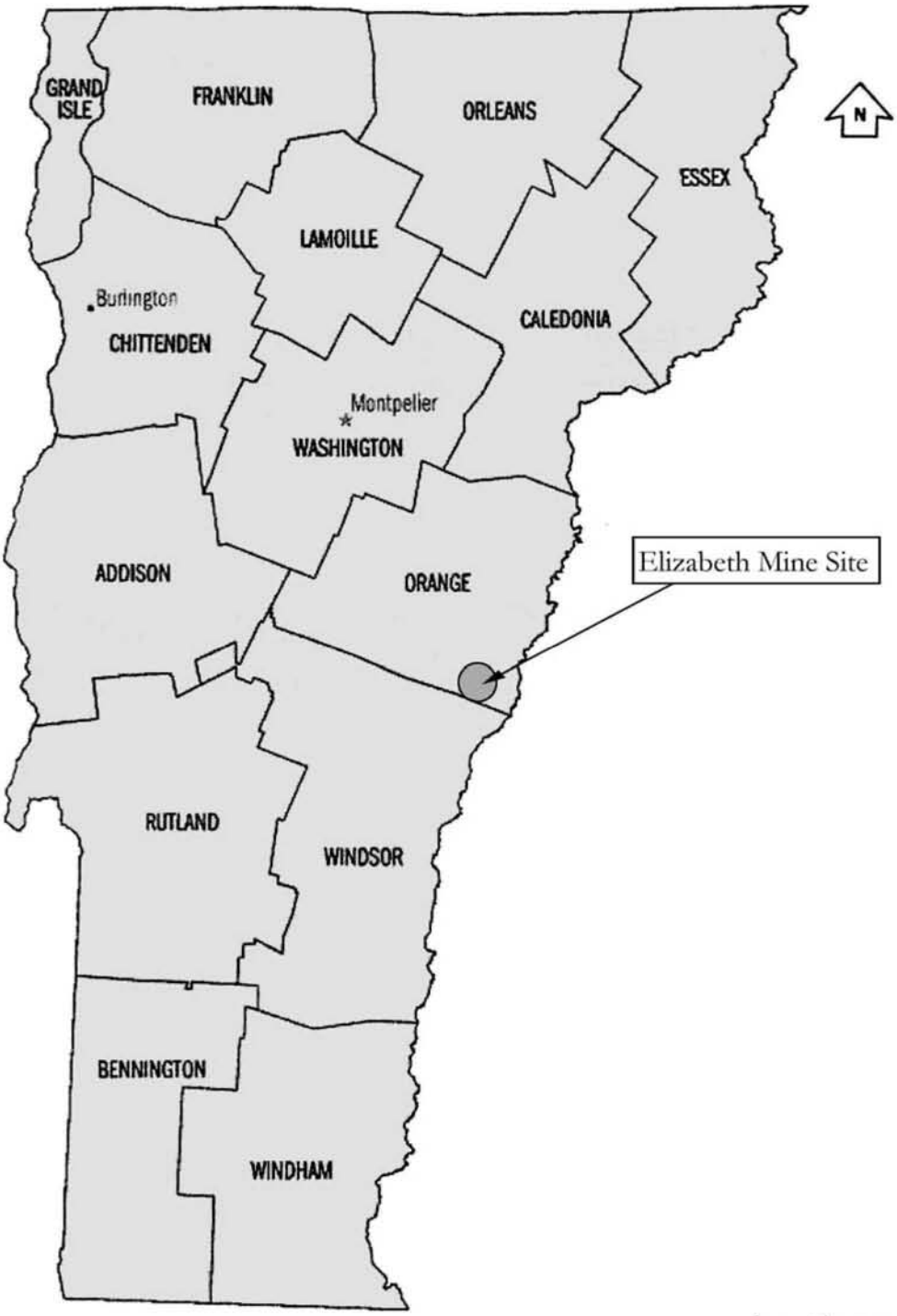


Figure 1-1. Map of Vermont, with the location of the Elizabeth Mine Site in Orange County.

Freedom Act of 1978 (P.L. 95-341; 92 Stat. 469; 42 U.S.C. 1996); the Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001-3013); the Advisory Council on Historic Preservation, Protection of Historic Properties (36 CFR 800); and the National Register of Historic Places, Nominations by States and Federal Agencies (36 CFR Part 60).

All archaeological survey work was undertaken in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, 1983), the Advisory Council on Historic Preservation's handbook "Treatment of Archaeological Properties" (1980), and the Vermont State Historic Preservation Office's (VTSHPO) *Guidelines for Conducting Archeology in Vermont* (2002).

Site Description

The Elizabeth Mine was established in the early nineteenth century and operated until the mid-twentieth century. It lies approximately one-half mile south of the West Branch of the Ompompanoosuc River, in the rugged uplands of east-central Vermont (Figure 1-2). This section of Orange County hosted mining activity in the approximately 20-mile long Copper Belt, and by the late nineteenth century was the location of several other mining operations, including the Ely Mine in Vershire (VT-OR-14) and Pike Hill Mines (Eureka and Union) (VT-OR-27) in the town of Corinth. Today, Elizabeth Mine contains major mining landscape features, numerous standing structures, and the aboveground and buried remains of structures and features related to several periods of mining operations at the site. There are also a number of non-mining historic period farmstead sites within the approximately 800-acre mine site.

Nature of Study

The current investigations of the Elizabeth Mine Site included additional background research and field investigations. The background research focused on collecting information needed to develop prehistoric and pre-/non-mining historic period contexts for the APE and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort; 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic
period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. These investigations resulted in the identification of historic period resources for which there is physical evidence and the preparation of archaeological sensitivity maps for prehistoric and historic archaeological resources within the entire site.

Personnel

Background research and field investigations for the Elizabeth Mine Site were conducted from May to August 2002. PAL staff involved in the project includes Deborah C. Cox (project manager), Suzanne G. Cherau (principal investigator), Matt Kierstead (industrial historian), Ben Ford (project supervisor), and Will Burdick, Jessi Halligan, and Fred Lumb (archaeological assistants). Matt Kierstead conducted the photography and assisted with the field mapping. Ben Ford, assisted by Paul White, collected the GPS data. Paul White created the GIS database, which was later modified by Ben Ford. Will Burdick and Dana Richardi digitized the field maps in AutoCAD. Tim Kardatzke (laboratory supervisor) and Timothy Ives (laboratory analyst) were responsible for the processing and cataloging of all cultural materials.

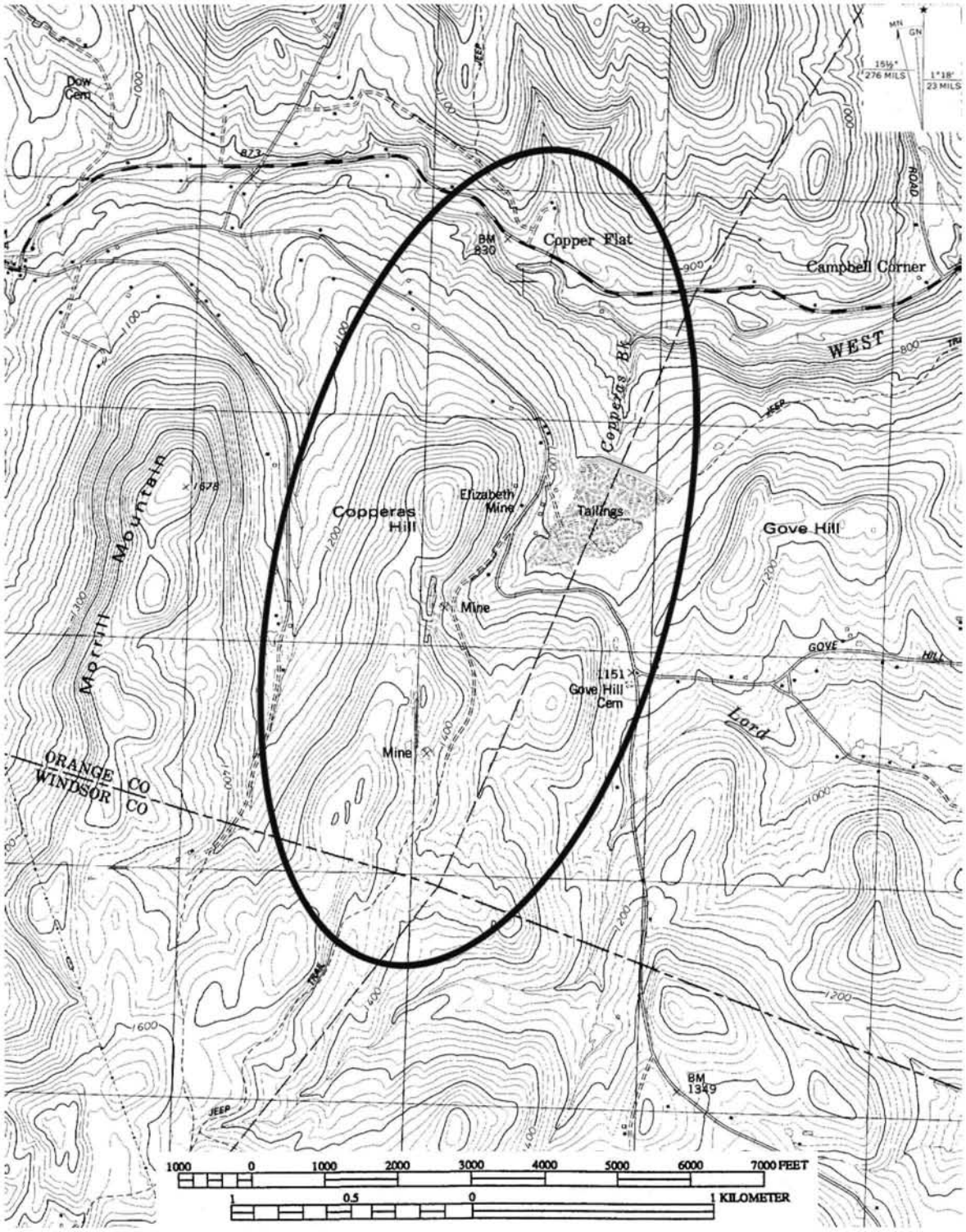


Figure 1-2. Location of the Elizabeth Mine Site on the South Strafford, Vermont USGS topographic quadrangle, 7.5 minute series.

Acknowledgements

The authors would like to acknowledge the assistance of mining historians Collamer M. Abbott of White River Junction, Vermont, and Johnny Johnsson of Finksburg, Maryland; Gwenda Smith, historian/curator of the Strafford Historical Society; and the staffs of the University of Vermont Bailey-Howe Library Special Collections Department, Burlington, Vermont; the Vermont State Library and Vermont State Archives, Montpelier, Vermont; and Vermont Historical Society Library, Barre, Vermont.

Disposition of Project Materials

All project information (i.e., field recording forms, maps, cultural materials, and photographs) is currently on file at PAL, 210 Lonsdale Avenue, Pawtucket, Rhode Island. PAL serves as a *temporary* repository for the recovered cultural materials. The permanent curation of this artifact collection will be the subject of consultation between the EPA, VTSHPO, and the individual property owners.

CHAPTER 2

METHODOLOGY

The goal of the archaeological survey was to locate, identify, photograph, map, and in some cases draw visible structural and landscape features and artifacts associated with the Elizabeth Mine Site. These activities were conducted in the APE where cleanup activities will take place and outside the APE within documented activity areas. To accomplish this objective, three research strategies were used:

- additional archival research and local informant interviews;
- field investigations, consisting of a comprehensive site walkover/GPS survey, limited subsurface testing in the APE, and detailed drawings of select cultural features; and
- laboratory processing and analyses of recovered cultural materials.

This report section describes the methods used during each of the background research and field activities. The results of the research and field investigations are discussed and evaluated in Chapters 6 and 7.

Archaeological Significance and Historic Contexts

The different phases of archaeological investigation (survey, site evaluation, and data recovery) reflect preservation planning standards for the identification, evaluation, registration, and treatment of cultural resources (National Park Service [NPS] 1983). This planning structure pivots around the eligibility of cultural resources for inclusion in the National Register of Historic Places. The National Register is the official federal list of properties studied and found worthy of preservation. The results of a field survey and site evaluation are used to make recommendations about the significance and eligibility of any resource.

The standards for determining the significance of cultural resources, a task required of federal agencies, are the guidelines provided by the NPS (36 CFR 60): the National Register Criteria for Evaluation. The following four criteria are given for determining if the "quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association" (36 CFR 60):

A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
B. that are associated with the lives of persons significant in our past; or
C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
D. that have yielded, or may be likely to yield, information important to prehistory or history.

Most archaeological sites listed in the National Register of Historic Places have been determined eligible under criterion A and/or D. For eligibility under these criteria, a number of issues must be addressed, including the kind of data contained in the site, the relative importance of research topics suggested by the data, whether these data are unique or redundant, and the current state of knowledge relating to the research topic(s) (McManamon 1990:14B15; VDHP 2002). A defensible argument must establish that a site "has important legitimate associations and/or information value based upon existing knowledge and interpretations that have been made, evaluated, and accepted" (McManamon 1990:15).

The criteria used to evaluate the significance of cultural resources are applied in relation to the historical contexts of the resources. A historical context is defined as follows:

> At minimum, a historical context is a body of information about past events and historic processes organized by theme, place, and time. In a broader sense, an historic context is a unit of organized information about our prehistory and history according to the stages of development occurring at various times and places (NPS 1985).

Historical contexts provide an organizational format that groups information about related historical properties based on a theme, geographic limits, and chronological periods. A historical context may be developed for Native American, historic, and/or modern cultural resources. Each historical context is related to the developmental history of an area, region, or theme (e.g., agriculture, transportation, waterpower), and identifies the significant patterns that particular resource can represent.

Historical contexts are developed by:

- identifying the concept, time period, and geographic limits for the context;
- collecting and assessing existing information about these limits;
- identifying locational patterns and current conditions of the associated property types;
- synthesizing the information in a written narrative; and
- identifying information needs.

"Property types" are groupings of individual sites or properties based on common physical and associative characteristics. They serve to link the concepts presented in the historical contexts with properties illustrating those ideas (NPS 1983:44719).

A summary of an area's history can be developed by a set of historical contexts. This formulation of contexts is a logical first step in the design of any archaeological survey. It is also crucial to the evaluation of individual properties in the absence of a comprehensive survey of a region (NPS 1983:9). The result is an approach that structures information collection and analyses. This approach further ties work tasks to the types and levels of information required to identify and evaluate potentially important cultural resources.

The following research contexts have been developed to organize the data relating to the Native American and Euro-American cultural resources identified within the Elizabeth Mine:

- Native American land use and settlement in the Ompompanoosuc Drainage, ca. 12,500 to 300 years before present (B.P.); and
- Historic land use and settlement patterns of South Strafford, ca. A.D. 1650 to present; and
- The mining history of the Elizabeth Mine Site, ca. 1809 to 1958.

Historical contexts, along with expected property types and locational patterns, are discussed in detail in Chapters 4 and 5. The potential research value of the known and expected prehistoric period, pre-/non-industrial, and historic period industrial resources identified within the Elizabeth Mine Site is evaluated in terms of these historical contexts. This evaluation, along with management recommendations, is presented in Chapter 7.

Background Research /Information Sources

Background research was conducted to assist in the development of prehistoric and pre-/non-mining historic period contexts. Historical contexts are needed to interpret and evaluate the significance of any Native American and Euro-American (non-mining) resources that may be identified during the field investigations. The background research for prehistoric sites primarily consisted of a review of archaeological site files and cultural resource management reports and studies maintained at the VDHP for up-to-date information about known prehistoric sites within and/or near the site. Interviews with the Native American Abenaki representatives also provided information relating to culturally sensitive locations within the site.

Additional historic research focused on examining primary and secondary documentary sources (town histories, maps, etc.), including those previously collected by PAL and others, to identify potential Euro-American (non-mining) archaeological sites within or adjacent to the project area. Interviews with local persons knowledgeable about the non-mining history of the area, including Gwenda Smith, historian/curator of the Strafford Historical Society, were conducted to assist in the development of the pre-mining historic context. An interview with mining historian Collamer Abbott regarding the industrial use of the site was also conducted, along with a review of his archival collection at the University of Vermont for preliminary information relating to its contents and potential contribution to the site's mining period history.

Walkover/Site Mapping

The first survey task was to produce a comprehensive site plan that depicts the spatial configuration of visible features and landscape elements. This site plan is linked to the GIS cultural resources database for the site. For the purposes of this survey, the Elizabeth Mine Site includes known and documented habitation and mining activity areas at TPs 1, 2, and 3, Old South Mine, South Open Cut, Sargent Brook Smelter Site, Furnace Flat South Smelter Site, and Furnace Flat North Smelter Site.

Initially, a walkover survey with close ground inspection was conducted to locate and identify visible features and landscape elements across the site. The types of resources that were recorded as part of the site mapping include structural features, area features, linear features, and isolates (Table 2-1). The walkover survey was designed to maximize coverage of open and wooded areas, using pedestrian transects at 30-meter (m) intervals. The transects were oriented along predetermined compass headings across roughly 460 acres of the historic mining landscape (Figure 2-1).

Visible features and landscape elements identified during the walkover survey were recorded using a GPS unit. A Trimble GeoExplorer 3, containing PAL's custom historic resource GPS database, with an external antenna, set to collect from a minimum of four satellites achieving a maximum PDOP (percent dilution of precision) of seven was used to collect geographic and attribute data for all identified features. With these settings a minimum accuracy of 5 m was achieved. Linear features such as roads, trenches, and stone walls were recorded as lines, while finite objects like building corners, exploratory drill casings, and discrete artifact scatters were recorded as points, and larger more amorphous features such as large artifact scatters and mine openings were recorded as polygons. Representative photographs were taken of all recorded visible features and landscape elements.

Table 2-1. Visible Features and Landscape Elements Included in GPS Site Mapping, Elizabeth Mine Site.

Feature	Examples
Structural Features	Standing/collapsed structures Building foundations Cellar holes Privies
Area Features	Prospect/Mining pits Regular depressions (e.g., possible graves or house pits) Ore roasting/leaching beds Waste or storage piles (e.g., slag scatter, stump dump) Artifact scatters
Linear Features	Drains Trenches Pipes/conduits Fences (inc. stone walls) Cribbing, trestles Roads, tram tracks, (historic) foot-trails
Isolates (Point Features)	Prospect sites Shafts, adit entrances Small-scale features, (e.g., wells, fire hydrants, gas pumps, power poles) Markers (e.g., claim or property cairns) Large-scale artifacts (e.g., flotation cells) Prehistoric artifacts

The information collected during the walkover was transferred from the GPS unit to the project map (see Appendix B) utilizing both ESRI ArcView 3.2 and 8.1 GIS. This data was instrumental in determining where subsurface testing would occur within the project APE. Additionally, the GIS data permitted a more sophisticated analysis of the landscape and visualization of the historic spatial arrangement of the project area.

Archaeological Sensitivity Assessment

Information collected during background research and the walkover survey was used to develop a predictive model to assess the potential for the presence of Native American and Euro-American resources, the types of sites that might be found, and their cultural and temporal affiliation. The development of predictive models for locating cultural resources has become an increasingly important aspect of CRM and planning.

The predictive sensitivity model used criteria to rank the potential for the project area to contain Native American or Euro-American sites. The general criteria used to assess the Elizabeth Mine project area were proximity of known and documented cultural resources, local land use patterns, environmental characteristics, and the area's physical condition

Native American Sensitivity Criteria

Sets of key environmental variables used to predict the location of Native American sites have been compiled from research conducted by professional archaeologists. These studies have demonstrated that certain environmental and topographical settings are strongly associated with the presence of Native American sites. The most productive studies have been of large areas with a variety of environmental settings that were field tested to determine the validity of the predictive model. For example, analysis of several hundred sites in southeastern New England (Thorbahn et al. 1980) found that the highest density and greatest clustering of prehistoric sites occurred within 300 m of low-ranking streams and large wetlands. Other studies have found that site locations are strongly associated with modern wetland densities (Mulholland 1984). Wetlands provide both a home and breeding habitat for a diverse set of animals, support foods, and other vegetation. Prehistoric Native Americans sought the most productive wetlands, including those with a wide variety of resources and those with consistent and reliable resource availability (Hasenstab 1991; Nicholas 1991; Thorbahn 1982; Thorbahn et al. 1980).

Geologic data provides information about lithic resources and about current and past environmental settings and climates. Bedrock geology helps to identify where raw materials for stone tools were obtained by prehistoric groups and gives indications of how far from their origin lithic materials may have been transported or traded. The variety and amount of available natural resources are dependent on soil composition and drainage, which also play a significant role in determining wildlife habitats, and forest and plant communities. Geomorphology assists in reconstructing the paleoenvironment of an area and is particularly useful for early Holocene (PaleoIndian and Early Archaic period) sites in areas that are different physically from 10,000 years ago (Simon 1991). Recent landscape changes such as drainage impoundments for highways and railroads, the creation of artificial wetlands to replace wetlands impacted by construction, or wetlands drained for agricultural use, can make it difficult to assess an area's original configuration and current archaeological potential (Hasenstab 1991:57). This is particularly true at Elizabeth Mine where the course of Copperas Brook has been manipulated a number of times and the imposition of Tailings Pile (TP) 1 on the landscape may have affected the natural freshwater drainage patterns.

Beyond predicting where sites are located, archaeologists attempt to associate cultural and temporal groups with changes in the environmental settings of sites. Changes in the way prehistoric groups used the landscape can be investigated through formal multivariates such as site location, intensity of land use, and specificity of land use (Nicholas 1991:76). However, distinguishing the difference between repeated short-term, roughly contemporaneous occupations and long-term settlements is difficult and can make interpreting land use patterns and their evolution problematic (Nicholas 1991:86).

Vermont Native American Predictive Model and Sensitivity Ranking

The prehistoric period Native American archaeological sensitivity of the Elizabeth Mine Site was based on the VDHP's environmental predictive model for pre-contact settlement sites and information collected during the walkover survey on current project area conditions. In the predictive model individual variables are first grouped by class (River and Streams, Wetlands, etc.) and then assigned a positive or negative numerical

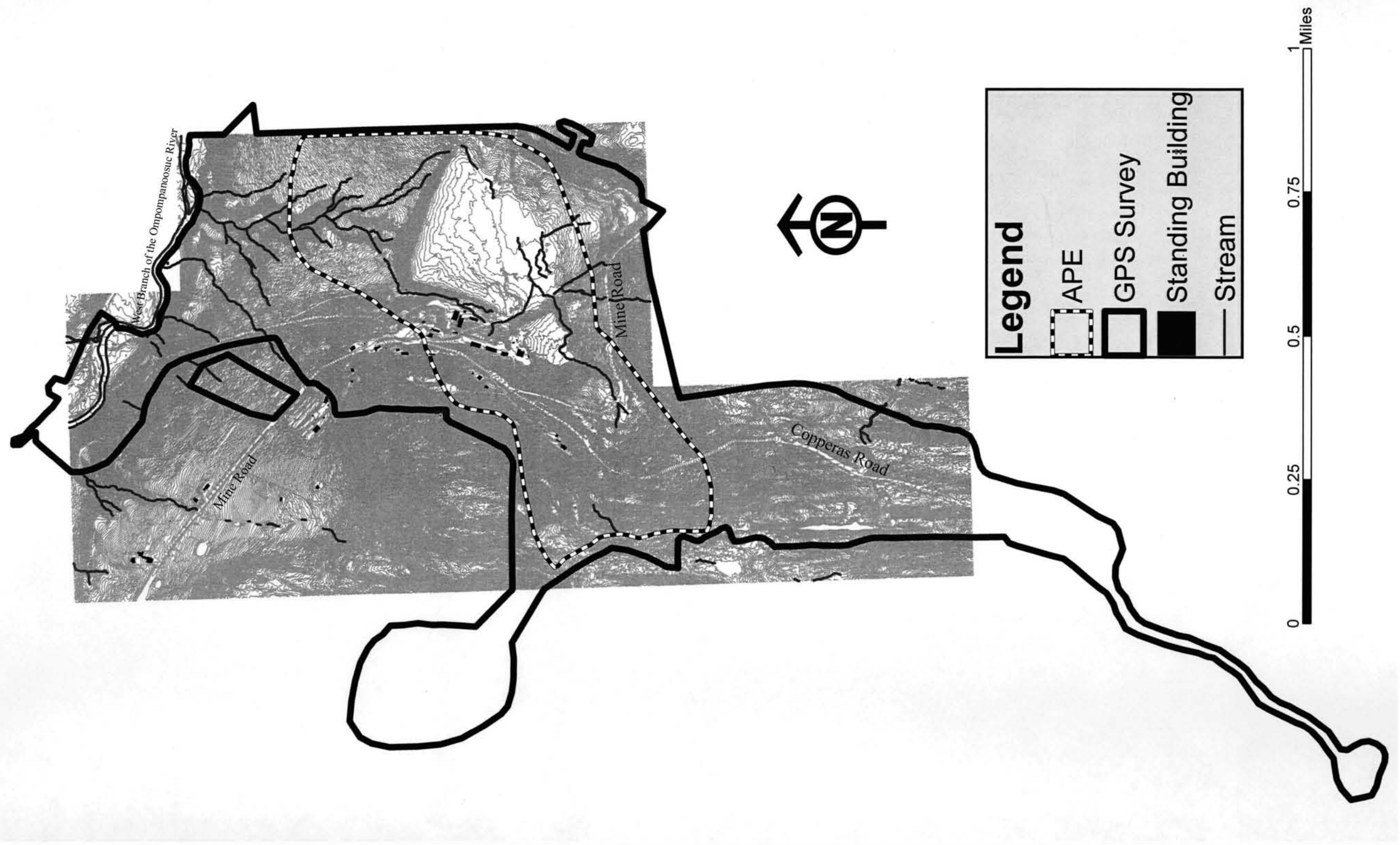
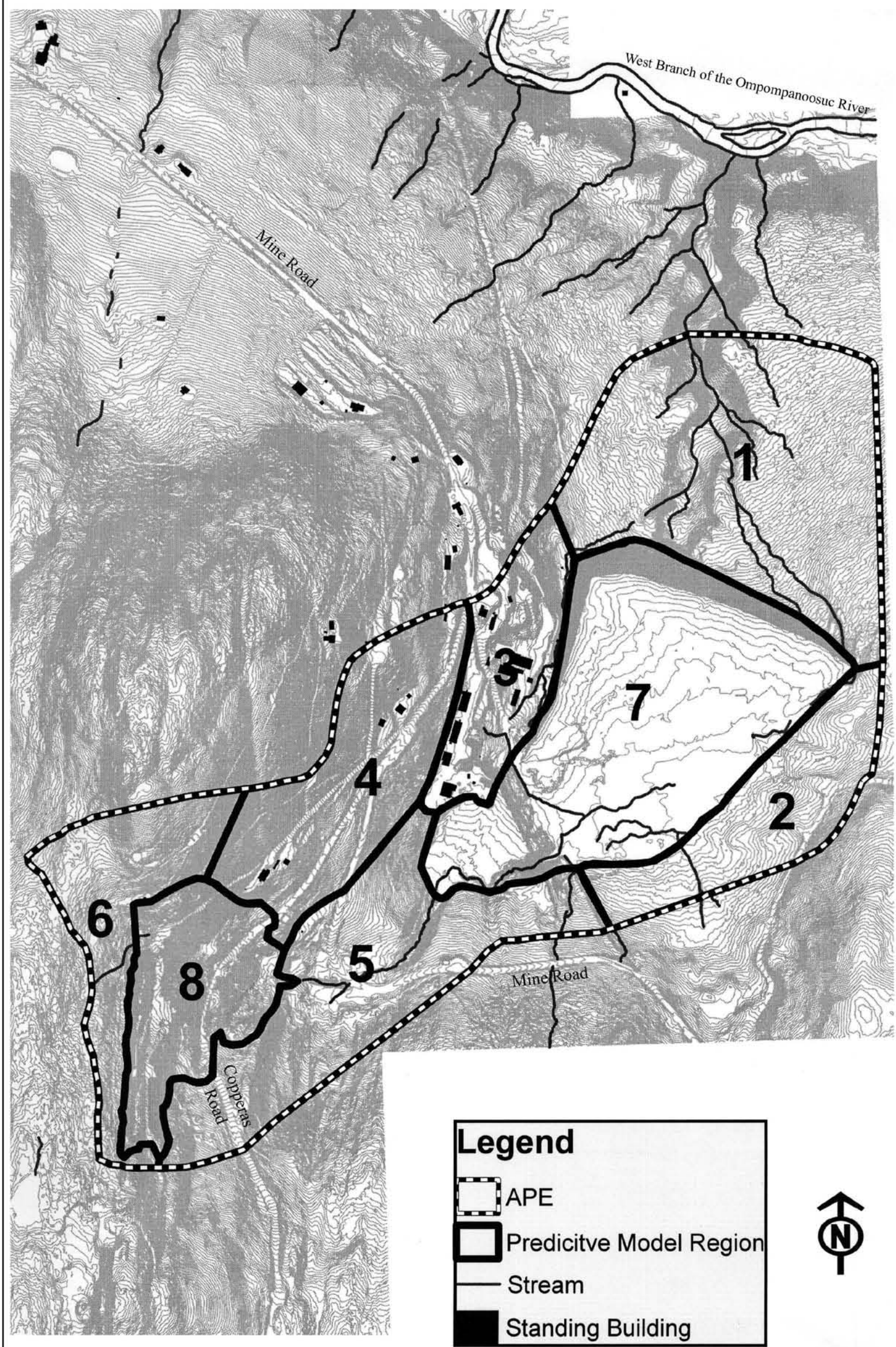


Figure 2-1. **Map of Elizabeth Mine Site depicting areas subjected to GPS survey and mapping.**



1 = Area north of TP1
2 = Area southeast of TP1
3 = Wprld War II area
4 = Area southwest of World War II area and north of TP3
5 = Area between TP1 and TP3
6 = Area west of North Open Cut
7 = TP1 and TP2
8 = TP3

Figure 2-2. Map of Elizabeth Mine Site, showing prehistoric environmental predictive model regions.

ranking from -32 to +32. Using this score sheet, an area can be sensitized by determining the presence and absence of the specific variables, combining the associated scores, and comparing the total score to a predetermined valuation scale; a score of 0 to 32 is assessed as archaeologically non-sensitive while a total score of greater than 32 is considered archaeologically sensitive. The predictive model alone was not sufficient because it provides only a rough approximation of an area's sensitivity while the walkover survey took into account the relative importance of resources and natural barriers to their procurement.

Because of the size of the APE and the diversity of environments contained within it, it was necessary to divide the Native American archaeological sensitivity assessments into eight regions (Figure 2-2). These divisions were based on an environmentally derived parsing of the landscape:

Region 1 (36.6 acres): north of TP1 contains a moderately to excessively sloped (11 to >15 percent) portion of the APE bordering Copperas Brook. This region includes a number of intermittent and perennial streams as well as a spring, and the steep bluffs overlooking Copperas Brook. Region 1 was scored as archaeologically non-sensitive (score of +24). However, based on the presence of the bluff overlooking Copperas Brook and the relatively flat nature of the land immediately surrounding the bluff, portions of this region were deemed to be sensitive and were tested. Sixteen Native American specific test pits were excavated in this area focusing on the margins of Copperas Brook.

Region 2 (13.5 acres): southeast of TP1 is a reasonably flat (approximately 6 percent slope) portion of the APE with a number of perennial streams and a few small rises above the wetlands. The area received a highly sensitive score (+66). However, this score may be inflated, as the wetlands appear to be seasonal and may have been caused by the imposition of TP1 on the landscape. Similarly, the "knolls" in the area are not particularly pronounced when compared to the high ground up-slope and outside of the APE. Despite these confounding factors Region 2 was selected for testing as its flat surfaces and water sources made it sensitive for habitation sites. A total of 28 Native American specific test pits was excavated throughout this area.

Region 3 (11 acres): consists of the section of the APE where the World War II operations were centralized. Besides having an excessive slope (>15 percent) the region was extensively graded in preparation for World War II era construction. Because of these factors this region was judged to be archaeologically non-sensitive (score of –42).

Region 4 (19 acres): is the steep (slope >15 percent) hillside southwest of the World War II buildings and north of TP3. This region contains no water features but has springs and streams in its vicinity. Similarly, a potential quartz quarry is located in the vicinity of the region. Despite these features the region was scored as archaeologically non-sensitive (+18).

Region 5 (25.3 acres): is located between TP1 and TP3 and straddles the bend in Mine Road. This portion of the site has a moderate (14 percent) to excessive (>15 percent) slope and contains a number of perennial and seasonal streams including Copperas Brook. In addition to water resources, the region is in the vicinity of a potential quartz quarry, a wetlands, and a ridge crest. These environmental features led to a high archaeological sensitivity score (+52). However, there are a number of confounding factors. The wetlands are at best seasonal, and the potential quarry is within 180 m of the region but is located up a substantial slope. Additionally, while the area contains a high elevated landform the region itself is particularly rugged and steep making it generally unsuited for habitation.

Region 6 (13.2 acres): located west of the North Open Cut near the crest of Copperas Hill contains no natural sources of perennial water, and has a moderate to excessive slope (12 to >15 percent). However, the region also includes at least two surface exposed quartz outcrops that may have been utilized by Native Americans. Based primarily on these outcrops the region was scored as archaeologically sensitive (+56). Besides the quarry, Region 6 is not assessed as sensitive for habitation as the intermittent stream of the region is not in close proximity to the moderately sloped portion of the region. Additionally, Euro-American disturbance of the region, including quartz quarrying may have destroyed any ephemeral evidence of prehistoric period activity.

Region 7 (39.1 acres): consists of TP1 and TP2, both of which have buried the original land surfaces. A non-sensitive score (-4) was assigned to this area, although an accurate sensitivity assessment is not possible since the extent of subsurface disturbances is unknown. Intact ground surfaces containing Native American cultural resources could be buried beneath the tailings piles.

Region 8 (13.4 acres): consists of TP3. Unlike TP 1 and TP 2, the ground surfaces at TP 3 were highly disturbed during the historic period mining activities. These disturbances included stripping the natural soils to bedrock in most places. TP 3 was, therefore, assessed to be archaeologically non-sensitive (score of +4). No intact prehistoric period resources likely survived the mining period manipulation of the landscape in this part of the APE.

Complete copies of the "Environmental Predictive Model for Locating Precontact Sites" for each of these regions are contained in Appendix D.

Euro-American Sensitivity Ranking

The likelihood of Euro-American archaeological resources was a foregone conclusion based on the intensive mining use of the site during the historic period and the previous historic and archaeological studies conducted by PAL and others. However, based on historic maps and the comprehensive walkover survey it was possible to identify areas of intensive Euro-American utilization, areas of sporadic Euro-American use, and areas where there were little or no Euro-American resources. Furthermore, by georeferencing, or "rubber-sheeting," historic maps of the mine on top of the modern project map it was possible to ascertain which historic resources had been buried or destroyed by subsequent mining campaigns.

Based on the GPS survey and archival research a number of Euro-American industrial and domestic occupation areas were identified within/adjacent to and outside of the project APE at the Elizabeth Mine Site. The large majority of these areas were grouped collectively within designated subsites, or vicinities of intensive occupation (Figure 2-3).

Industrial Resources:

- Furnace Flat North (5.3 acres) located north of the West Branch of the Ompompanoosuc River and south of VT Route 132 approximately over the ore body.
- Furnace Flat South (6.4 acres) situated southeast of Furnace Flat North on the southern bank of the West Branch of the Ompompanoosuc River.
- World War I Era Smelter Site (0.6 acres) positioned on the hillside just west of the northwest toe of TP1.

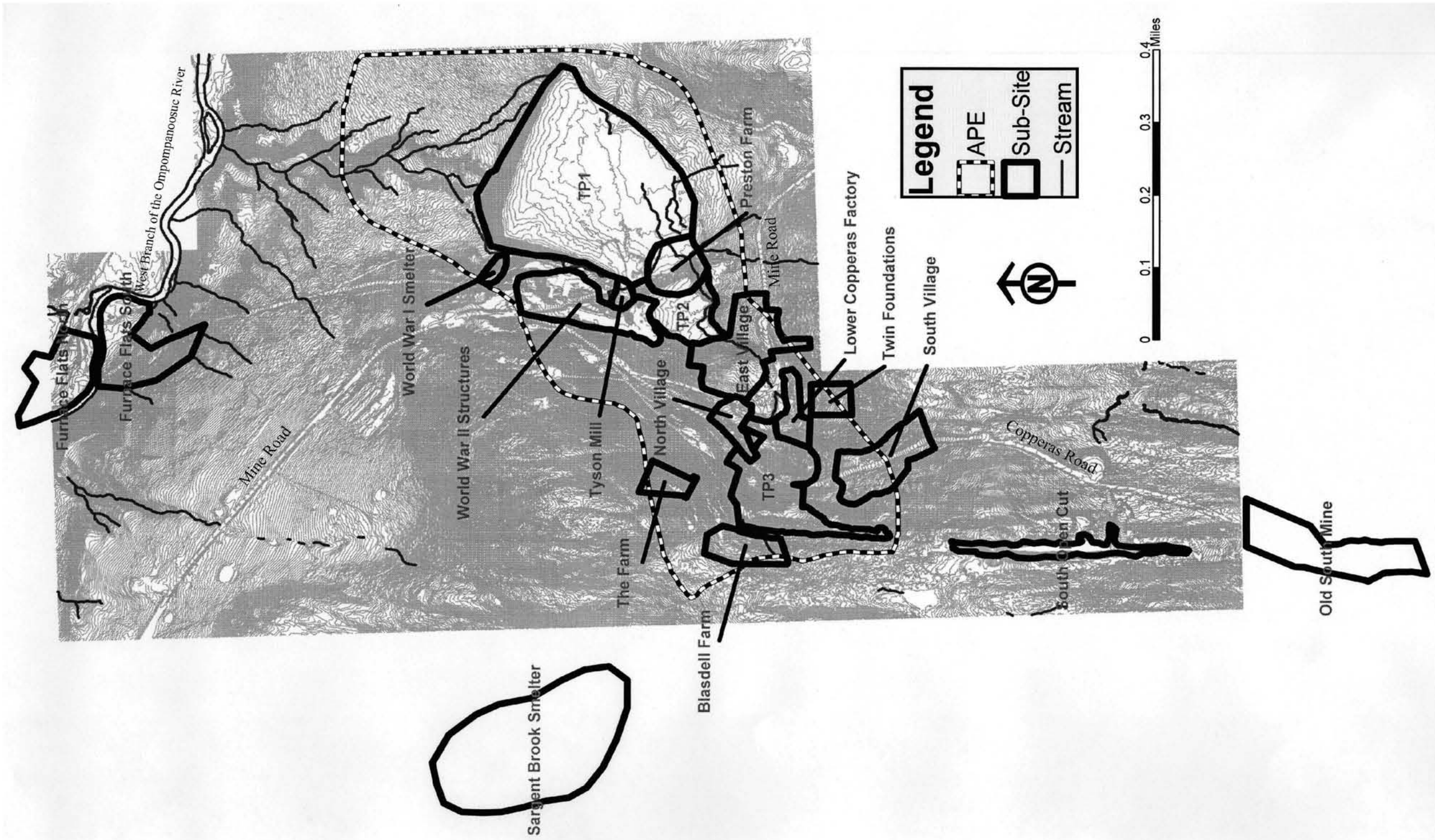


Figure 2-3. **Map of Elizabeth Mine Site, showing identified historic period industrial and domestic subsites.**

- The standing World War II era structures (6.35 acres) and associated landscape features.
- Tyson Mill Site (0.4 acres) located between TP1 and TP2 along their western margins.
- TP1 (33.2 acres), which in addition to being a major manmade landscape feature, inundated a number of historic resources including a smelter, boardinghouse, and dam.
- TP 2 (3.5 acres), also a major manmade landscape feature, which inundated a documented domestic site (**Preston Farm** – 2.8 acres) at the southeast toe of the tailings pile.
- TP3 (8.9 acres) including the North Open Cut, Tyson Mining Zone, Upper Copperas Factory, a cob shop, a blacksmith shop, Upper Adit, Evaporators, and a large number of roasted and leached ore beds along with associated timber scaffolding, cribbing and planking distributed throughout the hillside.
- Sargent Brook Smelter Site (21.6 acres) positioned along Sargent Brook northwest of the North Open Cut.
- Lower Copperas Factory (1.7 acres) located immediately west of East Village at the turn in Mine Road, including the unidentified berms west of the factory foundation.
- Old South Mine (7.6 acres) including a possibly early foundation immediately to its north.
- South Open Cut (4.5 acres) including the cut and the shaft directly to its north.

Domestic Resources:

- Blaisdell Farm (2.6 acres) situated just west of the north end of the North Open Cut.
- The Farm (1.4 acres) located north of the North Open Cut.
- North Village (1.7 acres) positioned east of the logging road that bisects TP3 just north of TP3. The village includes the domestic foundations just east of the road and the terracing north and south of the domestic foundations, as well as the office foundation west of Mine Road, just north of where the road bends.
- South Village (5.2 acres) located south of TP3 along the logging road that bisects TP3. This area includes foundations on both sides of the road.
- The Twin Foundations (1.4 acres) located between South Village and East Village.
- East Village (7.1 acres) situated along Mine Road 100 m beyond where the road turns from north/south to east/west. This site includes a farmstead located just north of the road with its associated stone walls and granite boulder quarry.

The term "farm" was applied to clusters of two or more structures suspected to have an agricultural or animal husbandry function. In all cases these clusters include at least house and barn foundations. The farmstead situated in close proximity to the East Village is not identified as a separate subsite because of its close proximity to the East Village. In the cases of the Blaisdell Farm and the Preston Farm (discussed under TP2, industrial resources, above) the "farm" appellation was indicated in historic documents. "The Farm" was designated based on an apparent agricultural component but no familial association was identified in historic documents reviewed during the current survey.

The term "village" was applied to finite clusters of domestic foundations and associated features. The term "village" was adopted as an expedient reference for these clusters despite the fact that they are not large enough to fulfill the classical definition of a village. Traditionally a village is an appreciable number of homes clustered around a community center such as a meetinghouse or green.

While these features represent the majority of the visible cultural resources at the Elizabeth Mine Site, they are connected by and interrelated with a large number of more dispersed resources. Many of these resources are transportation-based such as the tramway to the Sargent Brook Smelter Site, Copperas Road (a former private copper-company road, now a Class-4 town road), and ca. 1830 haul road to Furnace Flat. Other resources such as power poles, the teamsters house foundation, stone walls, and exploratory drill casings indicate the pervasive use of the surrounding landscape. Of the 18 subsites listed above, the World War I Era Smelter Site, the Standing World War II Structures, TP1 (along with visible and buried resources), TP2 (along with visible and buried resources), TP 3 (along with visible and buried resources), the Tyson Mill Site, the Blaisdell Farm, the Farm, North Village, South Village, East Village, the Twin Foundations, and the Lower Copperas Factory are located entirely or partially within the project APE. With the exceptions of TP1 and TP2 , all of the subsites were deemed to have the potential for intact archaeological features accessible through hand excavation based on the walkover survey.

Subsurface Testing

Limited subsurface testing was conducted in moderate and high archaeologically sensitive portions of the project APE to locate and identify any potentially important archaeological resources. A total of 73 test pits were excavated for historic period resources within the project APE (Table 2-2; Figure 2-4, Back Pocket). These test pits, 50-x-50 centimeters (cm) in size, were excavated at 8-m intervals along 14 judgmental linear transects and as 28 judgmentally placed test pits. Specific subareas subjected to subsurface testing include: the World War I Era Smelter Site. The Tyson Mill Site (specifically the blacksmith shop), the Preston Farm, the Blaisdell Farm, the Farm, North Village, South Village, and TP3 (cob shop, Upper Copperas Factory).

Subsurface testing was conducted at a representative sample of visible historic period resources within the project APE. This testing was designed to collect archaeological data on the temporal affiliation, possible function(s), and subsurface soil matrices for individual resource areas (or subsites) where this information was not readily discernable based on visual characteristics alone. For example, the Tyson Mill is a well-documented resource in terms of age and function, and its physical condition could be detected on the basis of aboveground elements; therefore, it was not subjected to subsurface testing. In contrast, the suspected location of the documented blacksmith shop, which has no aboveground physical remains, was tested to determine the presence and condition of any belowground physical remains.

Judgmental transects and JTPs were placed within the selected historic resource areas as follows:

Transects A and B were excavated within and around the Blaisdell Farm to collect information on dates of occupation and function.

Transects C and D were excavated at the Farm to collect information on dates of occupation and function.

Transect E and JTP-1 and JTP-2 were placed on TP3 to examine soil stratigraphy and to examine the integrity of the wooden cribbing and the structures at the adit mouth.

Transect F was placed in and around the North Village in order to recover a representative sample of cultural materials that would provide an indication of dates of occupation and building function(s).

Transects G and H and JTP-5 and JTP-6 were placed in the vicinity of the Preston Farm to locate belowground remains related to the documented farm buildings. Test pits were excavated within the possible farm area at the most likely locations of intact cultural deposits. Transects G and H were placed in areas of minimal disturbance from TP1 and TP2. JTP-5 and JTP-6 were placed on the margin between TP1 and TP2 to examine the stratigraphy in that area. The historic road trace between Transects G and H was used as a guide for placing the test pits.

Transects I, J, and K, in addition to JTP-7 were located in the vicinity of the documented James Tyson Jr.-era blacksmith shop to confirm its suspected location and examine belowground integrity of any identified remains. The placement of these pits was based on historic map and photograph information.

Transects O and P were excavated in the vicinity of the World War I era smelter to examine its integrity and belowground soil stratigraphy. Test pits in this area were placed in relation to surface debris scatters.

Transect U and JTP-16 and JTP-17 were placed in the vicinity of an ambiguous stone corner to more closely examine the structural remains and the degree of disturbance around it.

JTP-3 and JTP-4 were excavated on the manmade tiers, which are likely barn foundations based on historic map research, to examine their internal soil composition and structural configuration.

JTP-8 through JTP-15 were excavated in and around the South Village in order to examine the belowground condition of visible structures and to collect some preliminary data on their age and function(s).

JTP-24 through JTP-28 were placed in and near the Upper Copperas Factory to examine soil stratigraphy in the area.

JTP-29 through JTP-34 were placed in and around the Office structure within the North Village subsite to collect some preliminary data on the use of the structure and its belowground condition.

In addition to the above testing, 44 test pits were placed in Regions 1 and 2 of the project APE (see Table 2-2 and Figure 2-4). These areas were determined to be archaeologically sensitive for prehistoric period resources based on the results of the predictive model, walkover survey, and consultation with representatives of the Abenaki Tribe. An additional four test pits were placed in the area northeast of TP1 in proximity to a culverted branch of Copperas Brook. All of these test pits, 50-x-50 cm in size, were excavated at 8-m intervals along nine judgmental transects and as six judgmentally placed test pits.

Table 2-2. Distribution of Subsurface Testing Conducted within the Project APE, Elizabeth Mine Site.

Site Location	Sensitivity Assessment	Number of Test Pits
World War I Era Smelter Site	Mining : Industrial Activities	8
Tyson Mill Site	Mining : Industrial Activities	12
The Preston Farm (southeast toe of TP 2)	Domestic : Farmstead	10
Blaisdell Farm	Domestic : Farmstead	6
The Farm	Domestic : Farmstead	6
North Village	Mining : Worker Housing and Offices	14
TP 3	Mining : Industrial Activities	9
South Village	Mining : Worker Housing	8
Region 1 (north of TP 1)	Abenaki Selected Locations ; Prehistoric Period Sensitivity Ranking = +24	16
Region 2 (southeast of TP 1)	Abenaki Selected Locations ; Prehistoric Period Sensitivity Ranking = +66	28
Non-Designated Area (northeast of TP 1)	Prehistoric Period Sensitivity along culverted branch of Copperas Brook	4
TOTAL :		**121**

All test pits were excavated by shovel in arbitrary 10-cm levels to sterile subsoil. Excavated soil was hand-screened through 1/4-inch hardware cloth, and all cultural materials remaining in the screen were bagged and tagged by level within each unit. The count and type of all recovered cultural material were noted. Soil profiles, including depths of soil horizons, colors, and textures, were recorded for each test pit on standard PAL test pit profile forms. All test pits were filled and the ground surface was restored to its original contour following excavation. Color slides and black-and-white photographs were taken of the various testing locations.

Detailed Drawings of Aboveground Structural Remains

Furnace Flat North, Furnace Flat South, Tyson Mill Site, Sargent Brook Smelter Site, Blaisdell Farm, the Farm, North Village, TP3, South Village, the Twin Foundations, East Village, and the Lower Copperas Factory contain visible structures and landscape features that were subjected to detailed plan and cross-section line drawings. Plan maps, which show the spatial relationship of the various features of a resource, were created at either a scale of 1 inch equals 2 m or 1 inch equals 5 m, depending on the size of the resource. Similarly, cross sections were employed to depict the topographic relationships between the various features as well as aspects of wall construction.

Cross sections were completed at a scale of 1 inch equals 2 m. In general the transit was used to establish a baseline and measurements were taken relative to the transit along a tape measure to create the cross sections. However, a number of the shorter wall profiles were drafted using a tape measure across the top of the wall with measurements taken down from the top of the wall. In general the plan maps were created using a hand

compass and tape measure to establish the angles and distances between points within a resource. However, in the case of TP3 where the exceedingly steep slope of the area prohibited the effective use of a tape measure, the transit was used to measure both angle and distance.

The field maps were digitized using AutoCAD 2000i and were then exported into the GIS database. Besides adding more detail to the GIS map the field drawings permitted the data collected during the GPS survey to be corrected for greater accuracy.

Laboratory Processing and Analyses

Processing

All cultural materials recovered from the project APE during subsurface testing and representative industrial-related artifacts collected from the entire site during the field mapping were organized by subsite and provenience, and recorded and logged in on a daily basis. Cultural materials were sorted by type and either dry brushed or cleaned with tap water depending on the material or artifact type and condition.

Cataloging and Analyses

All cultural materials were cataloged into a custom computer program designed using a combination of *FoxPro 2.5* and *FoxExpress* database software. This program consists of a core of databases relationally linked to multiple material type specific databases that allow for in-depth analysis of cultural materials. Materials that display similar attributes such as material type, functional and typological classes, size range, color, etc. were grouped and cataloged by lots. These lots were stored in 2-ml thick polyethylene resealable bags with acid-free paper tags containing provenience identification information.

No prehistoric period cultural materials were recovered during the field investigations.

Historic cultural materials were cataloged according to material (e.g., ceramic, glass, coal, synthetic) and functional (e.g., plate, bowl, bottle, building material) categories. Temporally sensitive historic artifacts, such as ceramics, were also identified in terms of type (e.g., redware, pearlware, whiteware) when possible. In addition, ceramic sherds and bottle glass were examined for distinguishing attributes that provide more precise date ranges of manufacture and use. These included maker's marks, decorative patterns, and embossed or raised lettering. Tentative dating of historic archaeological resources was performed using ceramic indices according to Hume (1969), Miller (1990, 1991), Miller and Hurry (1983), and South (1977). An analysis of the different nail and bottle types was used to refine the tentative date ranges of historic occupation generated by the ceramic assemblages. Additionally, faunal remains were identified based on their taxa and the portion of the animal represented.

The analyses of the cultural materials recovered during the archaeological survey also included mapping the density, horizontal, and vertical distribution of these materials within the project APE. Given the preliminary nature of the survey and the relatively small sample of cultural material recovered, analysis was limited to these basic tasks.

Curation

Following the laboratory processing and cataloging activities, all recovered cultural materials were stored in acid-free Hollinger boxes with box content lists and labels printed on acid-free paper. These boxes are being *temporarily* stored at the PAL facilities in Pawtucket, Rhode Island according to curation guidelines established by the U.S. Army Corps of Engineers.

CHAPTER 3

ENVIRONMENTAL SETTING

The Elizabeth Mine Site occupies approximately 800 acres within the drainage of the West Branch of the Ompompanoosuc River ("West Branch"), a major tributary of the Connecticut River, in Orange County, Vermont. The majority of the mine site is located in South Strafford in the southern part of the town of Strafford, with an eastern portion in Thetford and small portions at its southern extremity in Sharon and Norwich.

Geology and Geomorphology

Orange County is located in the northern portion of the Southern Vermont Piedmont Division of the New England Upland Physiographic Province (Figure 3-1). The county is characterized by low, north-south trending glaciated ridges and stream-dissected valleys. The greatest topographic relief occurs on the western boundary at the east flank of the Green Mountain Division, and the eastern half of the county contains lower, rolling hills. Elevation varies from 3,166 ft on Butterfield Mountain in Orange, to about 400 ft at the Connecticut River, which forms the eastern boundary of the county (Sheehan et al. 1975:5).

The Elizabeth Mine is the southernmost mine in the 20 mile long, Orange County, Vermont, "copper belt" that includes the Ely Mine at Vershire and the Pike Hill mines at Corinth. These metallic sulfide mineral deposits are located in the Paleozoic stratigraphic units of the Connecticut Valley Trough that stretches from western Massachusetts to the Gaspee-Peninsula. The bedrock underlying Orange County consists of Silurian and early Devonian metasediments with interspersed metavolcanics and igneous intrusives (Doll et al. 1961). These rocks were subjected to at least three stages of intense folding and metamorphism during the early Devonian Acadian (400 my) orogeny. Rock units typically dip steeply to the east, and become progressively younger from west to east. The Elizabeth Mine orebody is hosted by the Gile Mountain formation, which consists largely of metamorphosed pelite and graywacke (seafloor sediments) (Figure 3-2). (Seal et al. 2001:116; Sheehan et al. 1975:5; Slack et al. 2001:194).

The Vermont copper belt ore deposits are examples of one of the major classes of metallic ore deposits found in the eastern United States, the group known as the Appalachian sulfides. These ore deposits consist of iron sulfide in the form of pyrite or pyrrhotite, often mixed with lesser quantities of copper, usually in the form of chalcopyrite, and sometimes zinc (sphalerite), lead and trace amounts of other, sometimes precious, metals. The method of formation of Appalachian sulfide type ore deposits was debated by geologists for centuries until the advent of plate tectonic theory and the discovery of undersea hydrothermal vents. These orebodies are now generally understood to have been deposited on ancient seafloor as thick sulfide ore beds by hydrothermal vents that precipitated metals that had been leached from undersea magma by hot circulating seawater. These sulfide beds were eventually buried by sediments and incorporated into new continental crust in accretionary prisms where ocean crust was being subducted. These sedimentary and volcanic rocks were then included and metamorphically altered in the roots of folded mountain ranges, uplifted, and eroded, exposing them for discovery. Appalachian sulfide deposits stretch from Alabama to Maine, and continue into New Brunswick. Ore deposits of this type are found all over the world, and are being deposited in submarine environments today (PAL 2001:3.6–3.7). The seafloor hydrothermal metallic sulfide ore deposits have been further classified into subgroups according to their original depositional environment. Geologists consider the Elizabeth Mine and other Orange County copper deposits to be examples of what is called a "Besshi" type massive sulfide deposit,

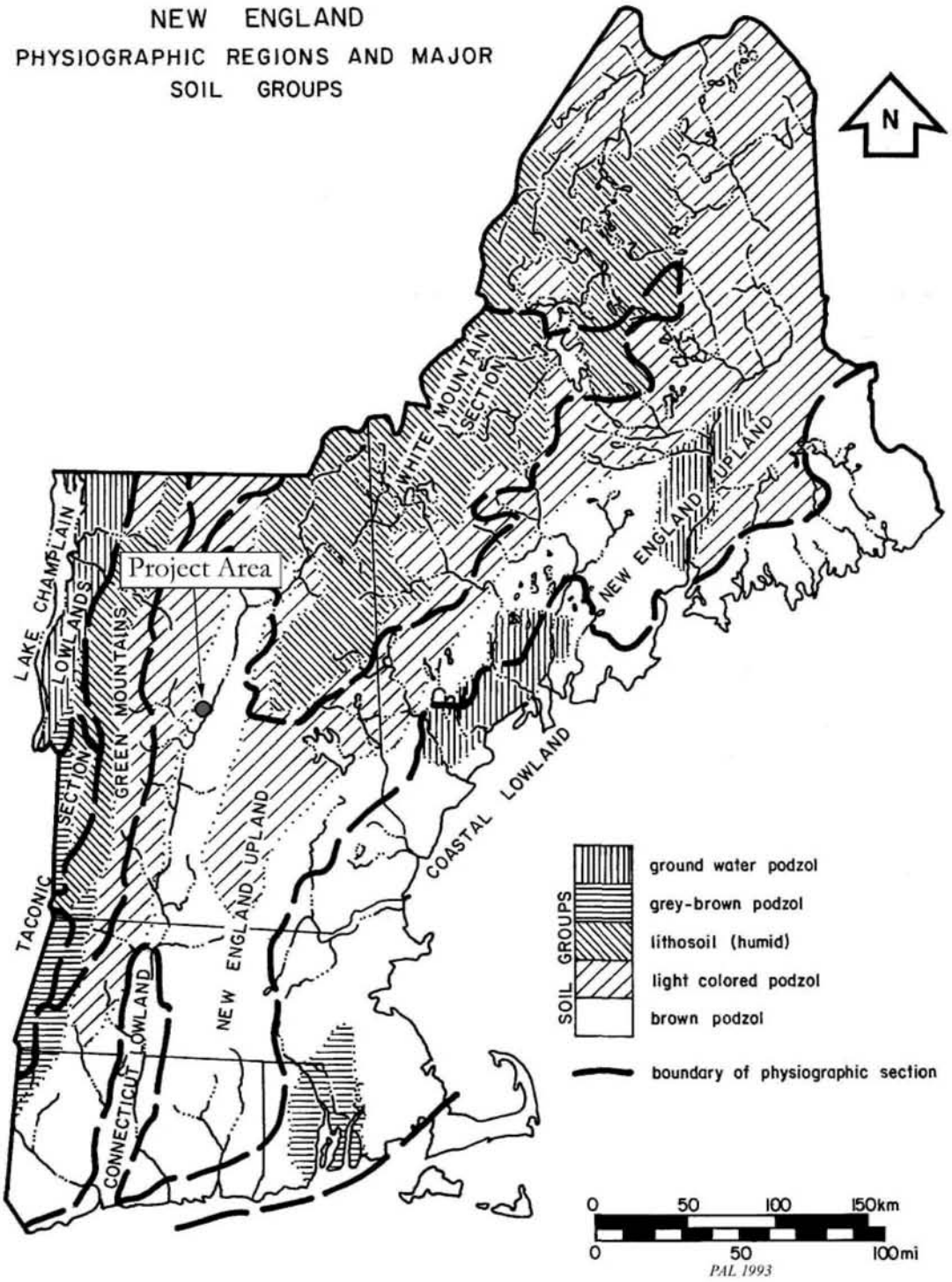


Figure 3-1. Physiographic zones of New England, with the location of the Elizabeth Mine Site (source: Fenneman 1938).

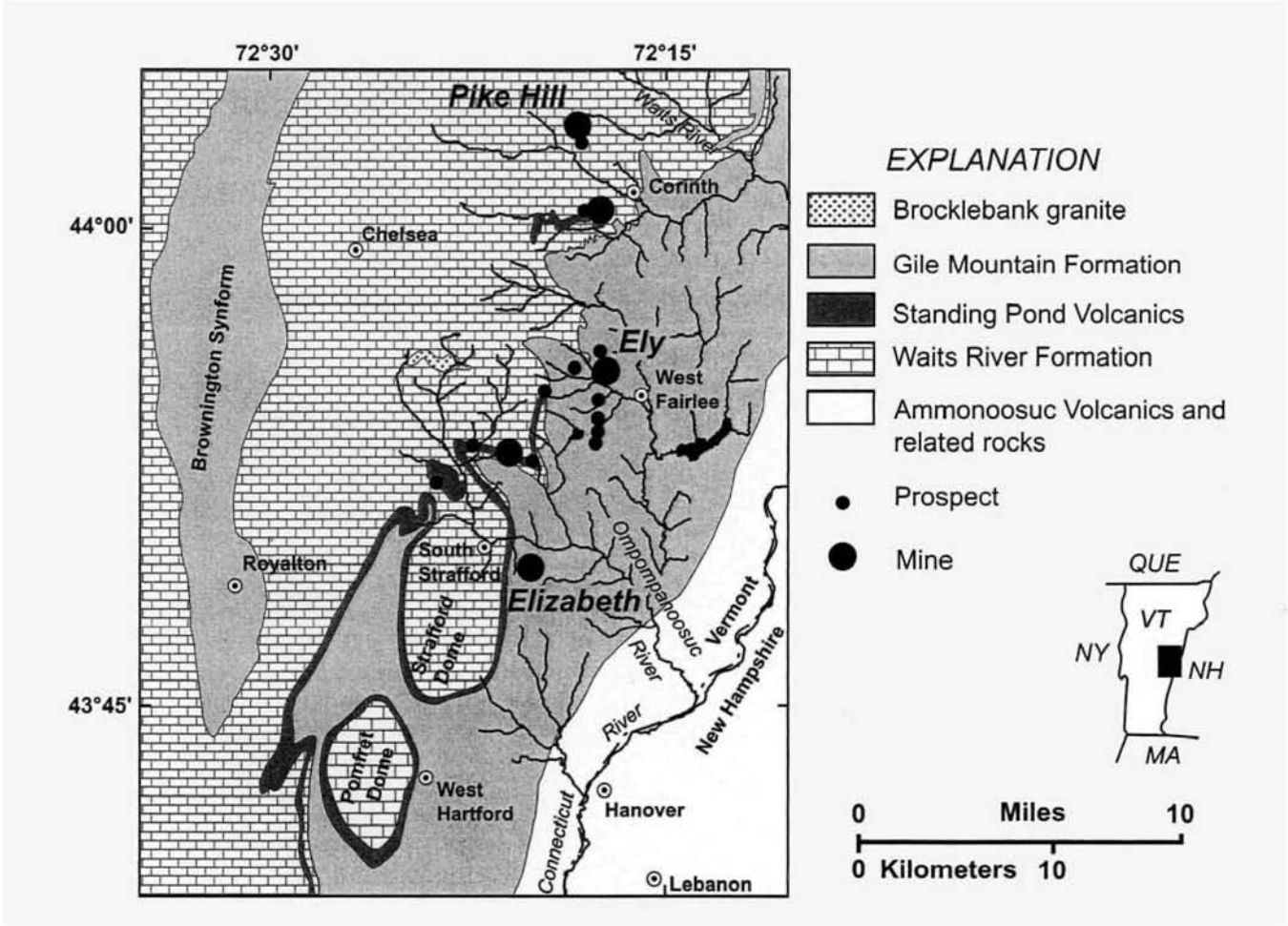


Figure 3-2. Generalized geologic map of the Vermont copper belt (source: Seal et al. 2000).

named for its type locality in the Sea of Japan. These particular hydrothermal seafloor deposits are thought to occur at rifting (spreading) continental plate margins at oceanic ridge crests or back arc marine basins. The depositional environment of the Orange County deposits is considered analogous to that of the Gorda Ridge and Juan de Fuca Ridge in the eastern Pacific Ocean today, where exhalative hydrothermal vents are depositing sulfide-rich mats on spreading seafloor crust that are being buried by turbidite sediments from the proximal continental land mass (Seal et al 2001:116; Sheehan et al. 1975:5, Slack et al. 2001:194,196,208–209).

The shape and orientation of the Elizabeth Mine orebody within its host rock was important to the historical development of the mine landscape. Appalachian sulfide orebodies are typically stratiform and stratabound, that is they conform to and are bound by their host rock layers, which were deposited at the same time. During the tectonic processes that emplaced them in their current location and orientation, they were subjected to intense deformation and remobilization. The orebodies that survived this activity are typically pod-like, lenticular, or tabular in shape, steeply dipping, and often swell and pinch or form overlapping lenses. They are generally massive and fairly sharply bound by their schistose host rock. The Elizabeth Mine orebody is thought to be emplaced in the limb and crest of an anticlinal fold. It is a north-south trending, elongate, tabular, sheet-like deposit of nearly continuous massive sulfide measuring approximately 11,000 ft long along its strike. It dips 70 degrees to the east and plunges from ground surface at the North Open Cut to a depth of 975 ft at its terminus north of the West Branch. The ore is more or less continuous, massive to heavily disseminated sulfide, with some local splits, rolls, and irregularities in width. It varies in width from a few feet to several dozen feet. At its southern end, this steeply dipping sheet was also longitudinally folded into a series of undulations. This section of the orebody and its host rock was subsequently eroded to the current surface elevation. The ore outcrops at the South Open Cut and Old South Mine are the bottoms of these undulating folds.

Soils

Orange County was covered by a glacier during the most recent, late-Wisconsin time ice readvance about 13,000 years ago, and soils in the county have formed in glacial material since that time. Glacial erosion on ridges was minimal, however scouring action of ice deepened and widened river valleys, which received outwash and glaciofluvial and glaciolacustrine deposits. Glacial till makes up approximately 92 percent of Orange County soils, and this cobbly, unsorted, nonstratified debris is distributed in a layer of varying thickness over the bedrock. The Ompompanoosuc River valley includes glaciofluvial features including kames and kame terraces, and glaciolacustrine littoral and lake-bottom deposits (Sheehan et al. 1975:5).

Soils in the vicinity of the Elizabeth Mine in South Strafford are of four general types: The West Branch bottomland from just north of Strafford village to just south of South Strafford village are of Merrimack-Agawam-Windsor-Winooski association. These are level to steep, well- to poorly drained, coarse and moderately coarse-textured soils on stream terraces, and moderately well drained, medium-textured soils on bottomlands subject to flooding. South of South Strafford village to the Windsor County (Sharon-Norwich) line, in the area west of Copperas Hill, the soils are of Pomfret-Tunbridge-Buckland association. These are level to steep, somewhat excessively drained to moderately drained, deep to moderately deep, coarse textured to medium textured soils that formed in glacial till on hilly uplands. In the area east of Copperas Hill including the Elizabeth Mine Site, the soils are of Vershire-Glover-Buckland association. These soils are level to steep, somewhat excessively to moderately well drained, shallow to deep, medium-textured soils that formed in glacial till in rolling uplands. East of this area the soils are of Tunbridge-Woodstock-Colrain-Buckland association. These soils are gently sloping to steep,

somewhat excessively to moderately well drained, shallow to deep, moderately coarse to medium-textured soils that formed in glacial till on hill uplands (Sheehan et al. 1975:General Soil Map).

The Elizabeth Mine Site includes large expanses of made land and disturbed soils. At TP 3, the original soil was stripped from the bedrock to prepare the hillside for the copperas roasting, leaching and conveying processes. The colorful soils and variety of waste rock there are the result of copperas and copper ore mining, sorting and waste rock disposal, and copperas ore roasting and leaching. At TP 1 and 2, the original ground surface has been buried under as much as 150 ft of fine mill tailings. The natural soils in peripheral processing areas including ore milling and smelting sites are also highly disturbed. The natural soils in worker settlement areas and associated agricultural lands have been modified to varying degrees by the historic and early modern period domestic occupations. The more wooded, steeply sloping and rocky areas of the site where little or no industrial activities occurred would be expected to contain undisturbed soil strata.

Flora and Fauna

The climate of Orange County is cool, temperate, and moist. Rainfall varies from 50 inches at higher elevations to less than 36 inches at White River Junction. The area experiences relatively long, cold winters and mild summers, with an annual average of 120 frost-free days. Forest vegetation in the county is typical of the temperate habitat of the Northern Hardwood Forest Formation of Vermont, and consists largely of American beech, sugar maple, paper and yellow birch, white pine, and hemlock. Game species include a variety of large mammals including white-tailed deer and black bear, and a variety of smaller mammals such as raccoon and beaver. Coldwater fish species include a variety of trout (Petersen and Petersen 1997:9; Sheehan et al. 1975:5; Thompson and Sorenson 1998:129,145). Within the Elizabeth Mine Site itself, the vegetation reflects the acidic soil conditions. Some ravines and rocky areas host pockets of Hemlock Forest. Much of the tailings piles and associated drainage channels are barren of vegetation, but acid-tolerant species including birch and hemlock have begun to return to the periphery of these areas.

Drainage Patterns and Topographical Relief

The West Branch constitutes the major drainage and watershed in the Elizabeth Mine area (Figure 3-3). The Ompompanoosuc River is 23 miles long, and has a drainage area of 136 square miles. The river consists of the East Branch and West Branch, and the Ompompanoosuc proper below their confluence. The East Branch rises in the northwest corner of Vershire, and flows east and south to the south edge of Thetford. The West Branch rises from Hawkins Mountain (elevation 2,363 ft) in southwest Vershire and Brocklebank Hill (elevation 2,111 ft) in northeast Tunbridge, which meet in northwest Strafford. The West Branch then flows southeast across Strafford, passing about 1 mile north of the mine site, and meets the East Branch to form the Ompompanoosuc proper just above the Union Village Dam in Thetford. This flood control dam was constructed in 1949 by the U.S. Army Corps of Engineers. The river then flows southeast to its confluence with the Connecticut River at Pompanoosuc in Norwich. The majority of the Elizabeth Mine Site is located in a broad, approximately 500 ft deep valley between Copperas Hill (elevation 1,480 ft) in South Strafford and Gove Hill (elevation 1,280 ft) in Thetford. The site is drained by Copperas Brook, a tributary of the West Branch. Copperas Brook rises at an elevation of approximately 1,200 ft at TP 3 on Copperas Hill, and flows northeast through and under Tailings Piles 1 and 2, and falls to meet the West Branch at an elevation of approximately 780 ft. The Old South Mine area is drained by Lord Brook, also a tributary of the West Branch.

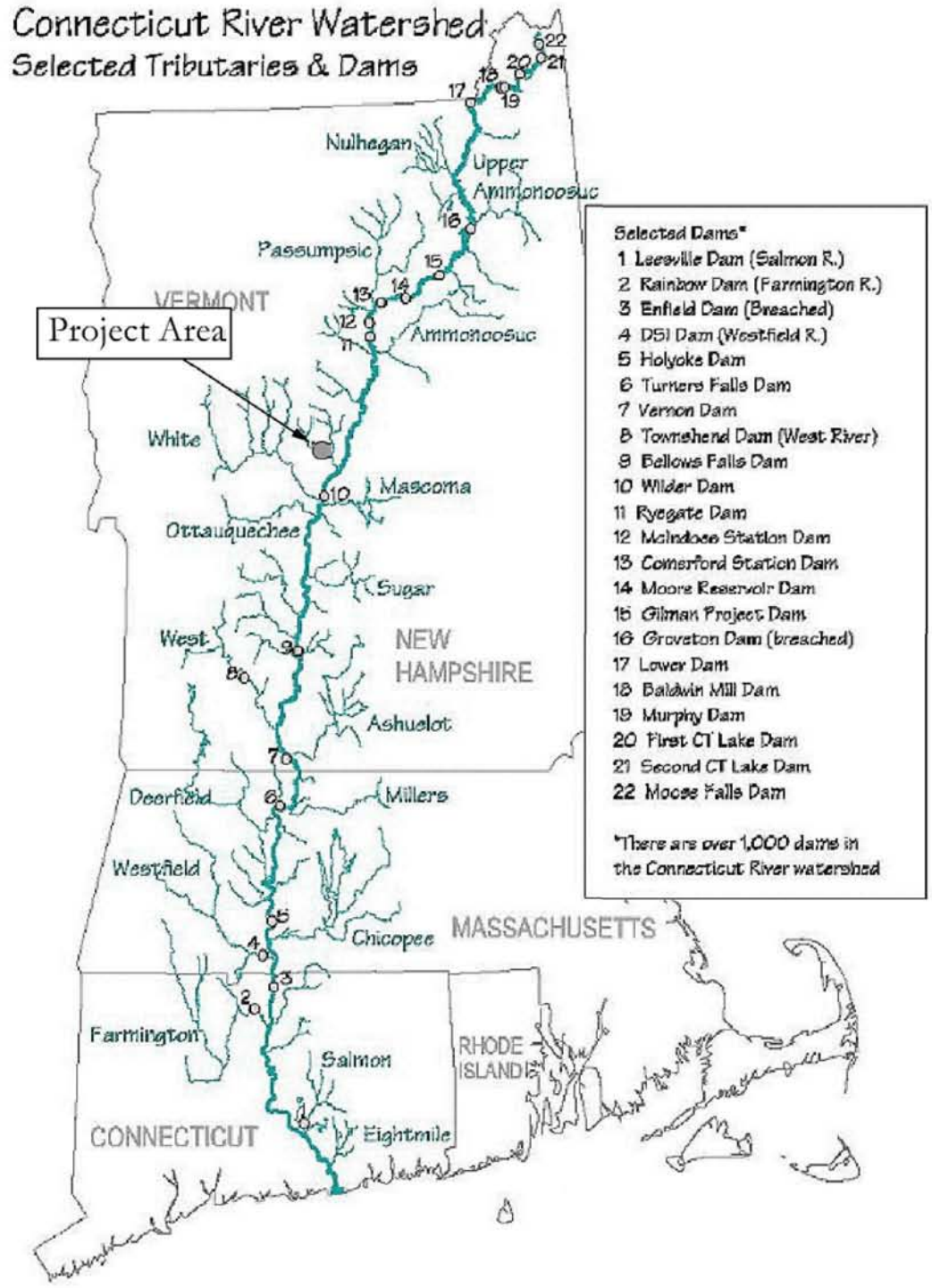


Figure 3-3. Drainage basins of the Connecticut River, with the location of the Elizabeth Mine Site.

CHAPTER 4

PREHISTORIC LANDUSE AND SETTLEMENT PATTERNS

The following discussion of prehistoric land use and settlement patterns for the Ompompanoosuc River drainage in east-central Vermont is based on a synthesis of the extant archaeological data for this region. Because of the fact that the nearest evidence of Native American occupation (VT-OR-69) to the Elizabeth Mine Site is more than 5 miles distant and consists of an isolated find, the database for this context has been assembled as a result of professional cultural resource management (CRM) surveys in a wider portion of east-central Vermont (Atwood 2000; Cox et al. 2001; Ohl and Potter 1992; Petersen and Petersen 1997; Thomas and Bourassa 1986). Additional sources include synthetic prehistoric cultural histories for Vermont (Haviland and Power 1994) and academic research reports for sites throughout the state.

PaleoIndian Period (9500–7000 B.C.)

The retreat of the Laurentide ice sheet in northern New England, beginning approximately 16,000 years ago, set into motion a series of profound environmental changes that shaped the landscape for the earliest inhabitants of Vermont. Glacial meltwaters formed end moraines that impounded massive lakes, including Lake Vermont in the present-day Champlain Valley and Lake Hitchcock in what is now the Connecticut River valley. By 10,500 B.C., erosion and/or isostatic rebound precipitated by the retreating ice mass breached many of the lake impoundments and, combined with the rising ocean levels, contributed to the development of inland seas (Ritter et al. 1995). The Champlain Sea covered approximately 20,500 square miles at its maximum extent but it, too, fell prey to the rebound phenomenon. By 8200 B.C., the land in northwest Vermont had risen far enough above sea level to cut off incoming tidal waters and effectively converted the Champlain Sea into the freshwater Lake Champlain.

Archaeological evidence suggests that sometime before the Champlain Sea transformed into Lake Champlain, possibly as early as 9300 B.C., the first human populations began to enter the subarctic environment of Vermont. During this period, the vegetative profile of the region was notably sparse, comprising lichen, moss, and low-growing scrub. Exploitable animal communities included elk, caribou, and mastodon and likely played a major role in the diet of these early populations, hence the "Big Game Hunter" moniker often ascribed to them. Proximity to the Champlain Sea/Lake Champlain also may have spurred intensive marine and estuarine exploitation, while smaller game and plant gathering also likely played a large role in subsistence activities (Haviland and Power 1994; VDHP n.d.).

Settlement strategies during the PaleoIndian Period are poorly understood. Because of the range of variability at identified sites, large base camps, small residential camps, and very small task-specific loci have been advanced as the primary settlement models. Vail and Bull Brook I, covering several acres and yielding thousands of artifacts, serve as examples of the large base camp models, while the Reagan site is a good illustration of a smaller residential camp. Dincauze (1993) has controversially suggested that many of the large base camps like Bull Brook may have served as colonization centers or "marshalling camps" for the initial influx of PaleoIndian populations into the region, while the smaller camps represent exploratory forays from those more established settlements.

Data about task-specific sites remains elusive. The Hidden Creek Site (72-163) in southern Connecticut does offer some possibilities. Tentatively dated between 9000 and 10,000 years old, the 34-square meter (sq m) site is situated on a kame terrace along the edge of a swamp basin and yielded a lithic assemblage dominated by chert unifaces and endscrapers. The small size of Hidden Creek and its temporary nature suggest a highly mobile Late PaleoIndian population using few durable artifacts. It also suggests that these types of sites are highly ephemeral with low archaeological visibility and may often be missed because of coarse-grained excavation techniques and an over-reliance on the use of fluted points as a diagnostic marker for the period (Jones 1997). The Varney Farm Site, a Late PaleoIndian site dating to 9400–8400 B.P. on the Nezinscot River in Turner, Maine, corroborates the latter point. The recovery of several non-fluted, parallel flaked chert projectile points with strong morphological similarities to Great Plains materials suggests that manifestations of the PaleoIndian Period in New England are too complex to be incorporated under a single diagnostic rubric (Petersen et al. 2000).

The best-known site in Vermont dating to the PaleoIndian Period is the Reagan Site. The roughly 2-acre site is located in East Highgate on a sandy bluff overlooking the Missisquoi River valley, and contains a varied artifact assemblage including diagnostic fluted points, knives, scrapers, gravers, hammer and anvil stones, and chipping debris. Lithic classes include chert, rhyolite, basalt, quartzite, jasper, soapstone, and talc, some of which derive from non-local sources and suggest fairly extensive movement of the site occupants across the landscape. The Reagan Site is unique among PaleoIndian sites for the recovery of 15 soapstone and talc "pendants." Unfortunately, little is actually understood about the configuration and context of the recovered materials, as the site was not excavated in a systematic or professional manner. Nonetheless, the site is dated to the Late PaleoIndian based on the presence of several Plano-like points, and it is inferred that it was occupied repeatedly by a population focused on big-game hunting as the primary mode of subsistence (Haviland and Power 1994; VDHP n.d.).

Most PaleoIndian sites and find spots in Vermont are located in the Champlain Valley along the northwest margin of the state. St. Albans, Milton, Ferrisburg, and Addison all have yielded diagnostic fluted points, albeit in isolation, and suggest that a favored settlement option was along the sandy shores of the Champlain Sea during its period of maximum extent. Outside of the Champlain Valley, fluted points have been recovered from along Otter Creek in Brandon and from a ridge along a small stream in Moretown. It appears that PaleoIndian peoples preferred to travel North/South along the more lush western margin of Vermont and did not often venture into the rugged uplands of eastern Vermont (Thomas and Bourassa 1986:21). The Vermont portion of the Connecticut Valley has yielded no evidence of PaleoIndian occupation, but the Whipple Site, a PaleoIndian occupation dating to roughly 9000 B.C., was identified on a tributary of the Connecticut River in Swanzey, New Hampshire.

More recently, Richard Boisvert has published a series of articles on the Israel River Complex, a series of fairly large PaleoIndian sites located in Jefferson, New Hampshire, on the Israel River tributary of the Connecticut. Jefferson I-III (27-CO-28, 29 and 30) yielded diagnostic fluted points and channel flakes as well as chipping debris associated with tool production. Analysis of the complex and artifact assemblages suggests an innovative and flexible approach to projectile point manufacture in the Gainey/Bull Brook style, an eclectic lithic profile of local and non-local sources suggesting wide-scale movement throughout northern New England during the PaleoIndian Period, and a settlement profile focused on major river terraces (Boisvert 1998, 1999, 2000).

Other major PaleoIndian sites in northern New England include the 1-acre Vail Site in western Maine and the substantially larger Bull Brook occupation in Ipswich, Massachusetts. A string of such sites also has been identified within the Champlain/Hudson River valley in New York State including the Davis, Kings Road, West Athens Hill, and Dutchess Quarry sites.

PaleoIndian sites are scarce in general and even more rare in the Northeast. This is, in part, a real phenomenon generated by harsh environmental conditions in the region during that period. Conversely, the perceived scarcity also may be an artifact of limited survey work, differential preservation, a reliance on fluted points as the primary diagnostic marker of the period, and the possibility that many of the earliest sites are deeply buried under lake and river deposits.

Archaic Period

The Archaic Period in Vermont spans roughly 6,000 years and is marked by a gradual movement into and settlement of the region. Archaeological evidence suggests that settlement and subsistence patterns during this period are somewhat dynamic and shifting and likely represent a response to the dynamic and shifting climatic conditions in the wake of the final retreat of the Laurentide ice sheet. On balance, the Archaic is poorly understood in Vermont as the database remains rather limited and few solid radiocarbon dates exist for those sites that have been identified.

Early Archaic Period (7000–5500 B.C.)

The Early Archaic in Vermont saw the end of the Wisconsin glaciation and a substantial temperature increase referred to as the Hypsithermal period (6000–1500 B.C.) (Figure 4-1). During this time, average temperatures actually were higher than they are currently and plant and animal communities reacted accordingly. Dry, warm summers and dry, cold winters encouraged the spread of pine-dominated forest but also precipitated the decline of the megafauna populations on which earlier human communities had depended. In their place, smaller prey such as deer, bear, and other species recognizable to modern man emerged as well as a broader range of riverine, estuarine, and plant life that could not exist under the previously frigid conditions. Additionally, nut-bearing trees saw an increase during this period.

The lithic technology of the Early Archaic reflects this shift from a primary reliance on big game hunting to a more diversified subsistence strategy. Corner-notched, stemmed, and bifurcate-based points serve as the diagnostic artifact class for the period and attest to a continued reliance on meat in the diet. However, the recovery of hammerstones, milling slabs, and notched pebble sinkers also indicate an increasing utilization of wild plant and fish resources. Also characteristic of Early Archaic assemblages is the predominance of expedient tools and the nearly exclusive use of local lithic sources, the latter of which suggests a more settled lifestyle. For all of their similarities, Early Archaic assemblages have the tendency to be highly eclectic in terms of their actual composition, reflecting the flexible and adaptive technological responses of a population confronted with a broad new range of environmental contexts (Haviland and Power 1994; VDHP 1991).

Vermont hosts fewer than 40 Early Archaic Period sites in a range of environmental settings of which only six have been intensively sampled. For that reason, the settlement strategies of these people remain somewhat speculative (VDHP 1991). By the end of the period, people were moving into the area using two overlapping settlement methods: "restricted wandering," defined as seasonally based group movement, within well-defined territorial limits formed the basis for

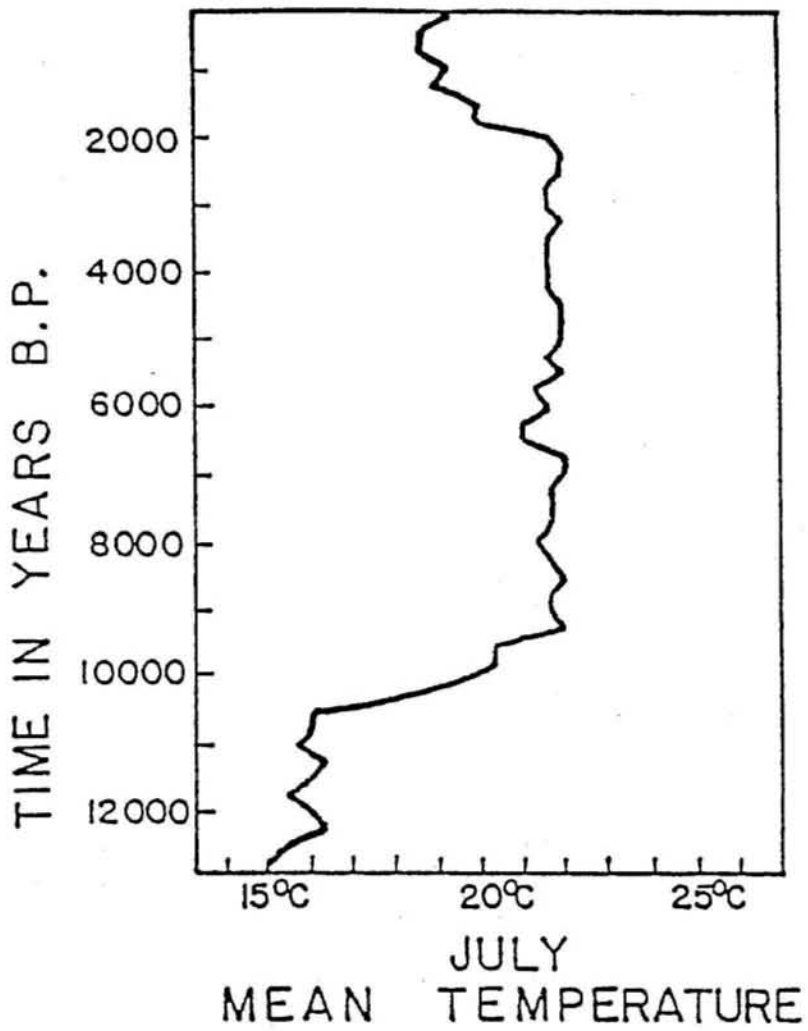


Figure 4-1. Graph of July mean temperature through time (source: Thomas and Bourassa 1986:26).

small residential groups foraging from one resource locus to another, and; "central-based wandering communities," interpreted as a large band of individuals, perhaps as many as several hundred, spending an extended period of time in a single location to which they may or may not have returned at a later date (Ritchie 1969). That one form of settlement was categorically distinct from the other is unlikely, but the terms do provide general typological tools with which to interpret sites dating to that period.

The relatively low density of sites dating to the Early Archaic, particularly when compared to subsequent periods, have fueled the notion of commensurately low population densities. The low productivity of the early Holocene and, in particular, the low biotic productivity of the newly created Lake Champlain, have been cited as contributing factors. The identification of deeply buried Early Archaic sites on floodplains inside and outside of Vermont, including Bessette 2 and 3 on the Missisquoi River in northwestern Vermont, the Walnut Street site on the Connecticut River in Gill, Massachusetts, and the Eddy site at Amoskeag Falls on the Merrimack River in New Hampshire, suggest that this condition is more apparent than real.

The John's Bridge Site (VT-FR-69), located on the Missisquoi River in Swanton, represents one of the better-known Early Archaic sites in Vermont (Thomas and Robinson 1980). Dating to about 5900 B.C., the small site contained five deep pits, a huge assemblage of chert, quartzite, and quartz chipping debris, and a collection of tools including 11 Swanton Corner-Notched projectile points, skinning knives, perforators, scrapers, and abrading stones. Significantly, the association of the Swanton Corner-Notched points with a clearly Early Archaic occupation confirmed a new diagnostic tool form for the period in addition to bifurcate based forms (Skinas 1992). Although no evidence of a shelter was unearthed, the density and distribution of cultural material and the spatial arrangement of a surface hearth at the site indicate that one did exist and likely was used as a workshop area for the production and repair of tools.

The Bessette 2 and 3 sites (VT-FR-140), located just upstream of John's Bridge in Highgate and dating to 5780 ±70 B.C. and 6020 ± 270 B.C., are similarly restricted in size and scope. Bessette 2 yielded four typologically indistinct projectile points and more than 10,000 pieces of chert debitage, while Bessette 3 contained a shallow hearth, two bifurcate points and more than 200 pieces of chipping debris. The recovery of bifurcate base points from Bessette 3 is significant in that it illustrates the relatively rapid and extensive spread of Early Archaic tool technology from people living to the south along the Atlantic coastal plain, where the form is believed to have originated, to Vermont. Comparison of the two sites also underscores the range of camp sites organized by Early Archaic people, from a collection of residential base camps occupied for an extended period of time, as is the case at Bessette 2, to a small briefly occupied camp at Bessette 3 (Thomas 1997).

In addition to the abovementioned sites, bifurcate base points have been found thinly scattered throughout Vermont and, again, tend to be concentrated along the western side of the state, suggesting an overall settlement pattern analogous to the PaleoIndian. A bifurcate point was recovered from the Brooks Farm site in St. Albans, while others have been recovered from the Connecticut River valley in the southeastern corner of the state. Swanton Corner-Notched points have been recovered from 14 sites in the Champlain Valley along the Otter Creek, Lamoille, and Missisquoi Rivers as well as near Shelburne Pond in the Winooski River watershed (Haviland and Power 1994).

Middle Archaic Period (5500–4000 B.C.)

The Middle Archaic saw a shift from the dry conditions of the preceding period to a climate characterized by significant increases in precipitation, perhaps as much as 25–30 percent higher than current levels (VDHP n.d.). Increased rainfall and snowmelt caused extensive flooding along major river systems as observed through rapid sedimentation sequences and channel migration along portions of the Missisquoi River floodplain. Vegetation patterns also shifted in response to the increased rainfall as the pine-dominated landscape gave way to a deciduous forest of oak, beech, sugar maple, elm, ash, and beech, with smaller numbers of hemlock and white pine. With the emergence of this "mast" forest, deer populations expanded and likely became a major subsistence focus. Bear, wolf, otter, and wild turkey also emerged in greater numbers, while comparatively smaller populations of moose, elk, and caribou remained in the spruce-fir-northern hardwood forests of the Green Mountains.

Sites in Vermont dating to the Middle Archaic Period are exceedingly rare, with fewer than 12 currently identified. This seems paradoxical given the increasing abundance and predictability of subsistence resources and may reflect a problem of recognition rather than a true absence of sites. The period is defined by three stemmed projectile points that have their origin along the Atlantic coastal plain including Neville, Neville variant, and Stark. The Neville type site was identified by Dincauze in Manchester, New Hampshire and contained a substantial collection of these points, some with slightly bifurcate bases hinting at their Early Archaic lineage (Dincauze 1976). Despite its northern New England identification origin, subsequent finds tend to be concentrated in southern New England. Middle Archaic sites are infrequent in the Champlain Lowland, south into the upper Hudson River drainage as well as in the upper St. Lawrence. To date, only a half dozen sites dating to this period have been identified in Vermont on the basis of Neville and Stark points. This infrequency suggests one of two scenarios: first, that Middle Archaic populations in Vermont shared a closer technological affiliation with the upper St. Lawrence-Great Lakes region than the Atlantic coastal plain and, as such, Neville and Stark points are not adequate diagnostic markers or, second; that there was an extremely small Middle Archaic population in Vermont.

Neville, Neville variant, and Stark points often are found in association with steep-bitted scrapers, flake knives, perforators, adzes, axes, and choppers. Heavy woodworking tools also are common and suggest the appearance of dugout canoes during this period, perhaps a response to the increased river travel concomitant with increased precipitation. Excavations of a sealed, dated mortuary feature at Annasnappet Pond in Carver, Massachusetts also have conclusively linked the emergence of atlatl weights to this period (Cross 1999; Doucette and Cross 1997). Like the Early Archaic, informal tools appear to dominate the many Middle Archaic assemblages.

Settlement and subsistence patterns among Middle Archaic people in Vermont are difficult to infer because of the extremely limited database. The Fleming Museum collection yielded only three Neville points for Chittenden County out of a total assemblage of 5,000. To date, only six sites have been identified in Vermont on the basis of Stark or Neville points. Three of those points have come from amateur collections including the Benford Collection, which contained a Neville from Bomoseen Lake in southwestern Vermont, a Stark point in the Coane Collection from Salmon Hole along the upper West River, and another Stark in the Lathrop Collection from Batten Kill in Sunderland. A single Neville was reported from a mixed plow zone context at the Auclair site (VT-CH-3) near the outlet of Shelburne Pond, while two possible Neville points also have been recovered from on the shore of Lake Champlain in Ferrisburg. A terrace along Leicester River in the Otter Creek watershed yielded two additional Neville points and, finally, an isolated Stark point was found on an alluvial terrace adjacent to Otter Creek in Rutland (Thomas et al. 1983).

This limited database does suggest that Middle Archaic sites are oriented toward ponds, lakes and rivers with an attendant emphasis on seasonal rounds. Base camps and residential camps are provisionally hypothesized, although physical evidence of houses or shelters has yet to be identified in the Northeast. The Neville site in Manchester and the WMECO site (19-FR-15) in the Riverside archaeological district in Gill, Massachusetts are both posited as base camps because of their locations on highly productive fisheries along major falls (Dincauze 1976; Thomas 1980). While such sites have not yet been found in Vermont, similar large camps are possible in analogous environmental settings, particularly at Vernon and Bellows Falls along the Connecticut River. All of the identified Middle Archaic sites in Vermont currently are believed to represent smaller residential occupations. Subsistence practices in Vermont during the Middle Archaic also are largely speculative, but based on information from WMECO and sites along the

Lamprey River in New Hampshire and the Lund and Lindquist sites in Maine, a broad range of terrestrial and non-terrestrial resources were exploited including deer, shad, salmon, fox, otter, and bear.

Burial sites dating to the Middle Archaic are non-existent in Vermont, as is the case in all non-coastal areas of New England. If coastal burial practices are to serve as a guide, elaborate ceremonialism is characteristic of the period. L'Anse Amour, on the southern coast of Labrador, included a single individual buried face down with its head oriented toward the east and interred with a rich variety of ochre-stained grave goods. The Morrill Point burial complex in Maine and the Table Land burial site in Manchester, New Hampshire, both contained ochre-stained human remains, some of which had been cremated and all of which were interred with elaborate grave goods (VDHP n.d.).

Late Archaic Period (4000–900 B.C.)

Environmental conditions during the Late Archaic Period in Vermont are marked by a climatic shift to drier and slightly warmer conditions (see Figure 4-1) with a significant decrease in precipitation. River and lake flooding became an uncommon event as reflected in the lack of substantial alluvial deposits along the Missisquoi River as well as by a dramatic drop in the Shelburne Pond water table. During this period, oak, pine, and beech reached their full extent, while hemlock became much scarcer in response to the increasing dryness. Wetlands also became more abundant along river margins. Animal communities remained essentially the same as the preceding period, but it is likely that deer became even more plentiful with the full maturity of the mast forest, and that wetland/estuarine resources became an even greater subsistence resource.

Perhaps in response to an increasingly resource-rich natural environment, Late Archaic populations underwent a substantial growth spurt relative to previous periods. This growth spurt, in turn, spurred an elaboration of settlement and subsistence models as well as a diversification in lithic technology unprecedented in the prehistoric record. As a means to better categorize and interpret the many local expressions of Late Archaic culture, the period has been divided into four traditions.

Laurentian Tradition (3600–2400 B.C.)

The Laurentian Tradition was first identified in New York on the basis of "Proto-Laurentian" lithic assemblages including broad side-notched points with ground bases. These points generally resemble Otter Creek and Brewerton side-notched points. These point types later were

recognized as diagnostic of the period along with Brewerton corner-notched and Vosburg projectile points. The association of Otter Creek points with heavy woodworking tools have led many to suggest that Otter Creek points are more appropriately grouped with Middle Archaic populations, but it is just as likely that this point style was grafted onto an older tool kit during the Late Archaic. In addition to projectile points, ground slate blades, celts, gouges, plummets, and ulus also serve as distinctive diagnostic markers for the period.

Within the Laurentian Tradition, three phases have been identified, referred to as the Vergennes, Brewerton, and Vosburg. Differentiated largely on the basis of diagnostic projectile points, the phases represent regional variations on the larger Laurentian Tradition rather than unique or specific adaptations. While the three phases overlap, the Vergennes phase is the oldest and the base from which the Brewerton and Vosburg technologies subsequently developed. Specific durations for each phase are difficult to determine. It is probable that they were largely contemporaneous (Haviland and Power 1994).

The Vergennes phase is characteristic of Vermont and is best represented by the Ketchum Island, or KI, site (Ritchie 1968). Roughly 1 acre in size, the site is located on a small, rocky, wooded island within a swamp along Otter Creek near Rutland. The type site for Otter Creek projectile points, the assemblage also comprised exceptionally robust atlatl weights, ulus, blades, choppers, celts, adzes, and scrapers fashioned from quartzite, slate, chert, and sandstone. A copper gorge also was recovered. Several hearth features, a roughly 15-ft wide circular dwelling, and a single red ochre burial were identified as well. While the occupation duration and seasonality of KI is somewhat speculative, the broad range of stone tools at the site suggests a population fully exploiting a broad range of food resources. Furthermore, the collection of heavy woodworking tools indicates the production of dugout canoes, while the relatively restricted range of lithic raw materials indicates a preference for locally available stone.

Other Vergennes Archaic sites in Vermont include five more sites along Otter Creek (Otter Creek 1–5), one of which, Otter Creek 2, contained the secondary internments of one infant, three children, and two adults. Vergennes phase artifacts also have been recovered from the Auclair Site at Shelburne Pond, the Winooski Site, and from the Hoosic and Walloomsac river drainages along the western edge of the state. The Bridge Site, located outside of Vermont but still in the Champlain Valley, was identified through surface collections during expansion of a sand pit operation and shares an analogous environmental profile with the KI Site. Otter Creek points are well represented in the Sweeney Collection (Thomas 1979) and in the Balder Collection from the Hoosic drainage (Fisher et al. 1977).

The Brewerton and Vosburg phases of the Laurentian Tradition are poorly represented and, consequently, poorly understood in Vermont. It is assumed that many of the basic patterns of the Vergennes phases, namely the exploitation of varied ecological niches and the pursuit of seasonal rounds, continued during these phases (VDHP n.d.). Brewerton projectile points are numerous in the Sweeney Collection, and one of the Green Mountain National Forest sites contained Brewerton points

The only temporally diagnostic prehistoric site in the immediate vicinity of the Elizabeth Mine Site dates to the Laurentian Tradition (VT-OR-69). This site consists of a broken Otter Creek point and a number of bifaces recovered from the vicinity of a permanent stream. This site represents the only known Late Archaic site in Strafford.

Narrow Point Tradition (2400–1600 B.C.)

This tradition, also known as Small Stemmed, is distinguished by the presence of relatively long and narrow bladed projectile points with generally weak shoulders and straight, expanding and side- or corner-notched stems. These points tend to be made from locally available materials, often quartz, and are abundant in both southern and northern New England. Variants of the narrow point/narrow stemmed projectile point type include Lamoka, Bare Island, Wading River, Sylvan side-notched, Sylvan Stemmed, and Normanskill and occur in every major watershed in Vermont. However, none of the points have been securely associated with a single component site.

Artifact assemblages dating to this period tend to be less diverse than during the Laurentian. Knives, drills, side and end scrapers, pestles, choppers, and hammerstones occur but in less eclectic groupings and there are significantly fewer ground-stone woodworking tools, suggesting a shift away from dugout canoes toward bark canoes in regions where birch trees were supported. Settlement occurred in a wide variety of locations including elevated bluffs, rockshelters, inland streams and lakes, and the back-country, all of which suggest a continuation and intensification of broad-based resource exploitation. During this period new settlement patterns also begin to emerge, including a more intensive use of marginal uplands and the occupation of upland ridges in the Winooski and Wells River watersheds as well as secondary to minor stream valleys in the lowlands.

Susquehanna Tradition (1800–800 B.C.)

This latest tradition of the Late Archaic is also referred to as the "Broadspear" or "Transitional/Terminal" Archaic. Diagnostic projectile points include large, broad-bladed stemmed points (Atlantic, Snook Kill, Perkiomen, Genessee, and Susquehanna Broad) as well as smaller "fishtail" points with expanding stems (Orient Fishtail). Flat bottomed, lug-handled soapstone vessels also appear during this period, often in association with Susquehanna Broad and Orient points, and evidence suggests that some of the earliest fired ceramics may date to this time as well. Known as Vinette 1, these earliest pots were coil built with concoidal bases and finished with cord-wrapped paddles. Atlatl weights, end and side scrapers, expanded-base drills, retouched flake knives, pestles, notched sinkers, whetstones, and hammer-anvil stones round out the Susquehanna assemblage for Vermont, although grooved axes, adzes, gouges and paintstones also have been recovered in association with Orient points on Long Island.

Settlement patterns appear to have shifted at approximately 1000 B.C. in response to a shift in the regional climate (see Figure 4-1). Cooler and wetter conditions precipitated a dramatic decline in the deciduous canopy and a return to a hemlock, pine, and birch dominated landscape. With the decline of the mast forest came a commensurate decline in the animal species dependent on it, namely deer, and it is probable that the subsistence diversity that characterized the previous traditions began to contract. Based on archaeological evidence or, more properly, lack of evidence, upland areas seem to have been used less and less until by roughly 800 B.C. that ecological niche was virtually abandoned.

Burial ceremonialism became exceptionally elaborate and complex during this period, particularly as it was manifested in the Orient phase around Long Island Sound. In that area, Fishtail points have been identified in association with single and communal cremation and inhumations on high hilltops, with the human remains and grave goods covered with red ochre and the inclusion of ritually broken, or "killed" soapstone vessels. No burials dating to the Orient phase have been identified in Vermont. However, an unusual burial complex was identified on

Isle La Motte at the northern extent of Lake Champlain. Referred to as Glacial Kame burials, the interments were discovered during graveling operations. Two in situ burial pits containing the cremated and ochre-stained remains of six individuals were identified along the gravel ridge. Elaborate and exotic grave goods also were interred in the pits including "killed" sandal sole gorgets, circular shell pendants, copper, unworked galena, and disc beads (VDHP n.d.). This burial complex is unique in Vermont and appears to have diffused into the region from the north and west.

Susquehanna Period sites are comparatively rare in Vermont and tend to be concentrated along the western border of the state in plow zone or multicomponent contexts. Orient phase components have been identified in small numbers throughout the Champlain Valley including at the Auclair, Donovan, Otter Creek No. 2, and Rivers sites. Only one single component Susquehanna Tradition site has been identified in Vermont, the Orient phase Highgate Converter Station site (VT-FR-61) along on the Missisquoi River in Highgate (Thomas and Dillon 1985). Dating to roughly 1200 B.C., the site yielded an assemblage of nine flake tools, chert chipping debris, a projectile point tip, and a chert preform, and is interpreted as the remains of a small hunting camp. Susquehanna sites are even less visible in the Connecticut River valley, and those that have been identified tend to be deeply buried by alluvial deposits. The Sumner's Falls Site in Hartland, dating to ± 800 B.C., contained Orient Fishtail points and a steatite cooking pot, while surface collection in the Skitchewaug area in Springfield resulted in the recovery of soapstone vessel fragments.

The point type of the same name defines the Snook Kill Phase. The largest Snook Kill component identified to date in the Hoosic River drainage is at the Weir Site (Funk 1978). Both Snook Kill and Genessee points are included in the Sweeney Collection, most notably from the Rudd Site (VT-BE-12) (Hasenstab and McArdle 1988; Thomas 1979). The Hudson Orient Phase, represented by Orient Fishtail and Susquehanna Broad projectile points along with soapstone (or steatite) pottery vessels are also present in the Sweeney Collection from the Hoosic River drainage.

Woodland Period

The Woodland Period in Vermont is marked, in the earliest phases, by a remarkable degree of continuity with the previous Archaic traditions. By the end of the period, a series of dramatic developments, including the development of horticulture and the earliest contacts with European populations, changed Native American lifeways in profound measure.

Early Woodland Period (900–100 B.C.)

Climatic conditions during the Early Woodland remained essentially the same as those that marked the Late Archaic Period after 1000 B.C. Cooler, wetter conditions encouraged the decline of nut-bearing vegetation in favor of hemlock, pine, and birch and imposed limits on the biotic carrying capacity of the region relative to earlier periods. Human populations in Vermont responded to this change by continuing a broad-based hunting and gathering strategy but one more explicitly oriented toward rivers, lakes, and ponds with limited seasonal use of upland settings. In short, general cultural settlement and subsistence patterns did not change dramatically from the Late Archaic to the Early Woodland. The Missisquoi, Lamoille, Otter Creek, Lemon Fair, and East Creek drainages on the western side of the state all served as settlement foci as did, to a lesser extent, the Connecticut River valley to the east. Group sizes are assumed to have been relatively small, perhaps between 30 and 50 people that in some cases splintered into even smaller residential camps of 5–15 individuals.

Diagnostic cultural materials for the Early Woodland include stemmed and side-notched Adena and Meadowood projectile points. Both point types are relatively rare and tend to occur in small numbers within Early Woodland assemblages. Lagoon points are also indicative of the period, but only have been provisionally identified in western Vermont, as they are far more common in southern New England. Lithic assemblages for this period comprise a high percentage of "exotic" lithic materials, including Munsungen cherts from northern Maine, and speak to an expansion and elaboration of long-distance trade networks. Low-fired Vinette I pottery, which seems to make its first appearance during the Late/Transitional Archaic, also becomes much more visible in the archaeological record during this time.

Once again, the occurrence of Early Woodland occupations in Vermont is low. Some have suggested that this low density of sites, not just in Vermont but throughout New England, indicates a population decline associated with any number of causal factors including unfavorable environmental conditions, "unknown prehistoric epidemics" (Fiedel 2000; Mulholland 1988; Snow 1981; Wendland and Bryson 1973). This assertion may be more a function of a lack of recognition of Early Woodland components from a cultural material perspective than a real decline in numbers. This idea receives some support from the fact that several Early Woodland components in Vermont, including a hunting camp stratum at the Highgate Converter Station Site, contained no diagnostic artifacts but rather were dated on the basis of radiocarbon dates (Thomas and Dillon 1985).

Other Early Woodland components in the Champlain Valley were identified in the Pearl Street Park site (VT-CH-234) near the headwaters of Sunderland Brook in Essex and the Ewing Site on Shelburne Pond. The former was identified on the basis of a broken Meadowood point, Vinette I ceramics and a resharpened lobate-stemmed point all made from non-local gray to dark gray chert, while the latter was radiocarbon dated to 765 ± 135 B.C. using the remains of ritually consumed dog. While no additional diagnostic material was recovered from Ewing, the recovery of a broken Meadowood from the nearby Auclair site confirms an Early Woodland presence in the area. An Early Woodland component also was recently identified with the recovery of a possible Meadowood point at VT-CH-201 in Colchester. This site, located between the Winooski River and Mallets Bay, was originally identified in the 1980s during a survey for the Chittenden County Circumferential Highway, has yielded evidence of occupation in the area from 2,500 B.C. –A.D. 1000 (Toney 2001).

The Canaan Bridge site, radiocarbon dated from 370–910 B.C. with a mean date of 635 B.C., provides the most detailed data about the Early Woodland from a residential context on the Connecticut River (Bolian and Gengras 1991). Located close to the Canadian border, the site was occupied repeatedly during the Early Woodland and yielded several shallow hearths, Vinette I pottery fragments, a red chert Meadowood point, chert flakes and knives, grinding stones and slabs, and a fragment of a highly polished ground-stone pendant. Overall, artifact densities were low, but the predominance of exotic cherts reinforces the expansion of trade networks during this period. The Skitchewaug site in Springfield is another large, complex, multicomponent site along the Connecticut River containing a deeply buried Early Woodland occupation dating to 720 ± 70 B.C. This level yielded a side-notched point, a broken cache blade, a reworked unifacial scraper, and Vinette I pottery fragments (Heckenberger and Petersen 1988).

The evolving trade network that resulted in the predominance of non-local lithic materials in many Early Woodland assemblages might also explain the increasingly elaborate and exotic mortuary complex that developed during the period. What is remarkable about the Early Woodland is the degree to which it is defined by mortuary data, particularly in light of the relative

paucity of domestic sites dating to the same time. Defined on the basis of New York typologies as the Middlesex mortuary complex (Ritchie 1969), four such cemeteries have been identified in the Champlain Lowland including Boucher (VT-FR-26), Swanton (VT-FR-1), East Creek (VT-AD-26), and Bennett (VT-AD-298).

Of these four sites, Boucher is the most thoroughly documented, containing 84 pit features positively identified as burials and an additional 18 pits presumed to have contained human remains that have since completely disintegrated (Heckenberger et al. 1989). Based on a range of radiocarbon dates from 885–100 B.C., the area is believed to have been used throughout the Early Woodland and contains a wide array of burial practices and grave goods. Cremations and inhumations, secondary internments, and flexed burials all were identified as well as a spectacular array of exotic grave goods including Ohio steatite blocked-end tubular pipes, Meadowood and Adena points, amulets, plummets, birdstones, gorges, and pendants. Three complete but broken Vinette I vessels were recovered and are rare for the fact of their incised decoration. Bone needles, punches, and fish hooks, shell beads and pendants, and copper awls, celts and rolled and tubular beads also were excavated. The inclusion of copper provided a positive preservation environment that allowed for the recovery of hide and plant fiber artifacts including medicine bags, cordage, mats, and shrouds. Osteological analysis of the human remains indicated a relatively healthy population that subsisted primarily on meat and fish but did suffer from a high, but not unusual, degree of pre-adult mortality. Overall, analysis of the Boucher assemblage reveals a largely egalitarian society with strong trade extraregional trade networks and strong, well-developed spiritual beliefs, particularly in regards to the treatment of their dead.

Middle Woodland Period (100 B.C. –A.D. 1050)

Beginning about 150 B.C., the climate appears to have stabilized as the previously damp and cold environment gave way to generally drier and warmer conditions (see Figure 4-1). If the number of identified sites is any guide, it appears that population densities increased during this period as well, but aggregated almost exclusively in the Champlain and Connecticut River valleys. This population expansion may have overtaxed the subsistence resources of the changing environment and led to a more diffuse hunting and gathering strategy that saw a return to a more intensive exploitation of the uplands. In general summer villages were located in the lower reaches of almost every major river with upland habitation sites prevailing in winter, spring, and fall.

Pottery style and decoration became far more deliberate and stylized than is evident in the preceding period, although there are no comparable examples of the dramatic Middlesex mortuary complex. The elaboration of pottery design may take its cue from the population expansion hypothesized for the period, in which a diversity of groups may have felt a cultural imperative to distinguish themselves from one another through decorative motifs.

The Middle Woodland in Vermont is the best understood prehistoric period in Vermont (Atwood 2000:V-5), thanks to several excavations in the Champlain Lowland. Perhaps for this reason, the period has taken on a degree of interpretive complexity that has resulted in the creation of four phases including the Winooski, Fox Creek, Intervale, and Colchester. Like the phases defined for the Late Archaic Period, these phases tend to overlap if not coincide with one another, and reflect regional variation on a basic adaptive suite. The Winooski Site, located on the east bank of the Winooski River close to Lake Champlain, has become the type site for the period in western Vermont and contains evidence of all three phases. Middle Woodland Period sites also are expected for the eastern part of the state, particularly within the Connecticut River valley. The Skitchewaug Site in Springfield, for example, contained a Fox Creek Point, several Levanna

points, and pottery with close stylistic affinities to Middle Woodland forms found in northern New England drainages, suggesting at least occasional utilization of that area

Winooski Phase (100 B.C.–A.D. 300)

Winooski phase settlements tend to cluster near riverine, lacustrine, and wetland environments with an obvious exploitation of the available resources in those environments. The Winooski Site yielded evidence of deer, domestic dog, fish, bird, and mammal bone as well as butternut, pigweed, and bedstraw (Petersen and Power 1983). Similar remains have also been recovered at the Donovan, East Creek, Ewing, Mudgett Island, Otter Creek No. 2, and Sunderland Falls sites, but because of mixed stratigraphic contexts, a clear association with the Winooski phase or clear indications of seasonality cannot be determined. Residential sites are assumed to have been rather small and reflect a restriction of the wandering community pattern so common during the Archaic. The Oxbow Type A projectile point is believed to be diagnostic of the period and it appears that lithic assemblages comprise mostly non-local materials, suggesting the continuance of long-distance trade networks. Grit tempered, coil built cylindrical and slightly bulbous vessels with pointed bottoms define the ceramic form and are generally well fired. Decorative motifs include stamps and incisions from the neck to base, with a psuedo-shell motif present on all vessels recovered from Winooski. Other sites include similar design elements with the inclusion of dentate decoration.

Fox Creek Phase (A.D. 300–500)

Fox Creek phase sites in Vermont are rare; no such phase was identified at the Winooski Site, but it is documented in New York. The closest comparative example to this phase in Vermont is VT-CH-201, located on a small tributary of the Winooski River in Colchester. The riverine setting is typical of the phase as is the artifact assemblage that included diagnostic Fox Creek stemmed projectile points, a chert preform, and fragments of two chert drills. Grit-tempered pottery with dentate and pseudo-scallop shell decoration also was recovered. The site has been interpreted as a small residential settlement as were two other similar occupations, VT-FR-7, located on the lower Missiquoi River, and VT-CH-127, identified on a narrow terrace below the Winnoski Falls.

Intervale Phase (A.D. 500–800)

Settlement patterns during the Intervale phase are similar to those of the Winooski and Fox Creek phases, and include small residential and base camps focused on riverine and wetland environments. Most of the identified sites in Vermont have been identified on the lower reaches of the Missisquoi, Otter Creek, Lamoille, and Winooski rivers although additional sites have been located near Shelburne and Bristol ponds.

A broad range of animal and plant remains was recovered at the Winooski Site including deer, sturgeon, muskrat, butternut, hickory, and black walnut, suggesting a summer through fall occupation, while other combinations of food remains at Bessette I and Sunderland Falls suggest a similar seasonal occupation. Bessette I also may contain evidence of an extended spring through late fall occupation. What all of this data suggests is a return to a restricted wandering pattern during this period and an increased exploitation of many environmental niches by large and small groups. VT-WA-35, a small site located on a narrow terrace above the Winooski River in Moretown, likely represents an extremely short-term "stopover" site used to take advantage of a seasonally specific resource, and bolsters the idea of a diffuse subsistence strategy (VDHP n.d).

Technologically, Jack's Reef Corner Notched projectile points function as the most diagnostic artifact for this phase, although Levanna and Jack's Reef pentagonal points also are common. Raw material types derive from both local and non-local sources. Coiled and grit-tempered ceramics are common in Intervale assemblages but, as was noted at the Winooski Site, tend to be of lower quality with commensurately lower survival rates in archaeological assemblages. Surviving fragments, however, exhibit a characteristic wavy line decoration that may be diagnostic for ceramics dating to that time.

Evidence for a large residential base camp has been recovered at the Reynolds Site on the Missisquoi River while the Knapp Site on Lake George represents a small extractive or processing station site. Additional extractive station components also have been identified at Otter Creek No. 2 and several sites near the Winooski Falls, all of which suggest a diversity of sites and functions for the Intervale phase. Evidence for the period is quite sparse for the southwestern part of the state. Jack's Reef Corner Notched points have been recovered from the Hoosic and Walloomsac valleys as part of the Sweeney Collection, but no inferences concerning settlement or subsistence patterns can be inferred from that data.

Colchester Phase

Sites dating to the Colchester phase are found in a wide variety of environments. Large sites tend to be located on the floodplains of the lower reaches of Winooski, Lamoille, and Missisquoi rivers and Otter Creek. Smaller sites occur on the upper reaches of those same rivers as well as along the Hoosic and Wallomsac rivers, small streams like Sunderland Brook, and along the edges of Shelburne Pond (Ewing and Palmer sites) and Lake St. Catherine and Lake Bomoseen. Based on this distribution model, settlement strategies clearly revolved around riverine and lake resources with an increasing emphasis on the uplands.

Levanna points appear to be characteristic of the period as are bone fishhooks, gorges, awls, and needles as deduced from excavations at the multicomponent river site at the mouth of Dead Creek. What is unusual about lithic assemblages during this period is the near-exclusive use of local raw materials such as local quartzite and Champlain Valley chert. This pattern was observed at the Winooski site as well as at the McNeil site and McNeil Borrow site across the river. This shift from exotic to local materials may reflect a hardening of territorial and cultural boundaries between native people in the Hudson Valley and groups in Vermont (Peterson and Power 1983). Grit tempered, coil built pottery, stamped and undecorated, dominates the ceramic profile in this phase.

Late Woodland Period (A.D. 1050–1600)

The Late Woodland represents a period of both continuity and innovation, one in which lithic technologies, an interpretive mainstay in archaeology, underwent very little change, while at the same time the development of horticulture dramatically altered the social and cultural landscape for Native American communities. During this period, archaeological and ethnohistoric literature begins to make reference to distinct Native American communities, for example the Iroquois and Abenaki. This distinction is not arbitrary but appears to reflect increasing levels of self-identification among these populations as reflected in distinctive ceramic styles and restricted trade networks relative to earlier periods.

While the number of identified Late Woodland sites is rather low, the distribution of these sites is far more evenly spread along the eastern and western boundaries of the state than is the case for the preceding periods. Large habitation sites appear to be concentrated along major river valley

corridors, including the Champlain and Connecticut River valleys, a phenomenon that likely reflects the increased desirability of floodplain environments for horticultural purposes. The multicomponent Skitchewaug Site in Springfield, located along the western bank of the Connecticut River, has yielded some of the most detailed and informative data about the period and, in view of its environmental similarity with similar sites in the Champlain Valley, will serve as the descriptive basis for the Late Woodland in Vermont.

The adoption of horticulture is undoubtedly the most significant cultural adaptation during the Late Woodland, and had serious, identifiable repercussions for nearly every other aspect of Native American life during that time. After the introduction of maize in ca. A.D. 1050 (Thomas and Bourassa 1986) settlement patterns became markedly more sedentary from A.D. 1100–1450 and residential groups became larger. Villages comprising small hamlets adjacent to cultivated fields began to emerge during this period and appear to have been occupied during the growing season. Skitchewaug yielded carbonized maize, beans, and kernels dating as early as A.D. 1100 and contained the deeply buried remains of two semisubterranean pit structures (Heckenberger et al. 1989). These 4–6-m wide oval structures are visible as a series of superimposed living floors separated by what are likely sterile flood deposits. House Pit 1 appears to have been occupied as many as 14 times and was peppered with deep storage and refuse pit features. Similar structures have been identified upriver in Windsor and Fairlee. A third site in Orange County also contained a series of dark organic living floors stratigraphically separated by subsequent flood deposits, but these living floors are considerably larger than at Skitchewaug, in some cases stretching as far as 24 m in length. The Donohue Site (VT-CH-94) on the Winooski Intervale in Burlington, also contained the remains of a residential hamlet similar to that unearthed at Skitchewaug, although with less clear-cut evidence of habitation structures.

The excavated storage pits at Skitchewaug provide confirmation of the primacy of horticulture for the families living at the site and also provided clues the seasonality of its occupation. Comprising basin- and bell-shaped forms, at least one of the identified storage pits contained evidence of having been lined with grass, a technique documented at other Late Woodland sites up and down the Connecticut River and correlated strongly with the storage of cultigens (Bendremer et al. 1991; Lavin 1988; Thomas 1990). Significantly, all of the excavated storage pits contained carbonized maize, beans, and squash. It is inferred that many of these storage pits were subsequently reused as refuse pits. The contents of the refuse pits suggest a diet consisting of both wild and cultivated plant foods and a wide variety of animals including deer, beaver, fox, fish, turtle, bird, and freshwater mussel. Based on this refuse profile, and in consideration of the observed flood deposits that separate the occupational levels, Skitchewaug likely was occupied nearly year-round with a temporary abandonment during the spring to avoid flooding. Similarly, the assemblage suggests that the introduction of agriculture did not cause a complete shift in subsistence strategies. Because of the short growing season in much of Vermont, agriculture may not have had the importance it achieved in southern New England (Thomas and Bourassa 1986).

This intensive occupation of a horticultural camp does not preclude the continuance of seasonal camps. Late Woodland sites located at prime fishing spots along falls have been identified in Vernon and Bellows Falls, while VT-CH-28 and 29, close to the first falls above the Lamoille River, appear to have been chosen for the same reason. Extractive camps, designed to quickly exploit a seasonal resource for processing back at a larger base camp, also continue during this period, especially in the lowlands. VT-FR-161 and VT-FR-140 along the Missisquoi River contained broken Levanna points, hearths, and burned bone suggesting the use of the site as expedient hunting camps, as did the Dewey's Mills site on the Ottauquechee River. A portage camp dating to this period also has been identified at Warrel Farm on the east bank of the Passumpsic River in East Barnet Small residential camps are, in fact, the most common site type

identified in Vermont. These camps appear in every type of environmental niche and, while often containing restricted artifact assemblages, likely represent a broad range of functions. Small upland camps containing Levanna points have been interpreted as family hunting camps occupied for several months during the fall and winter to capitalize on hunting and trapping opportunities. Sites of this nature have been identified around Shelburne Pond and Sunderland Brook on the northwestern side of the state, along the Hoosic River floodplain in Pownal and along the Wallomsac River and Jewett Brook in the extreme southwestern corner, and in upland locations along the West River in Jamaica in the south-central portion of Vermont. All were dated by the presence of Levanna projectile points and are assumed to date relatively early in the Late Woodland.

As suggested above, Levanna projectile points remain the "diagnostic" projectile point marker for the Late Woodland and are commonly manufactured from locally available stone. Assemblages tend to be rather restricted and often contain a narrow range of preforms, scrapers, drills, and expedient flake tools. It is possible that rather than using a restricted range of artifact classes, Late Woodland people are instead using a broader range of materials (bone, antler, and wood) with which to fashion an equally broad range of tools. These types of organic materials do not survive well archaeologically and, as such, would produce an assemblage skewed toward lithic materials that may or may not be representative of the assemblage overall.

Unlike the identifiable tool technologies of the period, ceramic traditions shifted rather dramatically beginning about A.D. 1300. At this time, crushed shell began to replace grit as the temper of choice and narrow concoidal forms began to take on a more globular appearance. Vessel rims become increasingly elaborate and are often decorated with incised geometric motifs. Ten Late Woodland vessels were recovered at the Donahue Site (ca. A.D. 1440) and, while grit tempered, provided a cross-section of the types of decorative styles common for the period. The Ewing Site at Shelburne Pond also yielded a large collection of ceramics, many of which were shell tempered and exhibited stylistic affinities with Owasco, proto-Iroquoian and subsequent historic period vessels (Petersen 1977, 1992).

Mortuary ceremonialism is markedly less elaborate than in previous periods. Individuals tended to be interred on their sides in a flexed position with few or no grave goods, although some bodies have been reported in a sitting position in the Connecticut Valley. Skitchewaug contained two burials, one a primary inhumation of a 30–50 year old woman, and the other a secondary internment of an adolescent. Neither burial contained evidence of grave goods (Heckenberger et al. 1992). The Chipman's Point rockshelter, located on a limestone bluff overlooking Lake Champlain, provides a more controversial picture of Late Woodland burial practices. The site contained two interments, one of which, a young girl, had been badly disturbed by pothunters (Haviland and Power 1994), The second body, that of a 45-year-old woman, was identified in three separate deposits at the eastern end of the shelter. The third deposit contained the skull and long bones of the body, the latter of which had been split lengthwise in a fashion mimicking that of a butchered animal carcass. Initial interpretations suggested cannibalism, a well-documented phenomenon among the Iroquois during the historic period, but also identified during the Late Woodland. Whether the body was actually cannibalized, who may have done it, and for what reason remains an open question and it stands as the only such burial in Vermont.

Contact Period

European contact in Vermont was initiated in 1609 with the voyage of Samuel de Champlain up the river that bears his name. Poor relations with the Iroquois discouraged further encroachment to the interior of the region for the next 40 years, but the southern and western proximity of non-

Native influences, including French, English, and Dutch, set into motion a series of fundamental changes in Indian lifeways (Duffy and Feeney 2000).

The Western Abenaki, concentrated in the Connecticut River valley, were the dominant native group in Vermont at the time of European contact (Day 1978). Valuable allies to the French in their struggle against the English for dominion in northern New England, the Abenaki waged pitched battles against the Mohawk for control of the lucrative fur trade up and down the Connecticut and St. Lawrence rivers (Haviland and Power 1994). The lines drawn between these two native groups reflected not merely the priority of newly introduced economic interests but the priority of cultural survival in ancient societies decimated by disease and warfare.

Because of their inland location and because of the long shadow cast by their Iroquoian neighbors to the west, little is known about the Vermont Abenaki during the Contact period (Day 1978). It is assumed that settlement and subsistence patterns practiced during the late Late Woodland Period were carried through (Berger 1998), but that subsequent disease and warfare reduced Abenaki numbers and likely precipitated a shift in survival strategies (Day 1978). One of the major documented shifts in settlement practices during the seventeenth century was the establishment of French Jesuit missions along the Connecticut River in the east and near Lake Champlain and along the St. Lawrence and Hudson to the west. The establishment of these "permanent" Catholic settlements did not preclude the continuance of seasonal rounds among the Native groups that populated them, nor did they guarantee Catholic conversion. They did, however, provide shelter from hostile European and Native groups, food and farming opportunities, and a central meeting place for Abenaki families displaced by war and disease (Calloway 1990). The mission at Koes (Coos) in what is now Newbury, was mapped by Father Joseph Aubery ca. 1713, and is described as the "ancien Village des Loups," the French name for the Western Abenaki (Haden 1959).

During this period it is probable that the Ompompanoosuc River watershed was utilized as a hunting, fishing, and trapping territory by the Squakheag (Sokokii) or Coassuck communities, which maintained horticultural fields on the Connecticut River bottomlands to the southeast and northeast, respectively (Thomas and Bourassa 1986:28). One possible mustering-ground for such extractive activities is the Old City Falls Site (VDHP site files VT-OR-FS1). This site, located at the falls of Old City Brook in Strafford, is reported as a large Native American campsite, the location of which suggests that it was inhabited during the spring alewive, shad, and salmon runs. However, with the incursion of Europeans the patterns in the Ompompanoosuc River basin were drastically altered. For instance, the Old City Falls Site became the location of the first European settlement in the area (VDHP site files VT-OR-FS1).

Known and Expected Prehistoric Period Resources: Ompompanoosuc River Drainage

The prehistoric cultural chronology for east-central Vermont and the area of potential effect is derived primarily from the Ledyard bridge replacement project in the Connecticut River basin (Ohl and Potter 1992) and the Union Village Dam Cultural Resource Management Study (Thomas and Bourassa 1986), with supplemental information gleaned from Cox et al. (2001) and Petersen and Petersen (1997). Research from these surveys has determined that the prehistoric culture history of the uplands regions of the Ompompanoosuc River drainage follows particular trends. These trends include 1) a prominence of the Late Archaic, Middle and Late Woodland, and Contact period cultures, and 2) a paucity of evidence for PaleoIndian, Early and Middle Archaic, and Early Woodland cultures.

There are a number of early anecdotal accounts of Native American artifacts being recovered nearby in the Connecticut and Ompompanoosuc river valleys. These accounts include a number of "Indian relics" recovered from the mouth of the Ompompanoosuc River, "arrowheads, ornaments, etc." recovered during the construction of the Connecticut and Passumpsic Rivers Railroad in 1848, and "a lot of curiously wrought pottery" discovered near the falls of the White River (Ohl and Potter 1992:9). Despite these accounts, precious few prehistoric archaeological sites have been officially recorded in the vicinity of the Elizabeth Mine Site. The four recorded resources in the vicinity of Elizabeth Mine include a Late Archaic site (VT-OR-69) about 5 miles from Elizabeth Mine in the town of Strafford, a Contact period site (VT-OR-FS1) in Strafford, and two sites (VT-WN-57 and VT-WN-60) with no temporally diagnostic artifacts in Hartford.

Neither PaleoIndian nor Early or Middle Archaic sites have been documented in the vicinity of Elizabeth Mine. Nor would any be expected in the immediate site area since it is located in rugged uplands with no sizable water source. While the Connecticut River may have been utilized as a transportation corridor during these periods, regional research has documented that during these early periods, Native Americans tended to prefer lowlands and particularly the margins of Lake Champlain.

The sensitivity of the region for Late Archaic Period sites is substantially greater than previous periods, as aboriginal peoples began to spread into the uplands at this time. During this period the seasonal round of native peoples included fall and winter hunting in the uplands. Evidence of Late Archaic populations in proximity to Elizabeth Mine comes from the Manning Site (VT-OR-69). This Laurentian Tradition site, which yielded a broken Otter Creek projectile point and a number of bifaces, may represent a seasonal camp, consistent with the hypothesis of intermittent use of the region. Additionally, the presence of natural outcrops of quartz within the project's APE suggests that Native Americans may have visited the area in order to procure material for stone implements. Regional research has determined that the Late Archaic Period witnessed an increased reliance on local stone such as quartz and quartzite for stone tools.

Similar to the Archaic Period, Native American use of the region was intermittent during the Woodland Period. With the transition from Late Archaic to Early Woodland, local populations returned to a lowland-focused subsistence pattern, concentrating their efforts on lake and river environments. Consequently, few sites from this period are expected within the Elizabeth Mine area. However, beginning in the Middle Woodland Period and becoming particularly pronounced in the Late Woodland Period, Native Americans once again ventured into the uplands to hunt during the fall and winter months. This pattern continued into the Contact Period, with local populations utilizing bottomland for agriculture and the uplands for hunting and fishing. One such habitation site was located at Old City Falls (VT-OR-FS1) on a tributary of the Ompompanoosuc River. Here, Native Americans could have gathered fish during the spring spawning runs and hunted during the fall and winter.

Most of the habitation sites are likely located in the uplands surrounding the Ompompanoosuc River are small and ephemeral because of the nature of Native American utilization of the environment. Foraging and hunting troops likely included only 10–20 individuals who stayed in a particular location for relatively short periods of time. Conversely, it is possible that favorable residential bases were visited recurrently or inhabited for extended periods of time, up to two seasons per year. However, given the relatively small size of the Ompompanoosuc River in comparison to the Connecticut River it is likely that the majority of major base camps are located along the Connecticut River while extractive camps predominate on the Ompompanoosuc (Thomas and Bourassa 1986:34). Consequently, only small short-term encampments are expected in the vicinity of the Elizabeth Mine Site.

CHAPTER FIVE

HISTORIC CONTEXT

Pre-Mining Period: Eighteenth Century to 1809

The Native American population of Orange County did not disappear with the arrival of Europeans as can be inferred from the transmission of Native American place-names, such as Ompompanoosuc River, between the two groups. The Coosuck, the primary inhabitants of the county during the Contact Period, suffered a significant defeat in 1721 in what is now New Hampshire. After 1721 the vast majority of the Coosuck moved to the St. Francis, Quebec, region of Canada and were absorbed by other tribes. Eventually some members of the tribe did return to the region, but their mass departure effectively opened the region for European settlement (Andrews 1964:60).

Strafford was chartered by Benning Wentworth, royal governor of New Hampshire, on August 12, 1761 to a group of men from Hebron, Connecticut, who were granted the 36-square-mile township in roughly 70 undivided shares (Vermont Secretary of State 1918). At first, disputes between the colonial provinces of New York and New Hampshire made the validity of charters in what is now Vermont uncertain, and the first permanent settlers arrived in early 1768. A 1771 New York census counted nine families in Strafford, most of them living in the eastern part of the town. Adjacent Thetford was chartered on the same day and was settled earlier than Strafford, likely because of its proximity to the Connecticut River, which was the major north-south transportation route of the period. Strafford remained a frontier town through the Revolutionary War and settlement did not begin to increase until Vermont was admitted into the Union in 1791. Census records for Strafford show that there were 845 residents in 1791, 1,643 in 1800, and 1,805 in 1810. Peak population for Strafford was attained in 1820 when there were 1,971 residents (Smith 2001).

The main economic activity in Strafford during the late eighteenth century was subsistence farming with limited local trade. A scattering of sawmills, gristmills, tanneries, fulling mills, and stores supplied local needs. Strafford was essentially self-sustaining, and commercial trade with outside areas was limited. Potash made from wood ashes resulting from land clearing was an early valuable local export (Smith 2001).

The weathered iron oxide outcrop of the Elizabeth Mine sulfide orebody was discovered in 1793, allegedly by two men who were tapping sugar maples on the east slope of what was then called Prospect Hill. They discovered discolored water draining from the deposit. Regardless of the mode of discovery, the unusual phenomena associated with this geochemical anomaly incited local curiosity before its specific value was understood. Deeds associated with the land on which the ore outcropped from the late 1790s contain references to iron ore mining rights. In 1798, Asahel Chamberlain sold a parcel of land to Jacob Stevens, but reserved the right to mine the ore for himself. This land was where the Vermont Mineral Factory Company set up a copperas works about ten years later. The identification with iron was typically associated with the discovery of Appalachian sulfide orebodies, as the gossan or weathered cap of the ore consisted of limonite, an iron oxide leached of metals (such as copper, zinc and lead) and sulfur. The primary constituent of the South Strafford orebody is pyrhhotite, an unoxidized iron-sulfur mineral that lay below the gossan. The belief that this material could be smelted for iron persisted until 1809, when a misguided attempt to smelt this unsuitable ore in the Franconia, New Hampshire, iron furnace caused it to shut down (Abbott *GMC* 1964:2–12). Mining work on the

outcrop at this time likely consisted of open-cut excavation of the soft oxidized layer in the vicinity of the north end of the North Open Cut.

Copperas and Copper Manufacturing: 1809 to 1880s

Copperas Production on East Slope of Copperas Hill 1809 to 1880s

After the failure to produce iron from the South Strafford ore at Franconia, attention shifted from iron to copperas production, and Prospect Hill became known as Copperas Hill. Copperas is a fourteenth-century term for crystalline green hydrous iron sulfate, an important early industrial chemical compound derived from processing iron sulfide ores. Copperas had a multitude of uses over the centuries. It was used to blacken and color leather, as a disinfectant and sheep dip, as an astringent medicine, and as a drier in ground pigment manufacture. Its properties as a wood preservative have resulted in preservation of timber and plank structures in the copperas production area at the mine. It was used in the manufacture of Prussian blue, indigo dye, and could be processed to make paint and polishing powder. It was used for water and manufactured gas purification. It was used for production of sulfuric acid and in associated metalworking, including precipitation of dissolved gold. It was used as a dye mordant, which fixes dyes by combining with them and turning them into insoluble compounds. It added color permanence to black and brown wool dyes and fabric printing inks, and was widely used in the dyeing and tanning industry (Agricola 1950:572; Biringuccio 1990:97; Brady 1947:272–273; Diderot 1751:Plate 151; Wagner 1988:32). The copperas from South Strafford was used primarily by the woolen, cotton, dyeing and hatmaking industries (Smith *Copperas* 2001:11).

Copperas production was a simple process that is well documented in sixteenth and seventeenth-century accounts, and changed little until the late nineteenth century. The raw material was iron sulfide, or pyrite-bearing soil or metallic ores that were gathered by excavation. The process made use of gravity, and was often located on a hillside. Typically, the pyritic material was piled into mounds, or beds, where it was left exposed to the elements to oxidize, for months or even years. Later, the material was roasted to promote breakage of the ore and release of the sulfur. The beds were usually on an elevated and cleared surface that was lined with clay to make it impervious. After a period of oxidation the beds would release a liquor of ferrous sulfate and sulfuric acid when water was allowed to flow through them. The resulting liquor flowed in plank-lined channels to a large holding cistern. The liquid was pumped into lead-lined boilers fueled with coal or wood and boiled. When the liquid was sufficiently concentrated, it was poured off into flat, shallow crystallizing pans where it crystallized on the inside surfaces and sometime on tree branches added to the tank. The leftover liquor was reboiled. The copperas crystals were scraped off, melted into molds, and packaged for shipment and sale (Agricola 1950:576–578; Biringuccio 1990:95–97; Diderot 1751: Plates 151 and 152; Wagner 1988:32).

Examination of illustrations of copperas manufacture from sixteenth- and seventeenth-century accounts clearly shows the individual steps, manipulated landscapes and buildings, and infrastructure associated with the process. Agricola's 1556 illustrations from *De Re Metallica* (Figures 5-1 and 5-2) clearly show the process. In Figure 5-1 the broken ore is being loaded into a roasting stall ("A"), then it is shown being carried by wheelbarrow to an enclosed leaching pad ("B") where the roasted ore is sprinkled with water. The resulting liquor is being boiled in a cauldron ("E") and the resulting concentrate is drawn off by a launder ("F") to a holding reservoir ("G"). These processes are conducted outdoors. In Figure 5-2 the process has moved inside a building, where liquor is further boiled (evaporated) ("A") and then placed in a tank ("B") with a system of ropes suspended by crossed sticks ("C") on which the copperas crystallizes (Agricola

Figure 5-1. Drawing of copperas process from Georgius Agricola, *De Re Metallica*. 1556. Translated by Herbert Clark Hoover and Lou Henry Hoover, Dover Publications, New York, NY, p. 571.

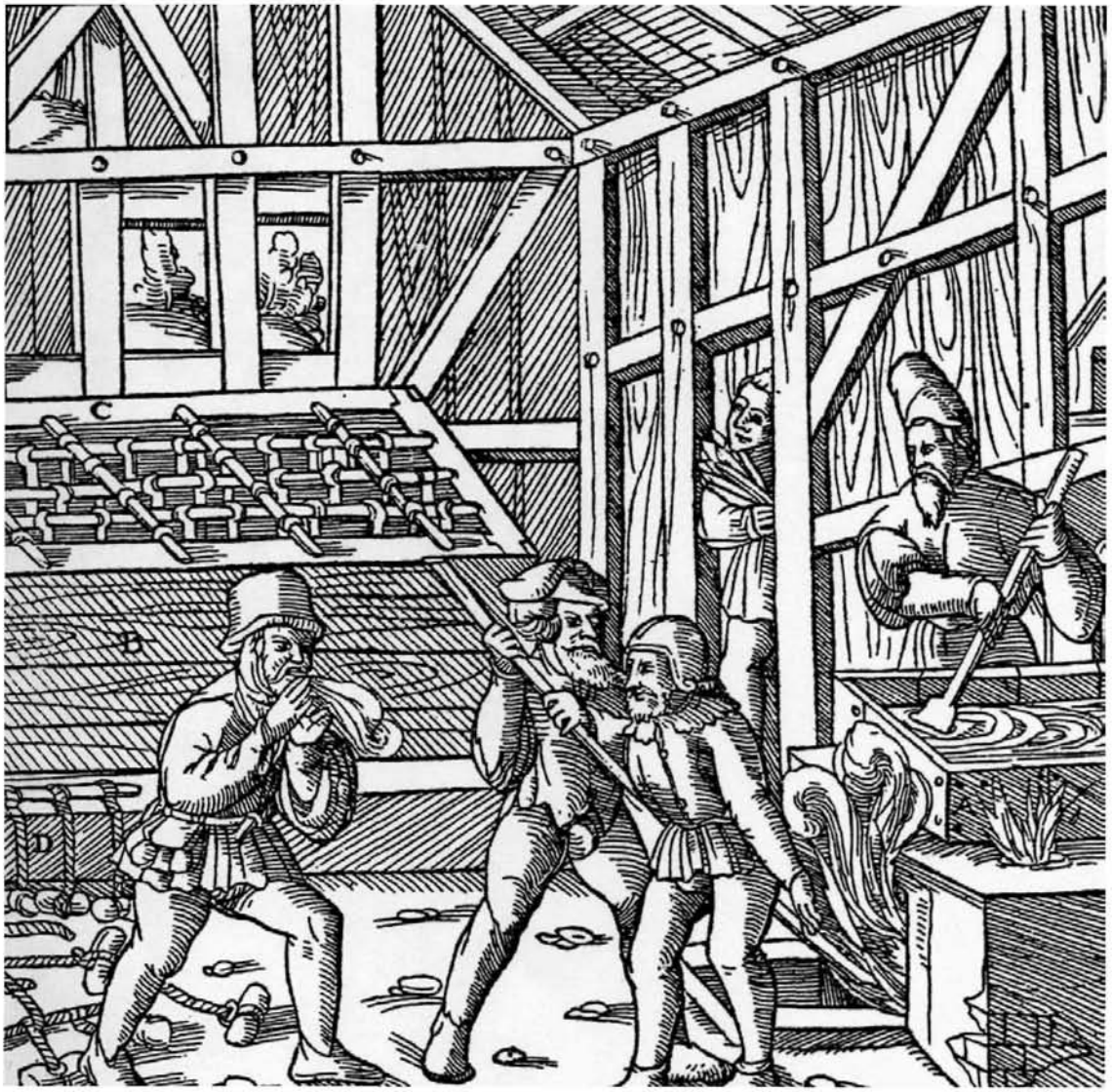


Figure 5-2. Drawing of copperas process from Georgius Agricola, *De Re Metallica*. 1556. Translated by Herbert Clark Hoover and Lou Henry Hoover, Dover Publications, New York, NY, p. 575.

1950:571, 575). Diderot's illustrations of the process from his 1751 *Encyclopedie, ou Dictionnaire Raisonne des Sciences, et des Arts et des Metiers"* show the same essential process (Figures 5-3). In a portion of Figure 5-3, which illustrates the nearly identical process for making alum, broken ore is heaped in conical mounds ("A"), two of which appear to be undergoing combustion. The ore is then piled in a layered and stepped heap ("B"), which is constantly recycled to keep up a supply of properly roasted ore. The roasted ore is conveyed by wheelbarrow to a series of leaching basins ("C," "D," and "H"), and is then conveyed by a launder to a final holding reservoir ("F") above the factory (Diderot 1751: Plate 151). Another plate from Diderot shows the indoor portion of the copperas process (Figure 5-4). The copperas liquor is held in the outdoor reservoirs ("G") directly above the factory. The liquor was then evaporated in a rectangular pan ("d") over a fire with a draft drawn through a firebox ("a"), under the evaporator and up a chimney on its opposite side. The concentrated liquor was drawn off, held in a tank ("k"), and poured into crystallizing pans with a network of parallel sticks suspended in them ("m–s"). The copperas crystals were then scraped off, and shoveled into barrels ("u") for shipment (Diderot 1751: Plate 152). This simple process was employed and improved upon over the course of about 75 years of copperas manufacturing at the Elizabeth Mine.

Copperas was an important chemical in eighteenth-century colonial America. Like iron and other products, its domestic manufacture was discouraged by the British, and the Revolutionary War created opportunities for its production. Late eighteenth-century copperas works were set up in Brookfield and Hubbardston, Massachusetts, areas known for strongly pyritic bedrock (Smith *Copperas* 2001:6–7).

The earliest people to dig the South Strafford ore were local men, but the deposit was not worked profitably until the arrival of the financial and technical aid of outside experts. A September 30, 1809 deed notes that the South Strafford deposit was being mined and copperas was being made by that date. Between 1809 and 1812 several companies were formed to mine and produce copperas in Strafford and the adjacent towns of Thetford, Norwich, Hartford, and Sharon. Starting in January 1809 a series of outside figures, several from New Hampshire, began to buy up the land around the South Strafford ore outcrop. On October 31, 1809, this group officially incorporated as the Vermont Mineral Factory Company, and continued to acquire additional land around the deposit. Key figures in the Vermont Mineral Factory Company were Colonel Amos Binney, a Boston merchant, and his son, Amos Binney Jr. The senior Binney figured prominently in the early Vermont copperas industry. In 1826 the junior Binney became a partner in the copperas business, and later pursued the first attempts at extracting copper from the ore (Abbott *GMC* 1964:7–11).

The initial operations of the Vermont Mineral Factory Company's South Strafford copperas works took place during a period of unfavorable economic conditions. Until 1807, all copperas was imported from Europe. The 1807 Embargo Act restricted trade with the belligerents in the Napoleonic Wars. Restrictions on imports of chemicals and minerals affected Vermont industries, and served as an inducement for the domestic production of compounds including copperas, the production of which was so important that copperas workers were exempted from some militia duty. In 1810, the first full year of production, the Vermont Mineral Factory Company produced 8,960 lbs. (about 4.5 tons) of copperas valued at $1,200. Before the War of 1812, copperas sold for 4 or 5 cents per lb. In 1812, Josiah Quincy petitioned Congress on behalf of the Vermont Mineral Factory Company to place a duty on foreign copperas. The company was confident that it could supply the country's entire demand and wanted a protective tariff in place to protect its interests. During the war the price of copperas rose from 12 to 16 cents per lb. and the operation became more profitable. After the War of 1812, the English flooded the copperas

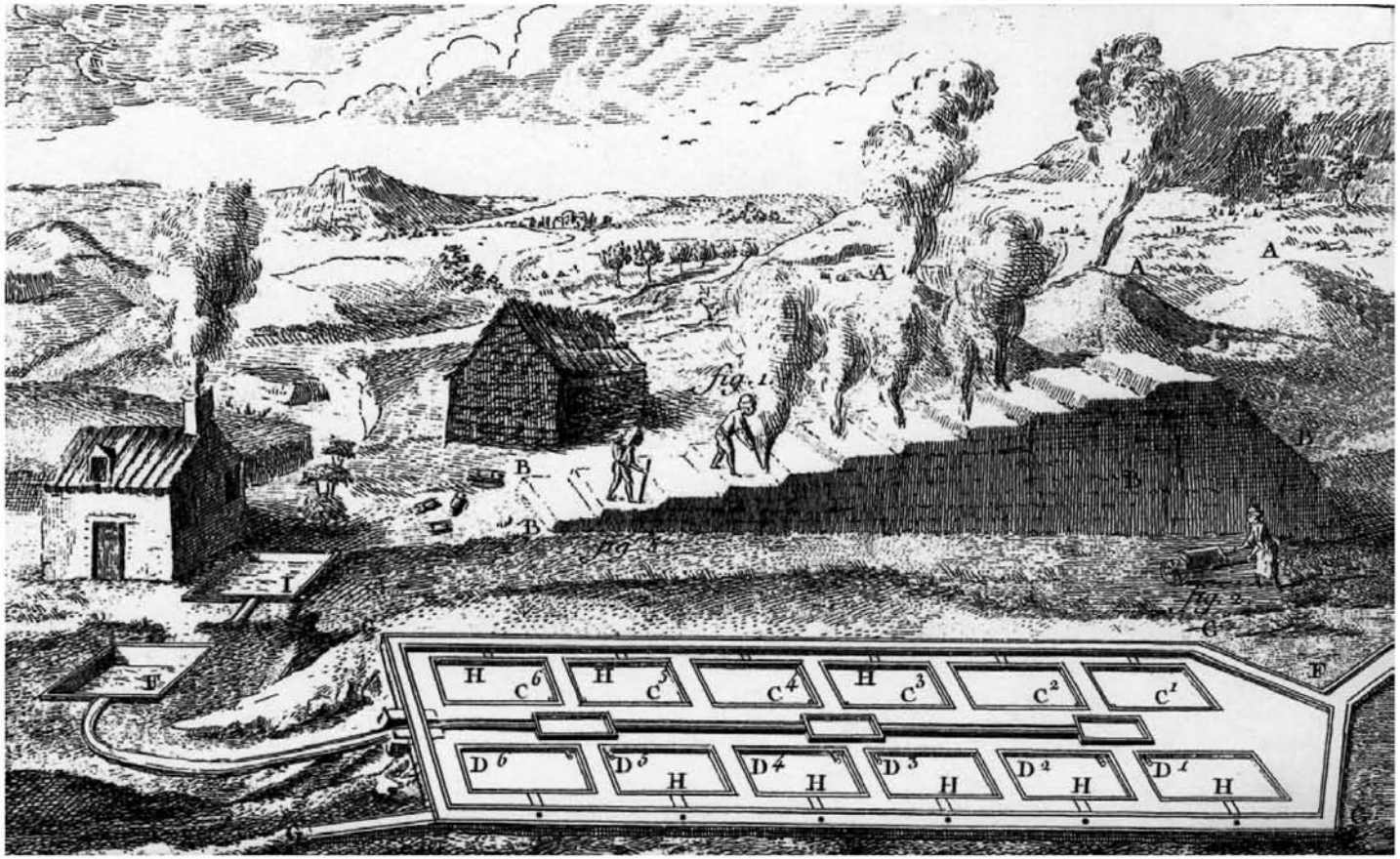


Figure 5-3. Drawing of alum process, from Denis Diderot, *L' Encyclopedie, ou Dictionnaire Raisonne des Sciences, des Arts et des Metiers.* 1751. Dover Publications, New York, NY. Plate 151.

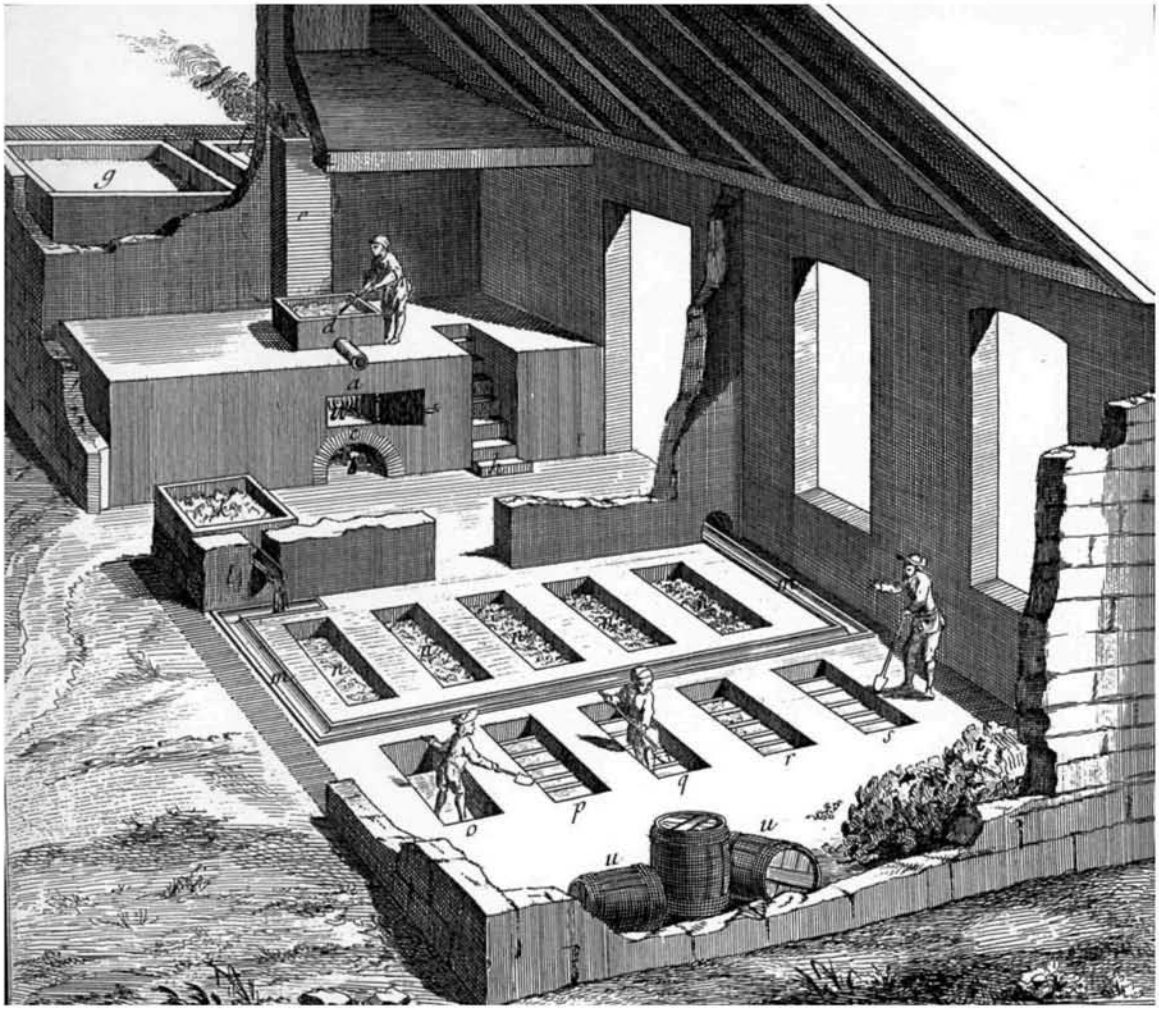


Figure 5-4. **Drawing of copperas (vitriol) process, from Denis Diderot, *L' Encyclopedie, ou Dictionnaire Raisonne des Sciences, des Arts et des Metiers.* Dover Publications, New York, NY. Plate 152.**

market and the Vermont Mineral Factory Company copperas works were unprofitable during the depression that lasted until 1822. Congress did establish a duty of 1 dollar per 100 lbs. on imported copperas in 1816, but it proved ineffective (Abbott *GMC* 1964:11–13).

In 1817 President James Monroe undertook a tour of the United States that included Norwich as the northernmost stop in eastern Vermont. Amos Binney had previously served as agent of the U.S. Navy Yard in Boston, where he had met Monroe. Binney encouraged Monroe, who had a deep interest in domestic manufacturing, to change his Vermont tour itinerary to include a visit to the Vermont Mineral Factory Company at South Strafford. As a major manufacturer of copperas, Binney wanted to influence Monroe's future support of the industry. Finally, in 1824 Congress raised the copperas tariff from 1 cent to 2 cents per lb., and maintained tariffs to protect the industry. According to Binney, this 1824 tariff was the key to profitability for the domestic copperas industry, and allowed the Vermont Mineral Factory Company to become profitable and to develop into a major American supplier. Before 1823, production averaged 25 tons per year, but it increased to 800 tons in 1826 (Abbott *GMC* 1964:12–15).

In 1828 Amos Binney, Jr., formed the Green Mountain Manufacturing Company to exploit another iron sulfide deposit at Cuttingsville in Shrewsbury for copperas production. Statistics for the period are not entirely consistent but give some idea of the magnitude of the operations. The Cuttingsville plant produced 200 tons of copperas in 1829, 400 tons in 1830, and 600 tons in 1831. The South Strafford works averaged 750 tons annually from 1824 to 1831, with production of 1,000 tons in the last year. According to Binney, the combined output accounted for 75 percent of United States production, with Ohio and several other states producing the balance (Abbott *GMC* 1964:17–18).

Until about 1830 the South Strafford copperas works drew its raw material exclusively from an open pit, the North Open Cut, located near the top of Copperas Hill. About 1829 Amos Binney began developing underground workings to access the ore more efficiently. He started to drive the Upper Adit (horizontal tunnel) west toward the orebody from a point about halfway down the hillside to the east, and sunk a 100 ft air shaft to ventilate the workings. The miners advanced only one foot per day using hand drilling and black powder for blasting. After tunneling 313 feet the Upper Adit intersected the orebody (Richardson 1882). By 1831 ore was being hauled out the new entrance in wheeled cars running on rails, possibly the first railroad operation in Vermont (Johnsson 2002). This development gave access to new sources of pyrhhotite for copperas, and with it larger quantities of copper ore for the copper smelting efforts described below.

Copperas production through the 1830s and 1840s remained around 1,000 tons annually. The Shrewsbury operation was closed in 1837. In 1844 and 1849, production was reported at 1,600 tons, and an 1854 report listed production at 1,500 tons. The Connecticut & Passumpsic Rivers Railroad reached Pompanoosuc (Norwich) in 1848, greatly improving the transportation situation for the copperas works. Copperas was shipped to major cities including Baltimore, Boston, Charlestown, SC, Hartford, Richmond, and Troy, NY (Abbott *GMC* 1964:19, 35). Between 1842 and 1862 the tariff on foreign copperas was gradually lowered to 2 cents per lb., allowing foreign sources to make inroads and prices to drop. In November 1854 another tunnel, the Deep Adit, was begun at a point lower down the hill, roughly west of the sharp bend in the road below the copperas works at TP 3 (Abbott *GMC* 1964:272).

After the Civil War, in 1867, the mine was taken over by the New England Chemical Company, which operated two copperas plants and a paint works at the site. Soon the New England Chemical Company was taken over by the New England Chemical Manufacturing Company, which operated the copperas works during the 1870s under William H. Foster and Joseph W.

Cleaveland. Around 1880 the copperas works employed 50 workers. In 1882 it was deeded to the Strafford Mining Company, but subsequently shut down because of competition from new sources of copperas. (Abbott *GMC* 1964:273–276). The manufacture of copperas from natural materials ended in the 1880s when large, inexpensive sources of iron sulfate became available as a by-product of the burgeoning steel industry. Iron sulfate was extracted from waste sulfuric acid that was used to pickle (wash) iron oxide scale from steel sheet and wire prior to galvanizing or finishing. The spent sulfuric acid was boiled with scrap iron and the resulting liquor was processed to yield large quantities of inexpensive by-product iron sulfate (Day 1885:952).

Process, Production and Employment

The owners of the South Strafford copperas works apparently expanded and improved their works several times. The scale of the works in terms of its landscape and factory buildings far exceeded any other manufacturing concerns in the area. The process generally followed the method described above, with some methods, notably ore roasting, employed to accelerate the ore decomposition process. An important general aspect of the arrangement of the works was the way that the steep hillside was used to promote the cascading nature of this process, using gravity and water to move the materials (Smith *Copperas* 2001:13–14). The affairs of the copperas works were documented in several mid-nineteenth-century accounts. Not all of these include descriptions of the works themselves, but a few do provide information about the operations that can be used to interpret the location and arrangement of the various phases of the operation and the function of the various features on the hillside. Data from the U.S. Census of Manufactures provides additional (and sometimes conflicting) information about production and employment.

The U.S. Census of Manufactures for 1810 notes that 20,000 tons of ore were blasted, and 12 scaffolds were built and filled with the ore, yielding about 4 tons of copperas (U.S. Census of Manufactures 1810). This indicates that the ore was placed in heaps or beds confined by some sort of structure, presumably made of timber. These were apparently for leaching rather than roasting, as that process was not adopted until later. This is supported by an 1821 account by Dr. John Locke, who reported that originally the ore had been simply leached for its copperas content, and later was roasted to speed decomposition:

> For several years the manufacturers effected the decomposition in the following manner: the ore was broken into fragments of a foot or less in diameter, and heaped upon inclined scaffolds erected and floored with plank for the purpose. Thus exposed to the action of air and moisture, it very gradually decomposes at the surface. Thus from the same mass of ore a solution was obtained, year after year, either by the rains or by the application of water by other means. The solution was received from the inclined scaffolds in plank cisterns.

[This process was slow, had limited throughput, and may have resulted in diminishing returns. Soon, they added a roasting step, which accelerated the leaching process and allowed greater throughput of ore]:

> For three or four years past [since 1817 or 1818] they have adopted a more expeditious method of decomposition, which was discovered in the first place by accident. They break the ore into much smaller fragments, three inches and less in diameter, and throw them into a convenient heap, taking care to leave air holes at the base so as to allow the air to pass freely through the heap. On applying water the decomposition commences, and so much heat is evolved as presently to raise the temperature of the heap . . . [so that] in the course of three or four weeks the whole becomes disintegrated and ready to fall

> into the state of powder. It then by lixiviation with water yields all its copperas at once; the process is performed in a plank cistern.
>
> The manufactory in which the processes of evaporation and crystalization are performed is placed on the declivity quite below the mine. This gives great facility to all the operations, allowing the various reservoirs to be so arranged one above another that the liquor may be transferred from one process to another merely by means of a trough.
>
> The bottoms of the evaporating vessels are of lead, and about ten feet square; the sides are of wood about three or four feet high. The bottom is supported by a number of parallel brick walls, placed at a small distance from each other. The avenues or arches between these walls communicate at one end with the arch in which the fire is placed, and at the other with the common flue.
>
> The ore is a sulphuret of iron with a small proportion of copper; and the solution, first obtained, is a sulphate of iron and copper with an excess of acid. During the process of evaporation a leaden vessel, having its sides perforated and containing fragments of old iron, is suspended in the liquor. The iron at the same time that it neutralizes the excess of acid decomposes the sulphate of copper and the copper is precipitated in the form of fine powder which the workmen call "copper mud." [Iron is more chemically active than copper permitting it to replace copper in solution causing copper to form a precipitate. Chemical activity refers to the fact that iron is more readily oxidized and donates electrons to receptors more easily than copper.] . . .
>
> After the liquor has been sufficiently evaporated it is drawn off into cisterns to crystalize. Branches of trees are put into them as a nucleus for the crystals. When the crystalization has proceeded as far as it will go, the remaining fluid is drawn off and returned to the evaporating vessels. The cistern remains lined several inches in thickness with crystals, like a geode. The branches have a fine crop of foliage and fruit composed of beautiful green crystals. The crystals are very large and perfect, presenting numerous brilliant facets which are often several inches broad. . . .
>
> An ingenious method has been contrived to catch the wash of the whole mine. There has been cut in the compact ore, quite across the lower edge of the mine, a channel, into which by its inclination the mine discharges the wash of every shower, together with the natural oozing from the hill above. A trough conveys the fluid from the channel to the boilers. To increase the effect of this natural brook of copperas, the ore has been broken into large fragments, and heaped along the upper side of the channel, there to undergo a slow decomposition precisely as it does upon the scaffolds mentioned above (Locke 1821:326–330).

The 1820 U.S. Census of Manufacturers lists eight leaches, two reservoirs, eight vats, three boilers, and six crystallizers at the works. It indicated that annual production had risen to 100 tons, and the works were described as “in good condition—establishment declining” (U.S. Census of Manufacturers 1820).
In 1824, Zadock Thompson reported that:

> In 1822 . . . the works having been considerably enlarged . . . The building in which the manufacture is carried on is 180 feet long and 46 wide. . . . The ore is . . . beaten to pieces with hammers and thrown into heaps several rods in length, about 12 feet in width, and seven or eight in height. Here it is suffered to lie exposed to the action of the air and

> moisture until a spontaneous combustion takes place, and the whole heap is converted from the sulphuret to the sulphate of iron, which usually takes several weeks. . . . After the process of burning is completed, the residue is removed to the leaches, where water is passed through it which dissolves the copperas and leaves the earthy matter behind. The water is then conveyed to the boilers, which are made of lead, four in number, and weigh about 2500 pounds each. Here it is boiled and evaporated to [a] certain extent, and suffered partially to cool. It is then transferred to the crystalizers, where the copperas continues to crystalize, while cooling, and when the crystalization ceases, the water is again returned to the boilers, mixed with water from the leaches, and again evaporated (Thompson 1824:251–253).

In 1827, the following description of the works appeared in the *Columbian Centinel*:

> Upon the highest extremity of the hill is the *Magazine,* which is almost inaccessible, and such a distance from the other buildings, that in case of an explosion, no other injury would be occasioned; a few rods below this is a *Blacksmith's Shop,* in which a workman is constantly employed in making and repairing drills, and various other utensils; a few yards distant from this, is the *Upper Factory, so* called; northeast of this, is the brick boardinghouse, adjoining which is the *Counting House*; directly opposite this, is the lodging house of the workmen. Descending the hill still farther (about ten rods distant) is another *Factory,* which is 267 feet long, and 94 wide, including the packing apartment; the two factories contain ten leaden vats, the average size is 10 feet by 12, and 21 inches in depth. In the southern part of the works are several temporary buildings, erected for the preservation of the copperas (sulphate of iron).
>
> The ore, by the following process, is converted into copperas: First with the use of a drill, a perforation is made from 10 to 30 inches in depth, and by means of powder large portions are separated from the fodina, which are broken into small pieces and conveyed to a suitable spot, until a sufficient quantity is accumulated for a *heap,* which in the space of a few days will ignite spontaneously. In this condition it remains burning without cessation for about two months, which mostly consumes or expels the sulphur with which the pyritous rock is saturated. Sometimes the heaps are set on fire by the workmen to hasten process, and entirely pulverizes the integral heap. The surrounding objects wear a sterile and deleterious appearance, but the health of the workmen is completely preserved. From these disintegrated heaps the pyrites is thrown upon leaches, and the lye drawn into reservoirs, from thence into leaden vats. Lead is the only metal which endures the operation of the liquid. The lye is boiled in these vats until it arrives at a proper degree of strength, when it is drawn off into wooden vats, where it remains for crystalization, upon the sides, and the boughs of trees, which were formerly thrown into it to form crystals upon, but of late an improvement has been introduced—a stick of wood, about 6 feet long and 2 inches in diameter, through which at proper distances holes are bored, and small sticks inserted about 18 inches in length and 3/4 of an inch in circumference, on which the crystals formed much larger and has occasioned the entire abandonment of the old method. The crystals are somewhat quadrangular, and in color a beautiful transparent green. From thirty to forty workmen are employed (anon., *Columbian Centinel* December 1, 1827:1).

The employment demands at the copperas works appears to have been seasonal, or highly variable. A note in an early 1830s ledger from the Copperas Hill store operated by Justin Morrill

contains the following quote: "August 1833 there are 210 men employed on the copperas workings on the hill . . . there is not one now, Nov. 28, 1834 (Vermont Historical Society, Justin Morrill Papers).

In 1842, Zadock Thompson, in his *History of Vermont*, described the copperas works:

> Strafford Copperas Works. . . . There are 2 factories, each about 267 ft. in length by 94 in width. These contain 8 vats made of lead, 10 ft. by 12 ft., 21 inches in depth and three fourths of an inch in thickness, used for boilers. Lead is the only metal that will endure the operation of the copperas liquor, and this requires constant repair. . . . The process of making [copperas] is as follows. The ore is blasted from the bed by means of powder. It is then broken into pieces with sledges, and afterwards the miners sort and break it up still finer with hammers. It is then thrown into large heaps, where it ignites spontaneously, or fire is sometimes set to it to hasten the process. In this condition it generally burns for the space of two months; in that time the sulphur is converted into sulphuric acid, and unites itself with the iron, forming sulphate of iron, or copperas. . . . These heaps of pyrites, being now thoroughly pulverized by fire, are carried to places where water, from a fountain on the summit of the hill, is made to run upon and leach this mass of crude sulphate of iron. The lye is now drawn off into large wooden reservoirs, and thence into the leaden vats as fast as wanted. In these vats the lye or liquor is boiled to a certain strength, tested by acidimeters, and then drained off into wooden vats, where it remains to crystalize. Branches of trees were formerly thrown in for the crystals to adhere to; but Mr. Reynolds, the present agent, has made an improvement. Pieces of joist 3 inches square, 6 ft. long, laid across the top of the vats, with holes bored, and round sticks 18 inches long by 3/4 of an inch in diameter, inserted at intervals of about 6 inches, are now used with great advantage. This makes a great saving of labor, although it has in some measure destroyed the fanciful shapes which the crystals formerly assumed upon some favorite branch. . . . The crystals are multiangular, and of a beautiful transparent green color. . . . After crystalization takes place the liquor is drained off, and the copperas is shoveled into the packing rooms. When dry it is usually put into casks holding about half a ton each, but frequently into casks of every size (Thompson 1842:167–168).

In 1844, geologist Charles T. Jackson made the following observations at the copperas works (Figure 5-5):

> [At Strafford] not only the inexhaustible quantity and purity of the ore, but its situation also give unusual facilities for the manufacture of the copperas. The vein is worked to the open air - large blocks of ore being blasted out and the with sledges broken to the size of an egg. These fragments are then removed a little down hill and formed into an immense conical heap, in which air and moisture sustain a smothered combustion, which has been only commenced by wood fuel and which, if not checked by an excess of water, would be sufficient to drive off the sulphur, and to vitrify the mass. In this process, the water flows from a higher level to the top of the heap, and the only inconvenience attending the manufacture is the limited supply of water in dry weather. In this process, by the oxygen of the air, the sulphur is converted into sulphuric acid (oil of vitriol), and the iron into oxide of iron, which, combining together, constitute copperas. This, being soluble in water, is leached out by the stream of water, and the lye runs down into a vat, in which it is concentrated. It is then drawn down into other vats for crystallization. Stalactites of copperas are seen pendant from the troughs, and, with the exception of the green tinge, exactly resemble icicles - a singular spectacle in the heat of summer (Adams 1845:56).

Plan of the Copperas Works, Strafford, Vt.

Figure 5-5. Sketch of the Copperas Works, Strafford, Vermont: *a* indicates the mine, *b* the cobbing shed, *c* the roasting heaps and *d* the factory (source: Charles T. Jackson, *Final Report on the Geology and Mineralogy of the State of New Hampshire.* Concord, NH, 1844).

The 1850 U.S. Census of Manufacturers indicated that the Vermont Copperas Company was making a variety of products. Annual production included 4,000 tons of copperas with a value of $10,000, 1 ton of alum with a value of $20.00, and 4 tons of paint with a value of $4,000. According to the census, the company employed an average of only 15 hands and used both manual labor and waterpower (U.S. Census of Manufacturers 1850). The 1860 census lists only 400 tons of annual copperas production worth $3,480 and 60 tons of copper worth $24,000, produced by an average of 45 employees (U.S. Census of Manufacturers 1860).

In 1861, Edward Hitchcock, in his *Report on the Geology of Vermont,* reported:

> The process consists in first raising the ore from the bed, which is principally done with the help of gunpowder. The blocks of ore are then broken up into small pieces to facilitate the decomposition, by suffering the oxygen contained in water and the atmosphere to come more directly in contact with the material composing the ore. Large heaps of these pieces, called leaches, are made upon a tight plank bottom, or upon a sloping ledge of solid rock, where the liquor or lye that subsequently runs from them may be saved.
>
> In dry weather, a small stream of water is made to flow upon, and penetrate these leaches, in order to produce a spontaneous combustion, which in warm weather commences in a few days, and if properly managed will continue several weeks. When combustion is taking place, great care is requisite in order to have the work go on successfully, for if too much water is suffered to penetrate the leach or heap, the decomposition is checked by the reduction of temperature, and the lye or liquor issuing from it is too weak to be valuable; and if there is not water enough put on the leach, the decomposition is also arrested by the absence of the oxygen found in the water, which is necessary to convert the sulphurous acid into the sulphuric, that sulphate of iron or copperas may be produced.
>
> The liquor that runs from the leaches is collected in reservoirs, from which it can be taken at pleasure. Below the reservoirs upon the hillside, buildings are erected, called evaporators, to which the liquor is conducted in troughs from the reservoirs in small streams, that are divided and subdivided by means of perforated troughs, brush, etc. Several tiers of brush are arranged in the building, through which the liquor is made to pass to facilitate the process of evaporation. In dry, windy weather, the evaporation is oftentimes so rapid that the brush and other substances with which the liquor comes in contact during the latter part of its journey, often have an incrustation of copperas formed upon them; but upon the return of rainy weather, the humid atmosphere checks the evaporation, and the crust of copperas is dissolved and passes with the liquor into reservoirs prepared to receive it.
>
> The liquor which is now very strongly impregnated with copperas, is conducted into leaden boilers, where heat is applied and the liquor reduced to a strength indicated by the acidimeter to be right for the production of copperas. The liquor is then placed in vats of lead or of brick and water cement, called crystallizers, and after remaining from eight to ten days, a crust of copperas is formed upon the bottom and sides of the vats, composed of nicely formed crystals. The water remaining in the crystallizers is then pumped back into the boilers, the crust of copperas removed, and, after being sufficiently drained, it is packed in casks ready for market (Hitchcock 1861:829–832).

The 1870 U.S. Census of Manufacturers includes data for the copperas works, then owned by the New England Chemical Company. It gives annual production of 500 tons of copperas worth $7,750, and indicates that only seven men were employed (U.S. Census of Manufacturers 1870).

The last detailed account of the copperas works appeared in Hemenway's 1871 *Vermont Historical Gazetteer*. The works as described are probably close in configuration to the works as depicted on the 1874 Vermont Copperas Company map (Figure 5-6). This is perhaps the most detailed description, and contains information about the preparation of the roast bed and heap leaching ground surface:

> The copperas works of the New England Chemical Co. . . . may be briefly described to consist of a prepared bed or bottom upon which the ore is burnt and leached. This bed is upon the hillside just below the vein. It is prepared by simply scraping the earth clean from the ledge and stopping all the seams and fissures in the ledge with moistened clay. The bed so prepared is nearly an acre in extent and is called the leaching ground. On the lower side of the leaching ground a trench has been dug in the ledge and this trench is connected, by means of spouts, with four large reservoirs near by, holding 20 hogsheads each. Still further below are two high sheds, open at the sides, with loose floors and each floor filled with brushwood these are called Evaporators. Upon a level spot below are the two factories of the Company, each 110 feet in length by 25 feet in width. These factories contain the evaporating pans, two pans in each factory, each pan being 26 feet long by 10 feet wide, and 16 inches deep. They are made of very heavy lead 1/4 inch in thickness. Lead is the only cheap metal which is not quickly destroyed by the action of the copperas. Beneath the evaporating pans run a series of flues, commencing at the fire arches at one end of the pans and terminating in the stack at the other end. There are also two lead coolers and 20 cemented brick crystalizers in each factory, each crystallizer being 14 feet by 7 feet by 18 inches deep. Directly beneath the crystalizers is the packing room.

The process of manufacturing copperas is as follows:

> The ore is blasted from the vein, broken up so that it can be easily handled, wheeled to the sheds by means of handcars where it is again broken into pieces the size of large apples; it is then shoveled into cars again and run out upon the leaching ground and placed in large heaps containing from 500 to 3000 tons each. A quantity of wood is placed under one side of the heap and set on fire. The heat of the burning wood raises the temperature of the ore, so that the sulphur is ignited, and by degrees the whole mass is heated, the interior portions often red-hot. Great care is exercised in burning, to prevent the heap from being overheated, as in that case the iron of the ore would be melted and run into large solid masses and the sulphur would be driven into the atmosphere as sulphurous acid gas. To prevent this, a stream of water is applied at frequent intervals to cool the burning ore, but not enough to put out the fire. In this way a large heap will burn during four months, and frequently after it has been thoroughly drenched with water and has shown no signs of fire for six months, it will be ignited by spontaneous combustion and burn again with great vigor, when it is again treated with water as before. The object of the burning is simply to oxidize and decompose the ore. The oxygen from the water and the air striking upon the heated ore forms a weak sulphuric acid, which acts upon the iron of the ore and thus sulphate of iron in its crude state is formed in the heaps. A heap, if properly burned, will in a year's time become thoroughly decomposed and ready for leaching.

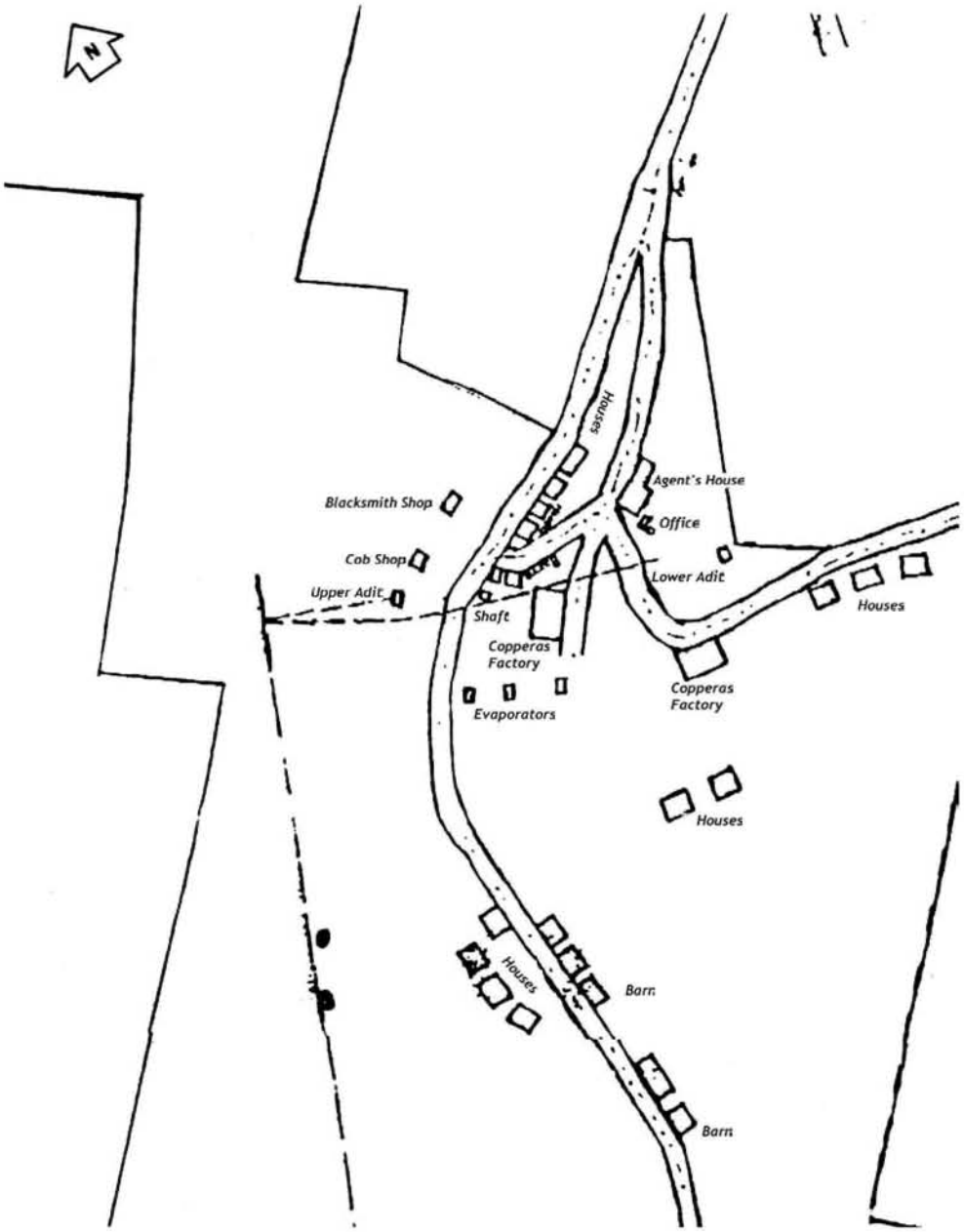


Figure 5-6. **Detail showing Copperas Works, from Plan of Property of The Vermont Copperas Co., Copperas Hill (South Strafford), VT, 1874 (source: Rauner Special Collections Library, Dartmouth College, Hanover, NH).**

> The process of leaching and evaporating has for its sole object the conversion of the crude copperas, as it exists in the heaps, into the beautiful green crystals, as found in the packing room, when ready for market. To accomplish this, a small stream of water is run upon the heaps and so directed as slowly to soak into and saturate the whole mass of decomposed ore. When the ore can contain no more moisture, the water settles to the bottom of the heap, falls upon the prepared surface, runs into the trench below and is conducted to the reservoirs near by. It is now called copperas liquor and its specific gravity or strength is measured by hydrometers manufactured for this purpose. The liquor generally shows a density of from 10° to 20°, water being 0°, and this density, as ascertained by the hydrometer, shows its strength or goodness. This liquor is crude sulphate of iron in a liquid state. After being allowed to stand and settle in the reservoirs two or three days, it is conveyed in spouts to the top of the evaporators, where it is run over a surface so arranged that it is sprinkled in drops through the brush of the successive stories and by this expedient a portion of the water is taken out by the influence of the sun and air. On a clear summer's day, the liquor will be increased from 3° to 5° in strength, in passing through these two sheds. From the lower evaporator the liquor passes directly to the factories where it is received in large reservoirs, whence it is drawn into the evaporating pans as needed. In these pans it is boiled down till it reaches the strength of 35° when it is drawn into the lead coolers and there allowed to stand two or three hours in order to settle any impurities which may still remain. When quite cool it is passed into the cemented crystalizers. Here it usually remains a week, during which time the process of crystalization takes place. The liquor of crystalization is then drained off and pumped into the evaporating pans, where it mingles with the fresh liquor. This process is repeated with the liquor of crystalization ad infinitum.
>
> The crystals of copperas are deposited in a thick, heavy coating on the sides and bottoms of the crystalizers; this coating is frequently 5 inches in thickness. The appearance of the interior of the crystalizers, after the liquor has been drained off and before the crystals have been disturbed, is extremely beautiful. The crystals are of a brilliant, transparent, emerald green, assuming various forms and sizes - some are spear-like and sharp as needles, while others assume the shape of German letters and fanciful devices. The figures formed on the bottom of the crystalizers by the grouping and arrangement of the crystals afford a beautiful and interesting study. One of the more common forms observed is that of perfectly defined rosettes of various sizes, raised an inch or two above the surrounding level. Sometimes these bottoms are broken up into regular successions of little rippling waves, as when a lake is agitated by a gentle breeze. The copperas is broken from the sides and bottoms of the crystalizers and shoveled down into the packing-room below. It is packed in strong casks holding 2000 lbs. and 500 lbs. each. In this state it is shipped to Pompanoosuc Station, on the Connecticut and Passumpsic Rivers Rail Road 10 miles from Copperas Hill, whence the larger portion is sent to Boston and there sold (Duncan 1871:1085–1088).

The 1880 U.S. Census of Manufacturers lists the greatest number of hands employed at any time of the year as 30, with two-thirds of the work force aged 16 years or younger (U.S. Census of Manufacturers 1880). A historic photograph taken from Mine Road looking west shows the copperas works ca. the 1880s (Figure 5-7).

Copper Smelting at Furnace Flat South Bank ca. 1830 to 1839

The Vermont Mineral Factory Company did not confine itself entirely to copperas production. As early as 1821, it became apparent that the pyrhhotite contained chalcopyrite, a copper-iron

Figure 5-7. Photograph of Copperas W orks, looking west, date unknown, showing one of the two copperas factories (source: Strafford Historical Society, Strafford, VT).

sulfide. Some copper was actually precipitated from the copperas solution by precipitation onto scrap iron, producing copper mud. Amos Binney, Jr., decided to pursue copper extraction on a larger scale, and undertook the underground mining activity on the east slope of Copperas Hill described above to open up more copper ore. By 1830 Binney had acquired additional copper ore prospects in Strafford and parcels of land on the Ompompanoosuc River approximately 1 mile north of the mine with rights to build a dam and raceway for a smelting plant. This area, now known as Furnace Flat, is located roughly 2 miles east of the village of South Strafford on Route 132, on the Ompompanoosuc River. Development in this area also included construction of a haul road from the mine to the roast beds and smelting furnaces on the south side of the river, which can still be followed (Abbott *GMC* 1964:16–17).

The pursuit of copper prompted the Vermont Mineral Factory Company to seek outside technical help. The first to arrive was Daniel Long of Harford, Maryland, in 1831 or early 1832. The source of Long's experience is unknown, but he may have worked for Isaac Tyson previously in Maryland. Under Long, it appears that two smelting furnaces were built on a bend on the south bank of the Ompompanoosuc River, 1 mile north of the mine. It is unlikely that much copper was produced before May 1833, when Isaac Tyson, Jr., took over as superintendent of the copper smelting and copperas works. Tyson had previously purchased copper prospects from Amos Binney and was involved in other Vermont mineral exploits. In 1833 Tyson, Binney, and members of the Reynolds family incorporated the Boston Copper Mining Company to work both the South Strafford and Vershire deposits (Abbott *GMC* 1964:17, 20).

Isaac Tyson, Jr. (1792–1861) was a pioneering nineteenth-century American industrialist in the areas of mining engineering, industrial chemistry and metallurgy. He established and dominated the American chromium chemical industry and established the world-renowned Baltimore Chrome Works, which supplied world markets for chrome for pigments for 140 years. He developed numerous chromite, copper and other mines in the mid-Atlantic states. Tyson was an instrumental figure in the development of the Orange County, Vermont, copper mines, and he successfully carried out several firsts in American copper smelting. He was granted a patent for copperas production in 1827 that may have influenced practices at South Strafford. Tyson was inducted into the National Mining Hall of Fame in 1996 (Johnsson 1996:1–2).

Ore from the North Open Cut and new Upper Adit was cobbed, or broken up by hammer and sorted to upgrade the amount of copper, at the mine works on Copperas Hill. The lean ore was used for the copperas production, and the copper-rich ore, which contained as much as 10 percent copper, was carted down the new road to a location near the river where it was roasted in long piles, or beds. Roasting prepared the ore for smelting by breaking it up into more permeable pieces and driving off part of the sulfur. The ore was smelted in charcoal-fueled, Continental-style, vertical-shaft, cupola-style copper smelting furnaces. These were tall, narrow, brick stacks that resembled a small iron blast furnace, with a firebrick lining, an opening near the top for charging ore, fuel and flux, an air blast pipe, and a crucible at the bottom to collect the molten metal and slag. Unlike iron smelting, in which reasonably pure iron was produced in one step, copper smelting involved several steps to remove the sulfur, iron, silica and other impurities as slag, yielding metal of useable purity. The first step resulted in what is called a copper matte, which could vary widely in percentage of copper. Usually this matte was tapped off, cooled, broken up, roasted, and smelted again in steps that produced a series of increasingly pure material, black copper, then blister copper, either of which could be cast into pigs. These products were not usually pure enough for crude applications and were usually refined using fire refining methods.

The nine different smelting campaigns conducted at the Elizabeth Mine between the 1830s and 1918 did not all produce pig copper. Refining matte to pig copper was extremely energy-intensive because of the fuel required, and shipping fuel to the Vermont copper mines was a constant and significant economic factor in their survival. The 1830s Tyson operation produced pig copper as there were no other smelters in the U.S. at the time that could refine copper matte. The arrival of the railroads to the Strafford area in the late 1840s presented more options, as fuel was easier to ship in and copper matte was easier to ship out to new East Coast smelters, including the Revere Copper Company's 1844 Point Shirley smelter in Winthrop in Boston Harbor, the Humphreysville Copper Company established in 1849 in Seymour, Connecticut, and others in Baltimore and New Jersey.

When Isaac Tyson took over the Furnace Flat smelter in May 1833 the works included a dam and waterpower infrastructure, charcoal fuel kilns, ore roast beds, and at least four smelting furnaces. Tyson used the furnaces at South Strafford for experimenting with fuels, fluxes, hearth and air blast nozzle configurations, and ore treatments. In an early attempt to profit from extracting all the values in the ore, he also experimented with making sulfur, paint, and sulfuric acid from the waste materials. It appears that there were as many as seven, and perhaps even eight furnaces, and an account notes that at one point six were operating simultaneously, and that each could smelt between 5 and 6 tons of ore per day. The works employed about 200 men. No production figures for this plant exist, and estimates are difficult. The total 1830 copper output for the U.S. and Canada combined was 50 tons, and in 1840 it was 100 tons. However, the documentary evidence alone suggests that this remote, mineside smelting plant was an unusually large and unprecedented operation. It cost $25,000 to construct, and was valued at $60,000. Despite the remote location and problems with fuel supply and transportation, Tyson succeeded in several major accomplishments for American copper metallurgy, including the first use of anthracite and hot blast for copper smelting, the first successful large-scale smelting of sulfide ores in a masonry-lined furnace, and what may have been the first successful mine-side smelting of copper. Tyson received a patent for the anthracite and his method of heating the blast in April 1834 (Abbott *GMC* 1964:22–25, "Early Copper Smelting in Vermont," 1965:233–242, "Vermont's Pioneer Copper Plant," 1964:33–41, Johnsson 2001, *Journal of the Franklin Institute* 20, 1835:407).

The 1833/1834 time period was critical for the development of hot air blast and the use of anthracite in smelting, when both innovations were first used and patented for both copper and iron smelting. Tyson was on the cutting edge of these developments. Because of its high iron content, chalcopyrite was a particularly difficult copper sulfide ore to smelt. Previously smelters had worked copper sulfides such as chalcocite, which was higher in copper and contained no iron. Prior to the 1830s the bulk of U.S. copper ores were shipped overseas, primarily to Wales, to be smelted. Copper was not typically smelted at mine sites, at least not with success equivalent to Tyson's, because of fuel and transportation obstacles.

The Panic of 1837 affected the Furnace Flat copper smelting works, which were shut down by 1839. In that year the Vermont Mineral Factory Company and the Green Mountain Manufacturing Company merged to form the Vermont Copperas Company, with Amos Binney, Jr., and several members of the Reynolds family at the helm. The Reynolds family had been involved in the mine since 1813, and John Reynolds, Jr. was the business agent from the 1830s to the 1860s (Abbott *GMC* 1964:34–35).

Copper Smelting at Furnace Flat North Bank 1854 to 1867, 1884

In 1854 the Vermont Copperas Company resumed efforts to smelt copper from South Strafford ore at Furnace Flat. This activity took place on the north bank of the Ompompanoosuc River, west of the 1830s Tyson smelting plant. Ore came from the North Open Cut, and from the Upper Adit and new Lower Adit. The ore was hand cobbed at the mine, and roasted either at the mine and/or along the road and bridge built to the 1830s Tyson smelter. The product was mainly matte copper shipped out to coastal smelters, but may have included some pig copper. By the late 1850s the smelter was producing roughly 5 tons of metal per month, and by 1860 the company had built another furnace and produced 60 tons of copper that year. During the Civil War the Vermont Copperas Company may have operated as many as four furnaces at this site. Several shades of red paint, including a "venetian red," were also manufactured from waste from the copperas plant. It appears that copper smelting ceased in 1867 when prices slumped after the end of the war (Abbott *GMC* 1964:35, 271–272; Johnsson 2001). The 1874 Vermont Copper Company map shows the layout of this area (Figure 5-8).

About 1884 the Strafford Mining Company, which owned the copperas works and associated mine workings at the time, erected a blast furnace type smelting furnace, possibly a water-jacketed model, at Furnace Flat on the north side of the Ompompanoosuc River and smelted on a small scale. The ore was taken from the North Open Cut, Upper Adit and Lower Adit, cobbed at a cobbing shed at the Upper Adit, roasted, and carted to the smelter. The product was copper matte, which was shipped by rail to off-site refineries. After it was shut down this furnace was dismantled and re-erected at the Ely Mine (Abbott *GMC* 1964:276–278; Johnsson 2001).

The water-jacketed smelting furnace was an incremental, but important advance in late-nineteenth-century metal smelting technology. Smelting furnaces had previously been lined with thick layers of acid silica firebrick that burned out quickly and had to be replaced frequently. The adoption of water-jacketed hearths, which consisted of hollow cast or wrought metal plates filled with circulating water that surrounded the hearth, resulted in the reduction in the amount of brick needed to line hearths and corresponding reductions in firebrick consumption and downtime for furnace relining. This technology was already making inroads in iron and copper smelting furnace construction by the early 1880s and their use at the Elizabeth Mine in the 1880s cannot be considered an innovation, but it does indicate that mine managers were keeping pace with industry improvements.

As both the 1860s and 1880s phases of operation occurred on the same site, they will be discussed together although they are slightly out of chronological order for operations at the Elizabeth Mine.

Non-Mining Developments in Strafford 1809 to 1880

The local population increased from 1,805 in 1810, to 1,971 in 1820, and decreased to 1,935 in 1830 (Arnold 1993; Smith, personal communication 2002). In 1810 William Jarvis, the American Consul to Portugal, imported four thousand merino sheep, the first in America, to his farm in Weathersfield, Vermont, roughly 30 miles south of Strafford. With the inception of the War of 1812 and the British embargo on woolens the demand for these sheep's wool increased and Vermont experienced a wool boom. By 1840 there were 1.7 million sheep in Vermont, and as much as half of the landscape had been cleared for sheep farms. Areas such as that around the Elizabeth Mine that were too steep and rocky too support successful farms were particularly

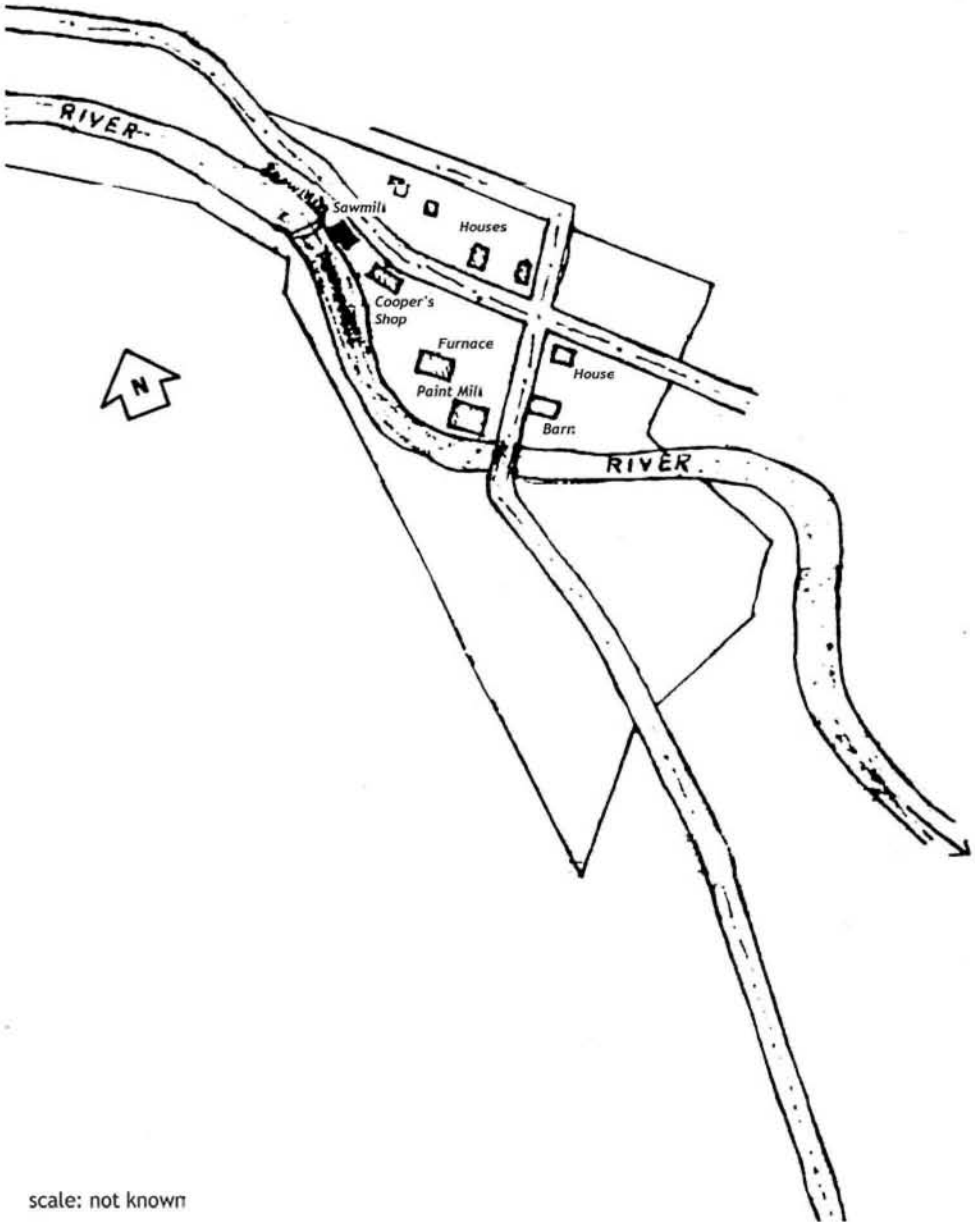


Figure 5-8. Detail showing Furnace Flat North Bank, from Plan of Property of The Vermont Copperas Co., Copperas Hill (South Strafford), VT, 1874 (source: Rauner Special Collections Library, Dartmouth College, Hanover, NH).

attractive for sheep husbandry. However, by 1840 the sheep "mania" had begun to subside because of sheep generated erosion that had destroyed much of the pastureland (Wessels 1997:57). Increased erosion coupled with the opening of the rich bottomlands of the Ohio River valley first by canals and later railroads caused increased competition with New England farms and ultimately the collapse of Yankee farming. As Strafford farms became increasingly less lucrative younger members of the community and whole families were drawn away to industrial and service jobs in larger cities or to more productive lands to the west. This fact is evidenced by a near-steady decrease in Strafford's population well into the twentieth century. In 1840 the population fell to 1,761, 1,540 in 1850, 1,506 in 1860, 1,290 in 1870, and 1,181 in 1880.

The changes in economic development during the period are evidenced by the agricultural censuses for Orange County in the years 1850, 1860, 1870, and 1880, as well as the national census from 1820, the 1840 census of mines, agriculture, commerce, and manufacturing (Vermont State Library), and the 1888 gazetteer (Child 1888). In 1820 there were substantially more people employed in agriculture than in any other occupation; manufacturing was a distant second ahead of commerce. By 1840 Strafford contained 12,102 sheep and 2,235 cattle, slightly above the average livestock populations of its neighbors. Conversely, the cereal and crop production of the town was slightly below that of other nearby towns. Of course with the presence of the mine Strafford was one of only two towns in the area that produced paints or dyes (Vermont State Library 1840). In both 1820 and 1840 the mine does not appear to have been a major source of employment for the town. Similarly, by the time the 1888 gazetteer was published (Child 1888) only 11 local men were recorded as employed in mining and many of them only part time. Animal husbandry saw a marked decline as well; 48 men were engaged in sheep husbandry and 14 in cattle. The majority of the remaining inhabitants (197) of the town were farmers, with subsistence farming rather than market farming being the dominant type. Additionally, 89 supplemented their living through sugaring, five with apple orchards, 67 were town officials (politicians, teachers, etc.), five were students, and 27 were in manufacturing and commerce (merchants, dressmakers, etc.). Not surprisingly, 90 individuals had no titles indicating that they were widows, retired farmers, etc.

Copper Smelting Efforts and Experiments 1880 to 1905

Copper Smelting at Sargent Brook 1882 to 1890

After the New England Chemical Manufacturing Company copperas works at Copperas Hill closed in the early 1880s, activity at the mine focused again on copper. During the 1880s the Tyson family returned. Isaac Tyson, Jr. died in 1861, leaving his business to his sons James and Jesse. James Tyson inherited the Vermont copper properties that his father had held onto, and slowly acquired additional land during the 1860s and 1870s, including the area immediately north of the copperas works property line. The land that he had acquired was transferred to the new Elizabeth Mining Company, named for James' wife. James W. Tyson acquired the Buena Vista property on Mine Road about 1882 and made it a seasonal home. The so-called Tyson cottage, built ca.1810 as the original farmhouse, was located across the road from Buena Vista as late as 1979 (Smith, personal communication 2002). The core of Buena Vista was built ca. 1850 by Chase Dow (Lord 1979a, 1979b). For more than 20 years the Tysons developed the mine and smelted copper in several furnaces. They did not produce high volumes of copper, but did make contributions to copper smelting technology (Abbott *GMC* 1964:276–278).

The New England Chemical Manufacturing Company would not allow the Tysons to use the Upper Adit or Lower Adit to access the orebody, so the Tysons undertook their own development

work north of the North Open Cut, which by then had been excavated into a massive open trench. About 1880, Cornish mining captain John Vial began sinking a new 160 ft deep shaft alongside the former turnpike just east of the top of the hill for the Tysons. Eventually the workings included a manway immediately north of the North Open Cut, a shallow adit, Shaft No. 1 just to the north, and Shaft No. 2 several hundred feet further north. Shaft No. 1, or the Tyson Shaft (Figure 5-9) was operated with a steam engine-powered hoist, and Shaft No. 2 was operated with a horse whim. The ore was crushed in a Blake jaw crusher, screened, and hand cobbed. It was then hauled west to the crest of the hill on a short tramway, and hauled down the west slope of Copperas Hill to several roast beds along a road leading to the smelter site on Sargent Brook. It was roasted in 24- by 50-ft beds for 11 weeks before being taken to the smelter (Abbott *GMC* 1964:276–278; Johnsson *Tyson Years* 2000:5–6).

Tyson built a new smelting plant on Sargent Brook at the foot of the west slope of Copperas Hill. This was the first steam-powered smelting operation at the Elizabeth Mine, and the use of steam power freed the Tysons to choose a smelter site closer to the mine. The smelting apparatus consisted of a 40 ton-per-day blast furnace-type vertical smelting furnace with a 48-in diameter water-jacket cooled hearth. Between 1882 and 1884 it produced about 40 tons per day of 20 percent copper matte that was shipped to the Orford Copper & Sulfur Company in Bergenport, NJ. Some of the matte was roasted in stalls on-site and further refined to 60 percent matte and then refined to pig copper that was shipped to Birmingham, England for manufacture of brass pins. Fuel was coke purchased from the Boston Gas Light Company or from the Connellsville coke district of western Pennsylvania. In this furnace, Tyson's metallurgist William Glenn carried out the first known American copper smelting experiments with basic chromite refractory material. Chromite sand was used on the hearth bottom to counteract the erosive action of the acid silica slag. This experiment ultimately failed. However, Glenn documented the efficiency of the water-cooled hearth, which was under scientific debate at the time, and developed a technique for layering the ore feed to increase capacity. Because of fluctuating copper prices the works closed in 1884. The Tysons briefly reopened the smelter at Sargent Brook between 1888 and 1890. The smelter then produced a 40 percent copper matte that was sold to the American Metal Company of New York for refining (Abbott *GMC* 1964:276–278; Johnsson *Tyson Years* 2000:5–10).

By the 1880s vertical-shaft copper smelting furnaces were evolving to handle increasing quantities of ore. They were being built larger and larger, their hearths were changing shape, and they were equipped with an increasing number of air blast nozzles. They came to be referred to as blast furnaces, which they looked more like than the foundry cupolas they once resembled. In addition to water cooling, furnace designers and operators sought other ways to increase the efficiency of the furnaces. One area of experimentation was with refractory materials. Refractories were heat- and chemical-resistant materials, usually in the form of bricks or moldable solids, that were used to line smelting furnaces to withstand the heat and erosive nature of molten metal and slag. Silica slags from pyritic copper ores were an acid substance and highly erosive when molten. They would eat through conventional acid silica firebrick rapidly, sometimes after only a week of smelting, as the iron consumed the silica from the firebricks. During the late nineteenth century the ferrous and non-ferrous smelting industries were experimenting with chemically basic refractory materials including chromite and magnesite. These materials offered longer refractory life, allowing longer furnace campaigns and less downtime for relining, increasing productivity. Success with these materials led to the development of the basic open hearth, which revolutionized steelmaking, and the copper

Figure 5-9. Photograph of Tyson Shaft (Shaft No. 1), Elizabeth Mine, ca. 1880-1888 (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).

converter, which reduced the number of intermediate refining steps previously required to refine copper matte to pig copper.

Non-Mining Developments in Strafford 1880–1905

The population of Strafford continued to decline throughout this period with only a slight resurgence in 1900. The population fell to 1,181 in 1880, to 932 in 1890, rebounded to 1,000 in 1900, and then fell again prior to 1910 reaching 776. By 1900 the mine had expanded to the point that its workforce consisted of 84 men while 181 men were employed as farmers or farm laborers. Additionally, a number of other tasks were fulfilled by townspeople including: butcher, cabinetmaker, miller, minister, attorney, and photographer. The most significant development in the town during this period was the establishment of a creamery in 1893. The creamery provided a market outlet for local agriculture but the majority of farms continued to be subsistence-oriented. Despite the loss of the younger generation to other areas, Strafford continued to support a number of schools, eight in 1900 with 135 students (Smith 1998).

Early-Twentieth-Century Mining and Smelting in the Copperas Brook Valley 1895 to 1919

The history and resources associated with industrial activity in the Copperas Brook Valley between Copperas Hill and Gove Hill, which includes the area in and immediately around TP 1 and TP 2, is complex. This area was utilized by several companies for several phases of milling and smelting between 1900 and 1958. Therefore, the resources for each chronological phase are evaluated separately rather than collectively for this part of the Elizabeth Mine site.

The Elizabeth Mining Company 1895 to 1902

In 1886 Boston-based copper metallurgist Henry M. Howe visited the Elizabeth Mine and recommended improvements including driving a new, long adit from the base of Copperas Hill to reach new ore reserves, and installation of a large semi-pyritic smelting furnace to make 90 percent black copper, or using a Bessemer converter to make high-grade matte. The Tysons were not in a position to make those improvements at that time, but reexamined Howe's findings in 1895. In November 1895 the Tysons began to drive a new adit located below Mine Road northeast of the copperas work site at TP 3. The work was carried out by hand at first and later with compressed air drills. The 1,400 ft adit reached the orebody in 1898, resulting in the opening being called the 1898 Adit (Figure 5-10). This development allowed access to more than 300,000 tons of ore and was used after enlargement until the last days of operation in 1958 (Johnsson *Tyson Years* 2000:8–13).

In 1899 copper prices rose and the Tysons built a timber frame ore concentrator mill and smelting plant northeast of the adit (Figure 5-11). Construction was ongoing while the company directly shipped richer copper ore opened up by the new adit to the Mountain Copper Company, Ltd. smelter in New Jersey. The concentrator mill was located east of where the World War II Compressor House and Workshop now stand, where the north tip of TP 2 meets the southwest tip of TP 1. The concentrator mill included a crusher as well as picking tables or belts for hand-sorting the ore, and conventional gravity separation equipment. It is unclear how much waste tailings this mill generated or where they were deposited, but it is likely that it generated a moderate amount that may be in the vicinity of the north tip of TP 2. North of the mill were roast beds served by parallel sets of railroad tracks to facilitate gravity loading and unloading of ore. The smelter plant was located to the northeast and included one each of three types of furnaces for the successive refining stages: a 150-ton water-jacketed blast furnace to produce copper matte,

Figure 5-10. Photograph of 1898 Tyson Adit, taken in 1943. Photograph of 1900-1905 Tyson Works at Elizabeth Mine (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).

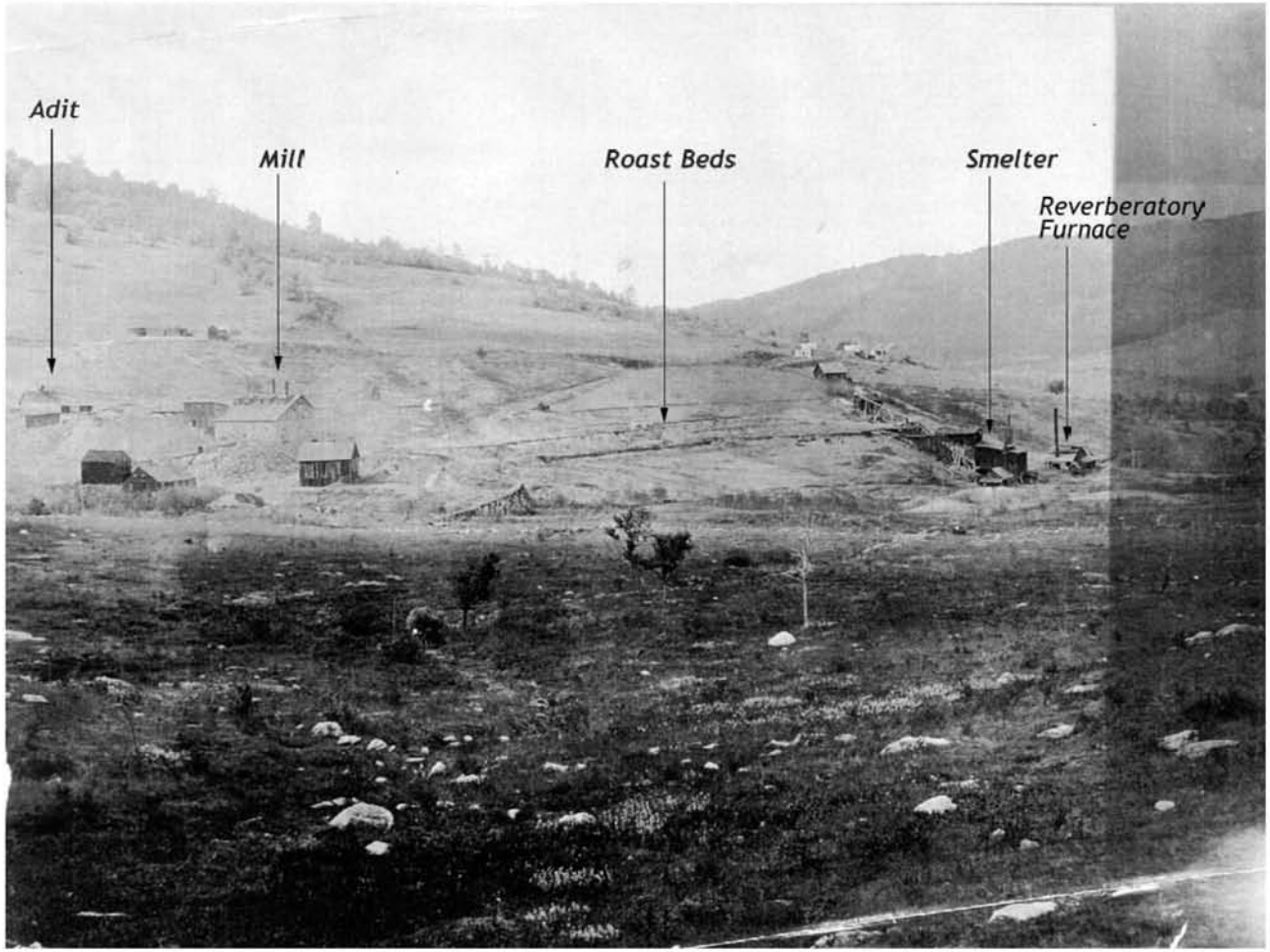


Figure 5-11. Photograph of the ca. 1900 Tyson milling, roasting and smelting operations (Source: Strafford Historical Society, Strafford, VT).

a 40-ton matte furnace to upgrade the matte, and a 10-ton reverberatory furnace to make pig copper of black or blister grade. In 1900 the smelter products were sold to the Bridgeport Brass Company and refined for them at the Nichols Chemical Company on Long Island. Despite the new mine plant the operation was not profitable. The company was cash-short and behind on payments. Fuel shortages and transportation difficulties continued to be a problem. The Tysons paid off their mortgage in 1899, only to see the price of copper fall steeply. James Tyson died in 1900 and his son, James Jr., was appointed receiver for the mine. The Tysons sought a buyer for the mine but turned down the offers. Fairly continuous smelting and exploratory work continued until June 1902 when the works were shut down (Abbott *GMC* 1964:278–280; Johnsson *Tyson Years* 2000:12–14).

Despite these hardships Tyson and Glenn made several technological innovations. Two of Tyson's furnaces were equipped with experimental basic chromite linings. Instead of chromite sand, Glenn installed a solid bottom of rock chromite ore in their 3 ft by 10 ft blast furnace. This lining functioned for more than 26 weeks where regular silica brick usually lasted only one week. The reverberatory furnace was also equipped with a chromite lining that proved equally effective. The reverberatory furnace was constructed so that the fuel did not come into physical contact with the ore, unlike the cupola and blast furnace, where they were mixed. The techniques of operating the reverberatory, or English type copper smelting furnace had earlier been kept secret at English custom smelting operations such as those at Swansea, Wales, and were only used on a large scale in the U.S. at Baltimore after the 1850s. This method eventually spread to general copper smelting practice as a way of obtaining high-purity copper. In the Tyson blast and reverberatory furnaces William Glenn achieved the first successful use of chromite copper smelter linings in America. Although Glenn is not officially credited with the invention of chromite refractories, he did share his findings with the American Institute of Mining and Metallurgical Engineers (AIME) in 1901 and chromite was subsequently widely adopted for copper smelter furnace linings. Another of Glenn's innovations was made in copper converting, one that eliminated the time and energy-consuming process of roasting copper matte once it came from the blast furnace. He succeeded in eliminating this step by treating copper matte from the blast furnace by blowing a mix of superheated air, steam, and silica sand on the molten metal in the reverberatory furnace, skipping the matte furnace entirely. The durability of the chromite linings was an important factor in the success of this method. Unfortunately Tyson and Glenn were unable to get a patent for this so-called reactor process, and a different process of copper conversion using the Pierce-Smith converter (with chromite linings) became the preferred method (Johnsson *Tyson Years* 2000:15–17).

Early-Twentieth-Century Experiments and Ventures 1904 to 1930s

U.S. demand for copper rose sharply at the end of the nineteenth century because of the increasing spread of electrical communication and power technology. As high-grade copper deposits were quickly worked out, the need for more and more copper drove metallurgists to develop processes to efficiently extract copper from leaner and leaner ores and even from slag, mill tailings and old waste rock. New processing technology, electrically powered equipment, and the application of mass-production techniques allowed savings in fuel and labor and the realization of greater and greater economies of scale in mining. Ultimately these advances made possible the profitable mining and milling of immense low-grade deposits in open pits. Some of the new processes that were tried out in the Vermont Copper Belt included magnetic separation, pyritic smelting, and froth flotation. None of the Vermont trials of this equipment were on the cutting edge of technology or influenced subsequent metallurgical practice. They were incorporated there simply in a dogged effort to make a known large copper deposit a paying

proposition. The reasons for failure included idiosyncrasies in the ore, dramatic accidents, and poor capitalization and transportation.

Magnetic separation was an old idea that had been used successfully in iron ore enrichment as early as the early nineteenth century, for instance, at the Franconia, New Hampshire, iron furnace. It experienced a revitalization and successful application with the advent of industrial electrification but the Elizabeth Mine's pyrhhotite proved difficult to magnetize and the process failed at South Strafford. In the semi-pyritic and pyritic smelting process, the ore roasting process was skipped and the smelting furnace was tailored to burn the sulfur in the ore itself to augment or replace conventional coke fuel. These processes were successfully applied by the metallurgical industry but were not particularly successful at the Elizabeth Mine. Froth flotation, discussed below, was successfully used at the Elizabeth Mine.

Judson & Rowand 1904

In 1904 John H. Judson and Lewis G. Rowand of New York, who were both involved in the development of the Wetherill electromagnetic ore separator and also had connections to the New Jersey Zinc Company, leased the mine from the Tyson receivers. They set up a pilot plant to test electromagnetic separation of the pyrhhotite from the milled ore, but the process, which also involved roasting the ore, was a failure. This pilot separator equipment was apparently set up in the vacant Tyson concentrator mill east of the 1898 Adit (Abbott *GMC* 1964:278–281). As this equipment was set up in the Tyson mill, no surviving resources are known or expected. It is unclear how much mill tailings this experiment generated or where they were deposited, but it is likely that it generated a negligible amount that may be under TP 2. This experiment was not significant, as it was an application of a reasonably established technology to an unworkable ore, but is related to the successful application of magnetic separation carried out at Pike Hill in 1907–1909.

Vermont Copper Corporation 1905–1909

In 1906 The Elizabeth Mine property was purchased by August Heckscher (1848–1941). Heckscher, a German native, came to the U.S. to join relatives mining anthracite coal in Pennsylvania. Heckscher was a founder of the Lehigh Zinc and Iron Company and was instrumental in facilitating "The Great Consolidation" of several zinc mining concerns into the New Jersey Zinc Company. Heckscher's consolidation led to NJ Zinc's rise to become one of the largest zinc producers in the U.S. Heckscher resigned as NJ Zinc's general manager in 1904 to pursue other projects including reinvigorating the Elizabeth Mine. August Heckscher has been nominated to AIME Mining Hall of Fame (nomination pending) (Johnsson *Heckscher* 2000:1–2). Heckscher brought all the holdings of the various companies that had owned land at the Elizabeth Mine and consolidated them under the Vermont Copper Corporation, with James W. Tyson, Jr. as superintendent. Ore was brought out through the 1898 Tyson Adit. Heckscher brought the conventional separation equipment in the Tyson mill back on line, and built a system of elevated tramway trestles for moving ore from the 1898 adit to the smelter. Heckscher built a new large 300-ton pyritic smelting furnace, which was designed to use the sulfur in the ore as a fuel. The smelter gases were carried off by a 400-ft-long brick flue with a 125-ft-tall brick chimney (Figure 5-12). The site of the smelter, flue, stack, trestles and a boardinghouse are now buried by TP 1. The smelter began operating in late 1908. However, in February 1909 the wooden smelter house was destroyed by a fire started by a splatter of molten metal. Heckscher promptly constructed

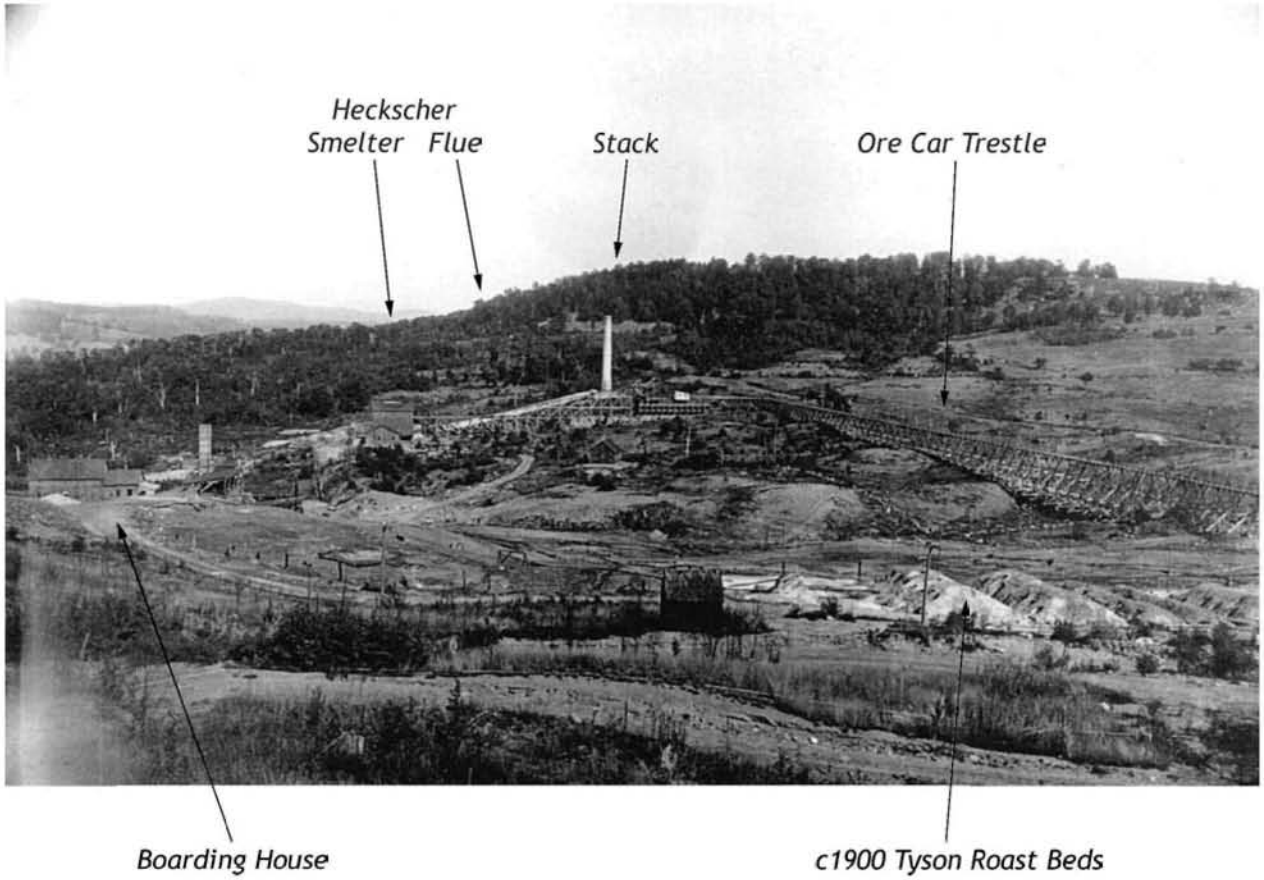


Figure 5-12. Photograph of August Heckscher's ca. 1908 Smelter (source: Strafford Historical Society, Strafford, VT).

another furnace with a steel building by August, but an explosion in the waste gas flue blew out about 100 ft of brickwork a few months later. Extensive diamond drilling of the property was conducted in 1909. No smelting ensued and in 1913 a quantity of slag was shipped out for copper recovery. It is unclear how much waste tailings the concentration mill generated or where they were deposited, but it is likely that it generated a moderate amount that may be under TP 2. About 1908, an access road (now Lower Bailey Road) was built from the smelter site east to meet Gove Hill Road near the West Branch of the Ompompanoosuc River (Abbott *GMC* 1964:281–282).

In keeping with the new industrial power applications of the early twentieth century, Heckscher's entire operation was powered by electricity. Heckscher established the Sharon Power Company, and built a dam and hydroelectric plant on the White River below Sharon and a transmission line to the mine. This power was not distributed to the local community. The power station, which was located approximately one to two miles south of the village of Sharon, was destroyed in the great Vermont flood of 1927. The ruins of the breached dam, an ogee-profile, reinforced concrete structure, are still visible. It is unknown whether there are any visible remains of the power station. Heckscher also ran a water line to a pump house on the south bank of the Ompompanoosuc River, east of the area where Isaac Tyson smelted copper in the 1830s.

Vermont Copper Corporation 1916 to 1919

In 1916 copper prices rose because of World War I demand and the Vermont Copper Corporation reopened the mine and again attempted pyritic smelting with an improved furnace. In 1917 the General Engineering Company set up new flotation equipment for the Vermont Copper Corporation. About 300,000 to 350,000 lbs. of copper matte were produced in the new smelter. This operation was only feasible because of inflated copper prices during World War I, and in 1919 the price of copper fell. The company decided to abandon the pyritic smelting efforts because of remoteness from fuel and flux, and threats of a lawsuit from a neighbor anxious about potential smelter fume damage to his property. The smelter was located higher up on the east flank of Copperas Hill above the earlier Heckscher and Tyson smelters, and escaped burial under TP 1. It is unclear how much waste tailings the flotation mill generated or where they were deposited, but it is likely that it generated a moderate amount that may be under TP 1 or TP 2. (Abbott *GMC* 1964:281–283). The 1939 aerial photograph shows a roughly 1-acre area in this vicinity that appears to be early flotation mill tailings (Figure 5-13). The location and relationship of the 1895–1902 Tyson works and 1908–1909 and 1916 Vermont Copper Corporation operations are shown in a historic map (Figure 5-14).

This operation was the first at the Elizabeth Mine to use froth flotation technology. The development of froth flotation, first used commercially in Australia in 1905, is considered the birth of the modern mining industry. The process relies on the attraction of fine particles of metallic ore to chemically treated bubbles. The process involves tumbling metallic ore in a series of rod and ball mills, large electrically driven rotating drums filled with steel rods or balls to grind the ore into talcum powder consistency. The fine ore is then added to tubs filled with water and special flotation reagents, and agitated with rising bubbles and motorized paddles. The metallic ore particles are attracted to the floating bubbles that rise to the top and are skimmed off, and the fine waste rock mill tailings are removed from the bottom of the flotation chambers. The first commercial froth flotation mill in the United States was installed at the Black Rock Mine at Butte, MT, in 1912. In 1914, three years before the General Engineering Company set up the Vermont Copper Corporation mill, there were 42 flotation mills operating in the U.S. (Bunyak 1998:29–30).

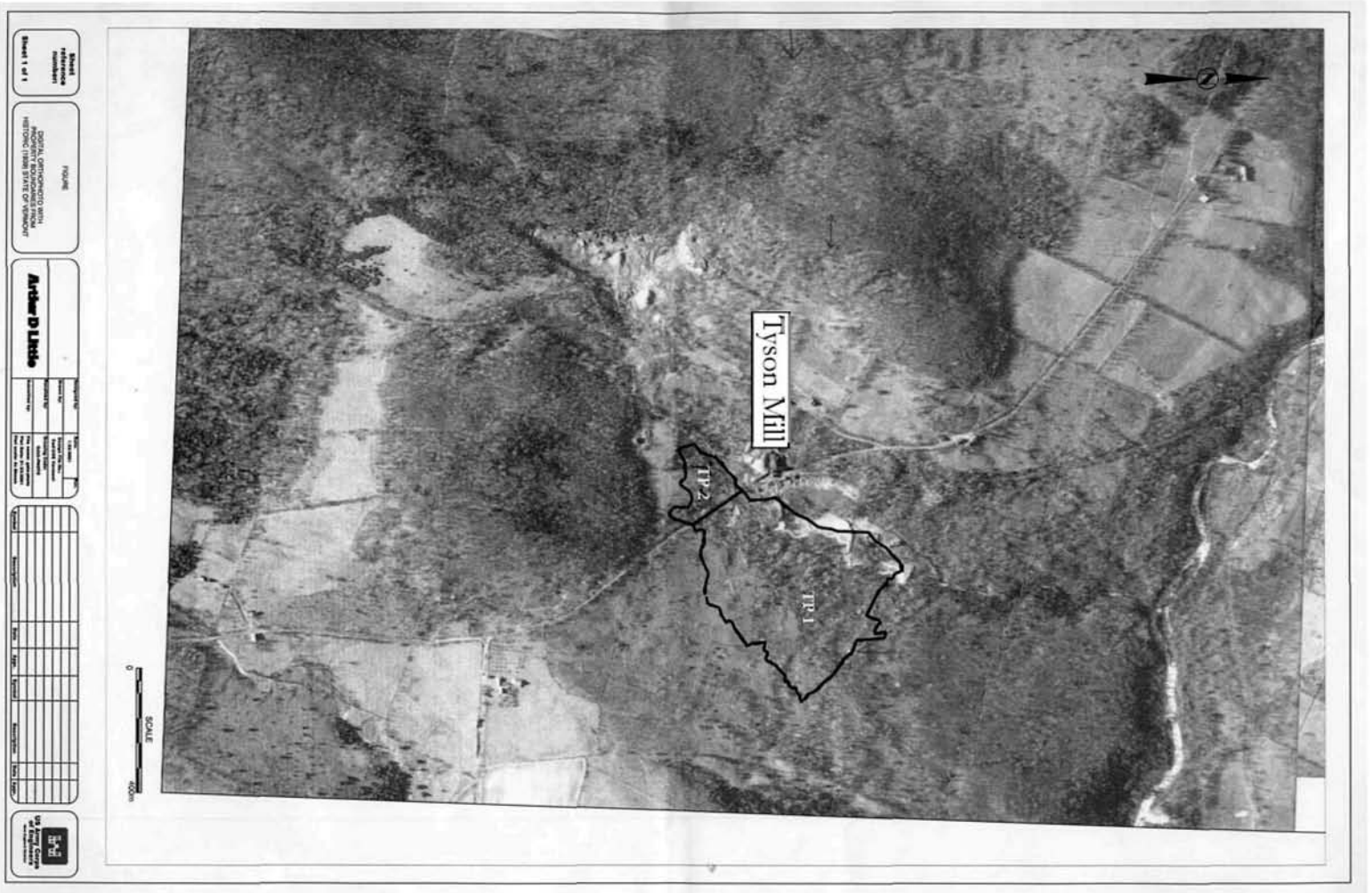


Figure 5-13. Digital orthophoto of Elizabeth Mine showing outlines of Tailings Piles 1 and 2 overlaid on State of Vermont 1939 aerial photograph (source: Arthur D. Little 2000).

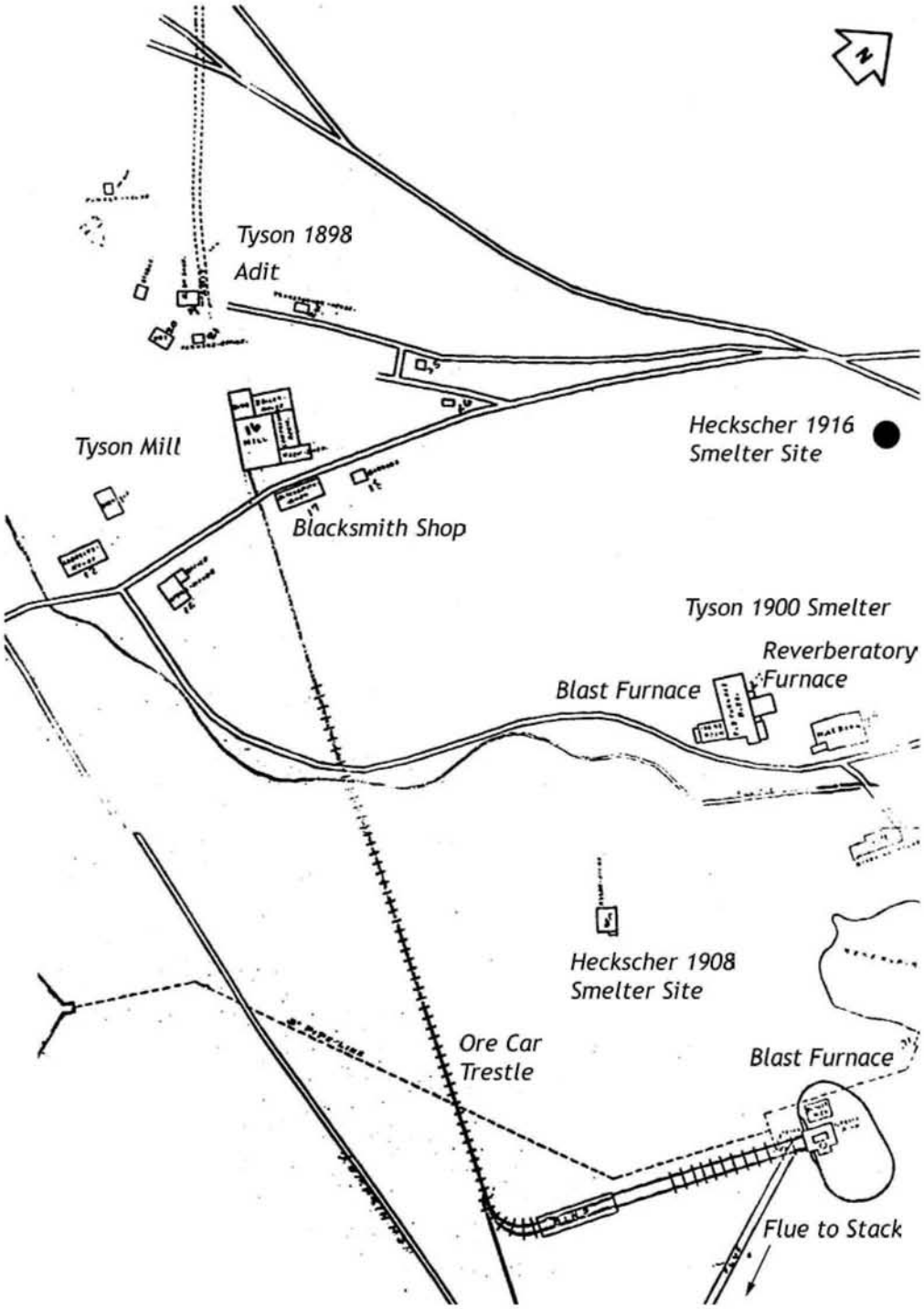


Figure 5-14. Detail plan of early-twentieth-century smelter area showing 1895-1902 Tyson Works and 1908-1909 and 1916 Heckscher operations (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).

American Metals Company 1925

For six months of 1925 the American Metal Company, a worldwide investor in copper properties, mined 20,000 tons of ore and milled 1,756 tons of 18 percent copper concentrate at the Elizabeth Mine. This concentrate was smelted at Carteret, NJ (Abbott *GMC* 1964:283). It is unclear how much waste tailings this experiment generated or where they were deposited, but it is likely that it generated a negligible amount that may be under TP 1 or TP 2. The extent of site development at this time and previous historic operations appear on a 1925 real estate map (Figure 5-15).

National Copper Company 1928 to 1930

After the fluctuating copper market and sporadic smelting and milling attempts of the first two decades of the twentieth century, the outlook for the Elizabeth Mine was bleak. Because of the lack of accurate production information from 1830 to 1930, it is impossible to accurately determine its total refined copper output, which appears to stand between 10 million and 19.2 million lbs. This is less than the 30 to 40 million lbs. estimated for the Ely Mine, and far less at Pike Hill. Exploration had proven ore reserves in an area 13,000 ft long and 1,500 ft deep, but the ore was low grade, hard to mine and beneficiate, and remote from sources of power and transportation. One last attempt was made to extract copper ore from the mine before the onset of the Great Depression. This effort was championed by Frederick W. Foote, a mining engineer with experience in sulfide ores who was convinced that the Elizabeth Mine could be made to pay. Foote convinced backers to form the National Copper Corporation in 1928. Foote believed that the mine could be profitable if more of the values in the ore, including the iron and sulfur, could be extracted by flotation. National Copper mined and milled 60,000 tons of ore in the re-equipped old Tyson mill between April 1929 and June 1930, producing 6,330 tons of concentrates before the plant was closed because of falling copper prices. During the last two months of operation under Foote, the flotation mill reached its predicted output of 300 to 350 tons per day of 20 percent copper concentrate and recovered more than 90 percent of the copper in the ore. A view of the expanded Tyson mill as it appeared about 1930 is shown in Figure 5-16. Experiments proved that the iron-sulfur content present in the pyrhhotite could be extracted through flotation. In 1931 Foote thoroughly analyzed the mine and proposed construction of a 500 ton-per-day mill, and sulfuric acid production. Exploratory drilling revealed reserves of 1,565,00 tons of ore carrying 1.76 percent copper, enough for 10 years of operation. When National Copper's lease expired, Foote took an option on the property for $50,000, and waited for market conditions to change (Abbott *GMC* 1964:283–287).

WWII and Korean War Era: 1941 to 1958

Vermont Copper Company, Inc. and Appalachian Sulfides, Inc.

As early as 1940 the U.S. government began to look to the Vermont Copper Belt as a potential source of strategic metals for the World War II effort, and after Pearl Harbor, interest in the Elizabeth Mine as a source of copper grew. The rebirth of the mine was championed by George Adams Ellis, a Vermont-born financier and industrialist, who worked with the Vermont War Production Board to reopen the mine. Vermont Governor Stanley C. Wilson was also involved. The Vermont Copper Company, Inc., was organized in April 1942 with Ellis as president. The company acquired the Strafford, Vershire and Corinth mining properties and spent $2,350,000 worth of private investments and loans to develop the Elizabeth Mine. Frederick Foote was retained as a consultant. U.S. Bureau of Mines drilling tests showed that 16,500 lbs. of copper could be produced within two years (Abbott *GMC* 1964:308–311).

Redevelopment work included clearing and pumping out the underground workings. By May, 200 men were employed cleaning and rebuilding the mine. The 1898 Tyson adit (at what was then renamed the 300 ft level) was straightened and enlarged for the new 3 ft gauge electric mine cars. The 300, 400, 500, and 600 ft levels were prepared for working by clearing a cavern for a work station at the end of the 300 ft level adit and installing a 250 hp hoist to pull mine cars up an 800 ft inclined shaft that led north to the 600 ft level. A 10 mile paved highway (that closely followed present-day Vermont Route 132) was built to the Boston & Maine Railroad at Pompanoosuc, a 7.5 mile electrical line was built to the mine, and a water line was run to a new pump house on the south bank of the Ompompanoosuc River, east of the area where Isaac Tyson smelted copper in the 1830s. The late 1890s Tyson-era mill and smelter buildings clustered around the 1898, or 300 ft level adit were torn down and a new complex of mine buildings was built that included a change house, compressor building, workshop, and warehouse/office in a straight line on a flat level east and north of the 1898 adit (Figure 5-17). A crushing plant, flotation mill and thickener/dryer building were located in tiers on the hillside below to take advantage of the flow of water and gravity in the beneficiation process. The 500 ton per day flotation mill was built by the Galigher Company of Salt Lake City. Other ancillary buildings included a heating plant, garage, laboratory, water tank building, high water storage building, first aid building, and boardinghouse. In August 1942 the U.S. Government gave the mine a contract for 16.5 million lbs. of copper. Ore production began in the spring of 1943, but the mill was not ready to process ore until October. By November the system was operating 24 hours a day, but did not reach its capacity of 500 tons per day for some time because of technical difficulties. The concentration process recovered more than 90 percent of the copper in the ore and the concentrate contained 23 to 28 percent copper. It was shipped to a Phelps-Dodge Copper Company smelter at Laurel Hill, Long Island, for refining (Abbott *GMC* 1964:312–316).

The copper concentrate was shipped in at least two truckloads per day to the Boston & Maine Railroad at Pompanoosuc Station, approximately 10 miles east of the mine via Route 132. The concentrate was transferred from the trucks into railroad cars for shipment to the smelter. The station area is located on an access road off Route 5 in Norwich. Today the site includes a small rural passenger station with an overhanging hipped roof and a station agent's bay window on the track side. This building is now a private residence. Until the advent of the automobile Pompanoosuc Station was an important satellite of the Elizabeth Mine, as it served as the closest passenger and freight station and communication center, and traffic and messages associated with the mine were handled through the station agent (Johnsson 2001; Smith 2001). The Boston & Maine Railroad took over the Connecticut & Passumpsic Rivers Railroad in 1887. After the paving of the highway to Pompanoosuc (which closely follows present-day Route 132) in the early 1940s it continued to be the shipment point for incoming equipment and supplies and outgoing ore. At that time the mine company constructed the copper shed across the road. It is a long, narrow, tall, gable-roofed building located parallel to the tracks, with the same tan asphalt siding used on the World War II-era buildings at the mine site. This building was used to store rail freight associated with the mine.

Because of a shortage of labor during the war, and skilled labor in general, the mine did not reach full capacity for several years. Fifty miners from Newfoundland were imported to ease the labor shortage. The quality of the ore and the milling fluctuated. Mine pumps broke, and water flows became a problem. The mine produced an average of 300,000 lbs. of copper concentrate a month through 1944, for a year-end total of 3,810,881 lbs. Additional ore was mapped out below the 600 ft level and a winze, or underground inclined shaft, was planned to reach a 975 ft level. After the end of World War II, labor shortages persisted and the price of copper fell. Production in

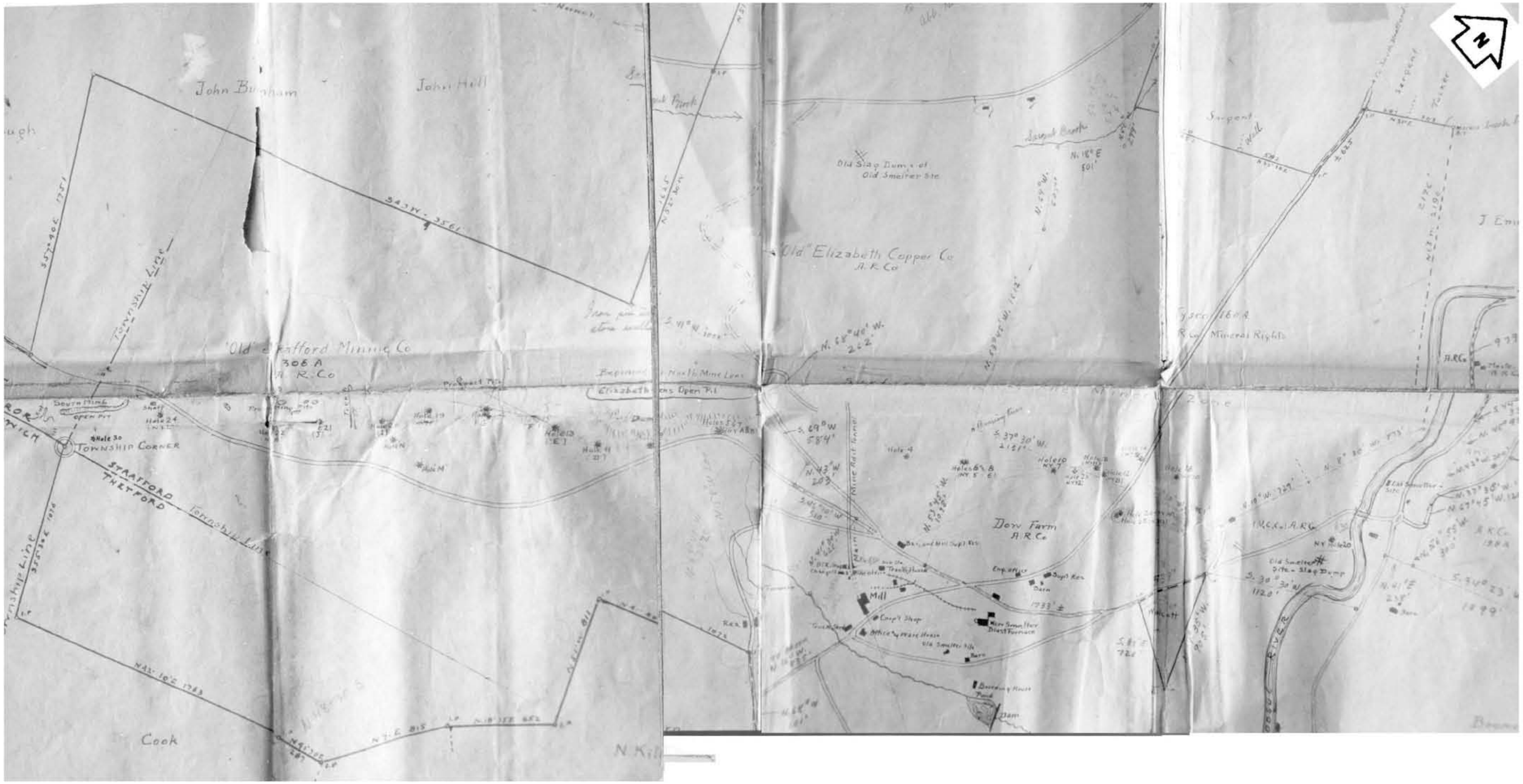
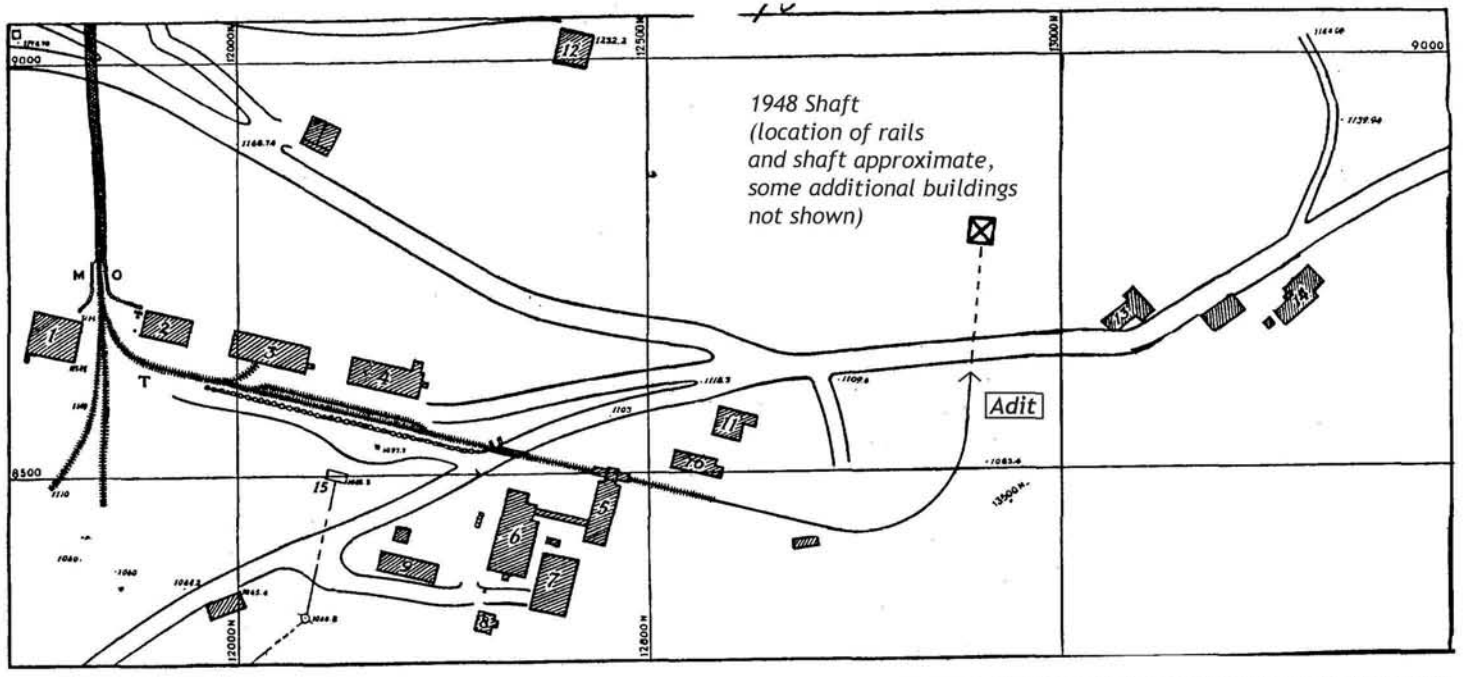


Figure 5-15. Map of Elizabeth Mine showing all historic operations, created by Anahama Realty Co., 1925 (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).

Figure 5-16. Photograph of Tyson Mill ca. 1930 (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).



PLOT OF BUILDINGS AND FACILITIES AT ELIZABETH MINE AND COPPER CONCENTRATE PROCESSING PLANT NOW IN OPERATION AT SOUTH STRAFFORD

M. O.—Mine Opening.
T.—Trolley for Ore Conveyance.
1—Change House.
2—Compression Building.
3—Workshop.
4—Warehouse and Office.
5—Crushing Plant.
6—Mill.
7—Thickener and Dryer Building.
8—Heating Plant.
9—Garage.
10—Laboratory.
11—Water Tank Building.
12—Water Storage at Elevation.
13—First Aid Building.
14—Boarding House.

Figure 5-17. Plan of 1944 buildings and facilities at Elizabeth Mine indicating approximate location of 1948 shaft, adit and tram line (source: *Randolph Herald*, Randolph, Vermont, December 14, 1944).

1945 fell to 3,777,718 lbs. In 1946 the 725 ft level was developed, new ore was mined, and production reached 6,064,572 lbs. Tramming and hoisting ore to the 1898 Tyson Adit at the 300 ft level became an inefficient way to move the ore out of the mine. A new vertical shaft was sunk about 1,100 ft north of the 1898 adit and a new adit was driven in to meet the shaft at the 300 ft level. This new adit exited just north of and above the new mill buildings, east of Mine Road. A hoist was installed that would allow the shaft to be sunk 3,000 ft and development of ore containing 10,000,000 lbs. of copper. Output in 1947 was only 4,495,054 lbs. By that year copper shortages cropped up again and the price rose, but the mine was only marginally profitable. The owners realized that in order for the mine to be profitable it would have to produce other values from the ore. A total of $250,000 was expended on experiments to extract pure iron from the mill tailings through an electrolytic process, which proved fruitless. The new shaft was completed in mid-1948, but the mine required more exploration and increased plant capacity to produce at a scale that would insure profitability, and some form of government assistance was sought. In early 1949 the company signed a contract with the U.S. government for 30 million lbs. of copper at 19.25 cents per lb. for four years, and received a $150,000 government loan (Abbott *GMC* 1964:320–326).

The new contract and new shaft promised a profitable future. The mine had been losing $15,000 to $20,000 a month for two years. The copper content of the newly developed ore was lower than anticipated and output for 1948 was only 4,415,865 lbs. The mine took on Frank Eichelberger as president and general manager. Eichelberger was a mining engineer with a reputation for running profitable operations and who had been a pioneer in the development of froth flotation. He instituted cost-cutting measures and concentrated on mining the best ore at his disposal and increasing the volume of ore running through the mill to maximize the economy of scale. In 1949 the company hauled ore from the Ely Mine waste dumps and mixed it with lean ore from nineteenth-century dumps and fresh ore from the Elizabeth Mine. This was problematic as the oxidized ore proved difficult to process. A recession in early 1949 lowered the price of copper to 16 cents per lb. and the Phelps Dodge refinery went on strike. By June the mine turned its first profit, and the Reconstruction Finance Corporation funded construction of a larger primary crusher plant. The capacities of the mill's various departments were tuned and matched for increased output of 750 tons per day to meet the increased ore production capacity. Copper output rose to 600,000 lbs. per month and 1949 production figures totaled 6,094,980 lbs (*Abbott* GMC 1964:327–332).

By April 1950 the price of copper rose again and was more than 24 cents per lb. by the end of the year. New exploration proved reserves of rich ore all the way north to the Ompomanoosuc River. The South Open Cut was started by that time. This long, narrow, steeply dipping exposure of the orebody was located several hundred feet south of the North Open Cut. The contract for excavation of the ore was given to a private contractor, who blasted the ore free, excavated it with a cable-shovel and trucked it to the mill on a new road built down the east flank of Copperas Hill, across the former copperas works area. This activity did not extend underground and resulted in a long, narrow, steep-walled trench several hundred feet long, now partially filled with water. Excavation of the South Open Cut required blasting a tunnel to connect it to the North Open Cut, and a small, perpendicular cut from the road north to the orebody to facilitate access. The waste rock from this development was dumped in a pile east of the cut and the haul road. The South Open Cut operation was short-lived, but it did provide a boost in the quantity of fresh ore for the mill. A total of 60,000 tons of Ely waste rock was also consumed in 1950. A total of 1,200,000 lbs. of copper were realized from milling Ely ore at the Elizabeth Mine. In 1950 the Elizabeth Mine produced a new record high of 7,000,000 lbs. of copper (Abbott *GMC* 1964:332–335).

In 1951 domestic sulfur shortages finally led to the realization of plans to extract sulfur from the ore under a contract with the Brown Paper Company of Berlin, NH, which wanted the sulfur for sulfite process wood pulp treatment for papermaking. The process would leave behind iron that could also be sold as a by-product. This required building an addition to the east end of the flotation mill to include extra flotation cells to remove the pyrhhotite from the tailings after the chalcopyrite was extracted. By 1952 this unit was producing 20,000 tons of pyrhhotite concentrates a year. By 1952 TP 1 had grown to fill the valley between Copperas Hill and Gove Hill to the east. When the new flotation cells went on line, TP 2, or at least its upper layers, was started south of TP 1 to keep the tailings segregated (Abbott *GMC* 1964:336–338; Condict 2001).

The price and demand for copper rose with the Korean War and in 1951 more ore was developed below the 975 ft level, raising estimates of ore reserves by 670,000 tons. In 1954, after the war, the company signed a government contract for 12,000,000 lbs. at just more than 31 cents per lb. In June of that year the mine was sold to Appalachian Sulphides, Inc., a subsidiary of Ventures-Nippissing of Canada, for $365,000. Under the new owner, mining rights increased to more than 8,000 acres along the Vermont Copper Belt. The company intensively prospected for more ore at the Elizabeth and other former mining sites in Vermont and elsewhere in the Appalachian Mountain chain. The mid-1950s were highly productive for the Elizabeth Mine because of improvements in equipment and a steady labor force. Although production never reached 10 million lbs., it rose above 8,500,000 lbs. in 1954 and 1955. Monthly production rose from 300,000 lbs. per month in 1944 to more than 700,000 lbs. The mill went from producing an average of 200 tons per day in 1943 to an average of 800 tons per day in 1952. Recovery of trace amounts of silver and gold at the refinery added to income. Employment at the mine reached a high of 220 workers who lived in 16 surrounding towns. The annual payroll was more than $1 million and sales were more than $3 million. The most successful year was 1955, when the mine yielded $1,016,705 in profits (Abbott *GMC* 1964:337–339).

Mining eventually progressed north of the Ompompanoosuc River, where two openings were driven down to meet the underground workings. These openings include an air shaft and an air vent. The air shaft is an inclined shaft capped by a small, square, concrete-walled shed about four or five ft square and about as tall with a concrete lid and an opening for a suction ventilation fan. It also includes a ladder to provide an emergency exit for the mine. An adjacent electrical utility pit surrounded by a chain link fence with "High Voltage" signs contained the transformer for the electric fan motor. The air vent is located on the south side of the Ompomanoosuc River, opposite the 1850s–1860s smelter site. It is a vertical hole less than 1 ft in diameter topped with a flanged steel pipe. It currently drains 75 to 200 gallons of water per minute from the mine workings and is surrounded by a deposit of ferrous and aluminous precipitates.

Production dropped below 7,000,000 lbs. in 1956 and 1957. High-grade copper ore was becoming scarce, copper was again in oversupply, and prices fell from a 90-year peak in 1956. By 1957 the number of employees dropped to 180 and the payroll dropped to $800,000. Appalachian Sulphides had been using profits from the Elizabeth Mine to reopen another historic sulfide copper mine at Ore Knob, NC. In February 1958 Appalachian Sulphides closed the Elizabeth Mine and shipped much of the equipment to Ore Knob. (Abbott *GMC* 1964:339–342). The 1948 shaft entrance was capped with a concrete slab, otherwise, the mine site and buildings were abandoned by the company.

The Elizabeth Mine produced an estimated 10,500,000 lbs. of copper before its World War II revival in 1943. During the subsequent 15-year campaign the mine it yielded 91,495,800 lbs. of copper, and probably had a total lifetime output of more than 100,000,000 lbs. It ultimately outstripped its nineteenth-century counterpart, the Ely Mine at Vershire. In 1953 the Elizabeth

Mine was the nineteenth highest producing copper mine in the U.S. Between 1946 and 1956 it was among the top 25 producers and was twentieth in five of those years. In 1950 there were 300 copper mines in the country. The top five produced 67 percent of U.S. copper and the top 10 produced 85 percent. When it closed, the Elizabeth Mine extended 11,000 ft horizontally and had about 5 miles of underground workings (Abbott *GMC* 1964:336–340; Howard 1969).

Post-Mining Era: 1958 to the Present

After owner Appalachian Sulfides, Inc., ceased mining in February 1958, they removed much of the mining and concentration mill equipment for installation at the reopened Ore Knob copper sulfide mine in North Carolina, which they mined for several years. Several of the transient management staff and some of the miners followed the company south, but most of the miners and operational personnel remained in Vermont (Smith, personal communications 2002). In 1961 Appalachian Sulfides sold most of the land east of Mine Road, including TP 1, TP 2, and the World War II-era mine buildings, to a local resident, who sold several parcels to other owners beginning in 1969.

Since the Elizabeth Mine closed, the mine site has remained undeveloped. The landscape has been impacted to varying degrees by natural processes and human activity. Erosion from the headwaters that form Copperas Brook has slowly changed the surface of TP 3, exposing historic timber and masonry features associated with the copperas production process both above and below the road that cuts through the tailings pile. Copperas Brook emanates from the base of TP 3, crosses under Mine Road in a modern culvert and eventually flows toward TP 2. It has cut a deep, eroded trench through the top and face of TP 2, and created a pond and additional subsequent erosion to the east edge of TP 1. This erosion has exposed the segmental concrete pipe drains installed to divert Copperas Brook under the tailings piles as they grew. Water flowing along the west side of TP 1 has resulted in a deep gully at the toe of the slope. Erosion has also resulted in hundreds of small, parallel gullies down the face of TP 1 and 2 that give it a corrugated appearance. Weathering processes have leached the top few feet of TP 1 and 2, altering their original dark brown color to an orange-tan hue.

During the 1970s and most of the 1980s the top of TP 1 was a barren expanse of mill tailings sand. In the mid-1980s the owner attempted to remedy the drainage problem at TP 1 by dumping organic material on its upper surface. This has resulted in the growth of grass and small trees, altering the original appearance of the tailings pile. Copperas Road through TP 3 cuts across an unstable slope and the road appears to have been built and/or repaired with fill brought in from elsewhere on site as the road embankment is full of mine-related debris, including drill core segments, that are visible in the eroded area below the roadway. This road is currently used by logging trucks. The brook that flows from TP 3 was recently channeled in the area immediately west of the bend where it crosses Mine Road directly east of TP 3.

Several of the mine buildings on Mine Road constructed for the World War II operations as well as a handful of earlier associated dwellings in the area, such as the Copper Castle and Buena Vista are inhabited and in varying condition and states of alteration. The World War II era mine plant operational buildings range in condition from good to poor. In particularly poor condition is the cluster of mill buildings. The 1948 adit entrance has collapsed. The roof of the water tank building on Mine Road and the Compressor Building collapsed under heavy snow in early 2001.

A considerable portion of the slagheap located on Sargent Brook associated with James W. Tyson's 1882–1890 smelter plant has been excavated and taken off site by the owner for use as fill material. This slag has the potential to contain fragments of mechanical equipment associated

with the smelting apparatus. Some slag has also been excavated from the Furnace Flat area south of the Ompomanoosuc River during the World War I era, with unknown impact to the 1830 smelter remains at that site. Earth moving equipment was brought across the bridge from Furnace Flat North for this removal. The use of this equipment is partially responsible for the current appearance of the site (Abbott, personal communication 2001).

The Miners

The majority of the recorded history regarding the Elizabeth Mine has focused on the industrial processes conducted there and the lead men who instituted and guided the process. However, it is appropriate to briefly mention the miners and laborers that constituted the muscle of the plant. The population at Elizabeth Mine actively involved in mining and processing the ore ranged from approximately eight in the early years when only Copperas was produced to around 50 during the mid-nineteenth century, reaching 84 in 1900 (U.S. Census, Smith 1998). U.S. Census data for the early decades of the nineteenth century appears to underreport the total employment figures. The 1840 Census of Mines, Agriculture, Commerce and Manufacturing lists only eight men employed in the production of drugs, paints, dyes etc. (believed to include the Tyson works) (Vermont State Library 1840), however the 1833-34 journal of Isaac Tyson, Jr., mentions 80 men mining ore. Additionally, there were support staff and families living at and around the site. The workers came from a number of different places. A letter dated May 22, 1836 from Ezra B. Stevens to his brother Jacob B. Stevens indicates that after eight workers left the mine, additional hands were recruited from Montreal. Another letter between the same two brothers dated May, 10 1839 states that of the 25–30 men working on the site there are "five yankes, one Welch [sic], the rest pats [Irish]" (Vermont Historical Society, Stevens Papers). By 1900, of the 84 men employed at Elizabeth Mine 34 were Vermont born, the remainder were from Poland, Ireland, Scotland, Germany, and elsewhere (Smith 1998). During World War II 50 miners were brought in from Newfoundland in addition to men from elsewhere in Canada.

Room and board for this motley assortment of workers was provided through a number of avenues. Some miners, especially those who were local men who operated farms or other agricultural concerns for part of the year maintained residences in the surrounding countryside, commuting to work everyday. The remainder, especially those of different nationalities huddled around the mine. In some cases these men were boarded with farmers in the surrounding community, but the majority lived in mine-supplied housing, either in single or duplex houses or boardinghouses (two in operation in 1900). It is possible that the miners were grouped by nationality. For instance, the boardinghouse now buried under TP 1 first housed the Polish workers imported during the first decade of the twentieth century (Gwenda Smith, personal communication 2002). Regardless, it seems that the cost of housing was deducted from the miners wages either by paying the boardinghouse or having rent deducted from their wages. During the second half of the nineteenth century the company charged $2.00 per month rent to miners living in company housing (Abbott 1986).

During much of the 1830s Justin Morrill maintained a store at Copperas Hill. It does not appear that the store sold bulk food-stuffs, indicating that the miners and their families were getting their daily sustenance from elsewhere, possibly the company-owned farm (see below) or other local farms. However, the store did carry luxury items such as sugar, nuts, raisins, oranges and tobacco, as well as necessities like brooms and scissors. However, there is no mention of alcohol since the temperance movement was in full effect at the mine during this period. Liquor was not allowed on the premises and any man found inebriated was immediately dismissed and forfeited 15 days wages (Vermont Chronicle 1833). However, this did not always stop miners from visiting the tavern in town (Vermont Historical Society, Stevens Papers, letter dated 1/22/1837). There are

historical accounts of the transitory nature of miners in the form of a list of "runaways," miners who left the company without settling their debts (Vermont Historical Society, Justin Morrill Papers).

High labor turnover may have been related to the dangerous nature of working conditions at the mine during the nineteenth century. In April of 1863 William B. Reynolds related that, "Yesterday was a rather unfortunate day for us, an ox was killed by a stone from a blast and one of the men had an eye put out." Similarly, during Isaac Tyson, Jr.'s tenure James Richards was killed by a premature blast (Abbott 1986). These and other accidental injuries were fairly common during the early industrial period.

The Non-Miners

Many of the miners, James Richards included, left behind widows and young children when they died. It was not uncommon for miners to have families, and some of these groups may have lived in housing present throughout the Elizabeth Mine Site study area. In addition to the support network of families, there was a number of mine-related employees who were not directly involved in the extractive industry. For example, coopers and blacksmiths were employed by the mine as evidenced by the documented presence of such shops on the historic maps. Coopers were necessary to build the hogsheads used to transport the copperas and blacksmiths repaired much of the machinery used in mining including sharpening the drill steels. Teamsters and private contractors were also maintained on staff to transport the copper matte and copperas from the mine to the rail station. A post office was established at Copperas Hill from 1853 to 1857 and from ca. 1858 to 1888 (Gwenda Smith, personal communication 2002).

Historical records also indicate that the mine operated a farm during the nineteenth century, probably to provide food for the miners. In 1828 a Benjamin Preston Jr. was hired to run the farm for three years. The contract between Amos Binney and Preston stipulated that Preston had to purchase all of the livestock, stores, and household goods of the farm; make improvements to the farm; and board miners and other mine employees. The benefit to Preston was that he could sell his produce to the mine and charge the boarders $1.25 per week rent. When Preston's contract ended in 1830 it was transferred to a Calvin Fairbanks of Eaton, New Hampshire, who signed a similar agreement to Preston, though he was permitted to charge company directors visiting the mine $2.00 per week. The farm is mentioned again in 1834 and in 1888 the farm was superintended by George W. Roberts (Anon. 1834; Child 1888:116). The company farm included a boardinghouse capable of housing 50 men, a lodging house, a barn, shed, stable, and in 1888 included 300 acres but its exact location is not specified (Strafford Town Records 1828, 1831; Child 1888:117).

As has been mentioned above the mining operations at Elizabeth Mine were seasonal and subject to recessions that closed the mine. This resulted in a transitory work force and/or the need for alternative sources of income. The miners who were from the Strafford area appear to have engaged in a number of agricultural pursuits in addition to mining. Five of the ten individuals associated with the mine in the 1888 gazetteer also worked as farmers.

In addition to the local farmers who worked as miners, there were a number of other families who lived in the immediate vicinity. Many of these non-mining families interacted with the mine on a regular basis. The Preston family who were present in Strafford by 1791 (Vermont State Library) operated the company farm from 1828 to 1831 (Strafford Town Records), the post office at Copperas Hill between 1858 and 1877 (Beers 1877; Walling 1858), and maintained a farm on the site in the 1890s (Elizabeth Mining Company ca. 1890). Another family of same antiquity are the

Blaisdells (Blasdell) who first appear in the 1800 census (Vermont State Library), owned property southeast of the mine in 1822 (Vermont Historical Society n.d.), and are recorded as owning a farmstead west of the North Open Cut in the 1890s that included the Sargent Brook Smelter Site (Figure 5-18) (Elizabeth Mining Company ca. 1890). The Dow Family also appears on the 1800 census. As mentioned above their property eventually became Buena Vista, the Tyson home. In 1888 George W. Dow worked as a teamster for the mine and farmed and raised sugar maples (Child 1888:110, second part). Both the Dows and the Blaisdells sold mining rights to the Elizabeth Mine, but continued to work the land mandating that the company repair any damage caused to their tillage and pasturelands. Other families in the area included the Burnhams, Clarks, Barretts, Wolcotts, Buells, and Bryants who lived in and around Furnace Flat North (Beers 1877; Walling 1858; Elizabeth Mining Company ca. 1890). Joseph Barrett, George Pixley, T.S. Sargent, Abiel Stevens, Elisha Warner, and Elisha Brown also owned property throughout the mine site in 1822 (Vermont Historical Society n.d.).

Clearly the mine and the surrounding community were interrelated. While the mine was not a substantial source of revenues or employment for the surrounding community, and the miners were kept primarily cloistered in the mine villages, it did provide a market for commercial and agricultural concerns and jobs for a handful of its neighbors. Miners were boarded amongst the farmers, food was likely purchased from the surrounding farms, and the miners did frequent some of the town's establishments to obtain goods and services not available at the mine.

Non-Mining Developments in Strafford, 1905 to Present

The population decline in Strafford continued almost unabated until 1970, with a slight increase during the 1950 census as a result of the revitalization of the mine. In 1970 the population of Strafford was, 536 individuals (Arnold 1993). The population decline is evidence of the continued abandonment of traditional agricultural lands as industrial and service jobs in larger towns became more attractive. Since then the population has begun to increase again, reaching 902 in 1990 and 1,045 in 2000 (Arnold 1993). The Vermont Law School, founded in 1972 in nearby South Royalton, formed a nucleus around which service industries could form. As the industries expanded the population in the surrounding area increased. Today Strafford is a mix of professional and agricultural households, with agriculture focusing primarily on animal husbandry.

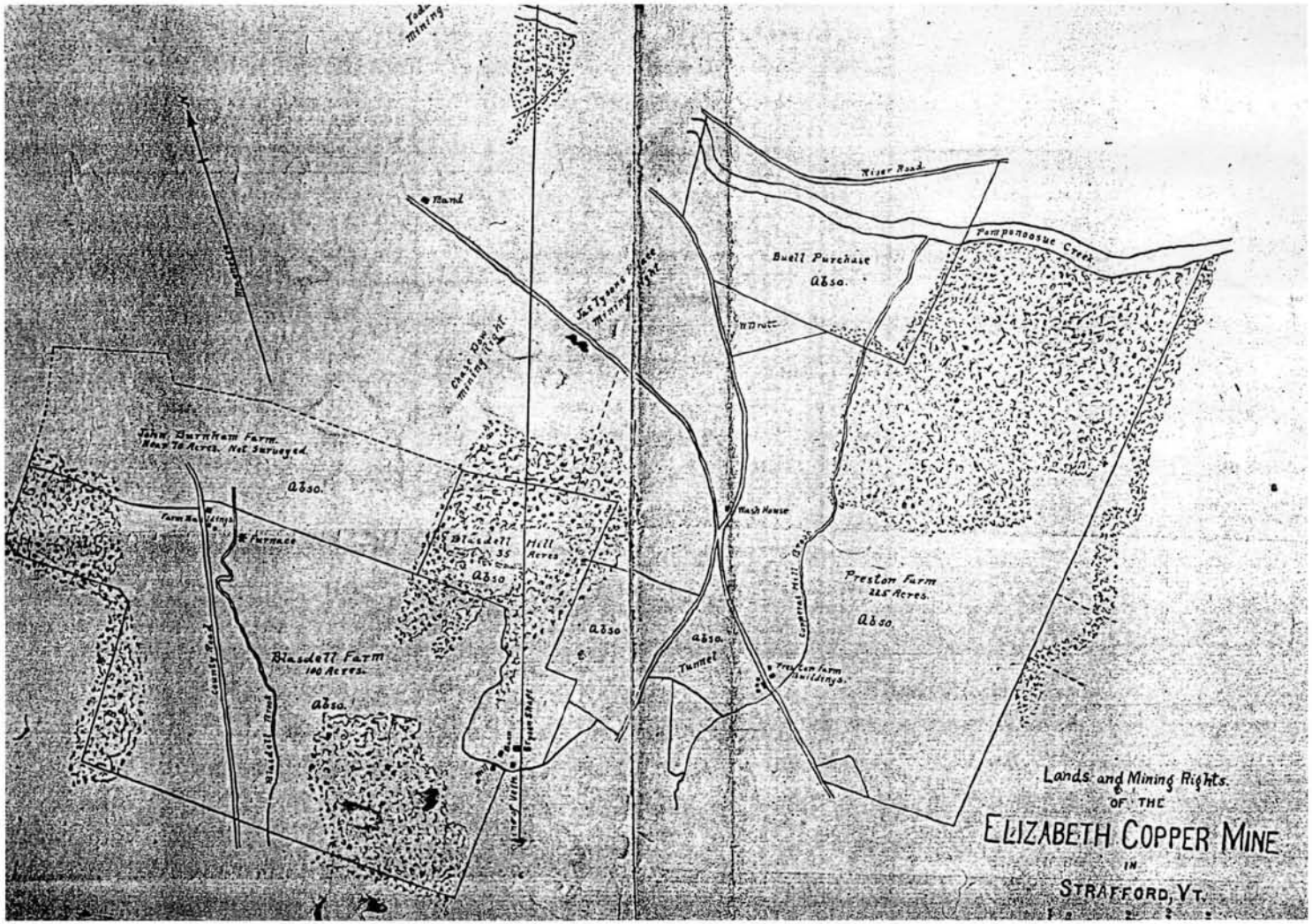


Figure 5-18. Lands and Mining Rights of the Elizabeth Copper Mine, Strafford, Vermont, ca. 1890 (source: Collamer Abbott Collection, Bailey-Howe Library, Special Collections, University of Vermont, Burlington, VT).

CHAPTER 6

RESULTS OF FIELDWORK

The fieldwork conducted at the Elizabeth Mine Site consisted of three main components: GPS mapping and walkover survey, limited subsurface testing in the project APE, and detailed drawings of visible aboveground historic resources. The methods used in each of these tasks are discussed in detail in Chapter 2.

The GPS survey encompassed 460 acres that extended from the cemetery in the south to Furnace Flat North and from the Sargent Brook Smelter Site in the west to east of TP 1 (see Appendix B). Areas not subjected to GPS survey, because of a lack of landowner permission at the time of the field investigations, include: 1) the majority of the area along the strike of the ore north of the North Open Cut and the West Branch on the Ompompanoosuc River; 2) Lower Bailey Road east of TP 1 (the haul road near Gove Hill); and 3) two house foundations near the intersection of Furnace Flat Road and Route 132. The documented historic period resources in these areas provide information as to their archaeological sensitivity in relation to the overall Elizabeth Mine Site (see Chapter 7 discussion).

A total of 545 distinct historic period features was recorded during the GPS component of the fieldwork (Table 6-1). Identified artifact, feature, and structure concentrations were collectively organized into 18 spatially distinct historic period industrial and domestic subsites (see Chapter 2 discussion). Of these, 13 fall within or are partially within the project APE, while five subsites are situated outside the APE, and as such, along with a number of inter-site and other resources, were only subjected to GPS survey and mapping.

Table 6-1. Summary of Cultural Resources Recorded During GPS Survey.

Resource	Count
Artifact Scatter	38
Brick/Timber Scatter	28
Collapsed Wooden Structure	5
Depression	43
Exploratory Drill Casing	7
Fire Hydrant	5
Foundation	57
Isolated Find (truck, shovel, gasoline pump, safe, etc.)	39
Mine Opening (shaft, adit, etc.)	11
Ore Pile	9
Pipe	3
Power Pole	29
Prospect Pit/Trench	22
Quarry	5
Retaining Wall	35
Road	92
Stone Pile	5

Table 6-1. Summary of Cultural Resources Recorded During GPS Survey (cont'd).

Resource	Count
Stone Walls	80
Terrace	2
Well	4

Native American Resources

No Native American artifacts or features were recovered during the walkover survey and subsurface testing program. Testing included the placement of test pits in the vicinity of a small quartz boulder located north of TP 1, identified by Abenaki representatives as being of possible cultural significance. No stone tools, lithic debitage, or other archaeological evidence of a related occupation was encountered during subsurface testing conducted in this portion of the project APE. Quartz appears naturally within the project area, including at least two historically utilized quartz surface quarries located on Copperas Hill.

Historic Period Industrial Resources

Twelve of the subsites during the GPS mapping and walkover survey are associated with the industrial history of the Elizabeth Mine. Five of these resources (Furnace Flat North, Furnace Flat South, Sargent Brook Smelter Site, Old South Mine, and South Open Cut) are outside of the project APE, while the other seven (World War II Standing Structures and Associated Resources, World War I Era Smelter Site, Tyson Mill, Lower Copperas Factory, TP1, TP2, and TP3) are within or partially within the APE. Subsurface testing was only conducted in the subsites situated within the APE.

Furnace Flat North (Outside APE)

Furnace Flat North is located on the first and second terraces between the west branch of the Ompompanoosuc River and Route 132 along the strike of the ore. The site consists of a linear arrangement of industrial and transportation resources along the West Branch of the Ompompanoosuc River, and domestic resources farther north, closer to Vermont Route 132. The industrial resources located along the first terrace of the river include a wheel pit several foundations, a bridge abutment, and the remnants of a dam. Surface artifacts in this area include a split wrought iron pole, an iron turbine shaft and coupling, wrought iron penstock hoops, and mid-twentieth century car parts in the vicinity of the north bridge abutment. Modern trash (e.g., soda/beer cans) associated with nearby Route 132 are also present on the ground surface. The remaining domestic foundations consist of a single large foundation on the second terrace south of Route 132 and two foundations north of Route 132. The second two foundations are in close proximity to one another.

While no subsurface testing was conducted in this site area, it contains a relatively dense concentration of mid-nineteenth-century foundations with good integrity (Figure 6-1). At a minimum nine structures are included within the site in addition to the remains of a dam, the remnants of a bridge and a number of other features. The detailed mapping of Furnace Flat North recorded fewer cultural remains than the Abbott sketch map of 1967 (see Appendix E for comparison). However, the missing resources tend to be smaller portable objects that may have been transported off-site in recent years.

At the northernmost end of this site area are the remains of the waterpower dam for both Furnace Flat North and South (GIS database #348, 349). The dam, long since washed out, is a stone and earth structure that runs from the edge of the terrace overlooking the river to the bank of the river itself, and rises approximately 1 m above the current ground level.

Directly south of the dam is a 3-m high dry-laid stone wall cut into the terrace above the river (GIS database #347). The wall has a slight angle 3 m from its northern and then runs an additional 15 m before reaching a corner. At the corner there is a slight jog in the wall from which both the main wall and the corner wall run an additional meter. Downslope from the wall is littered with wall-fall. It is unclear if the wall represents a retaining wall or a building foundation. While no test pits were excavated at Furnace Flat North, an oddly shaped wrought iron artifact was noted on the surface (not collected), located near the north end of the wall (Figure 6-2). The artifact consists of two round section pieces of iron rod that merge together to form a square section. The entire piece is 4-m long and appears to be a single piece of iron.

A footpath leads south from the wall to a roughly rectangular depression, the majority of which is formed by the terrace to the east and earth berms on the other sides (GIS database #350). The outer northwest corner of the berm is retained by a circular dry-laid stone wall. The river's edge portion of the wall has been partially washed out, but it appears that the wall was built in a semi-circular pattern and is still in situ. The interior of the depression contains a visible wrought iron hoop, an iron turbine shaft with coupling (Figure 6-3), and a Ricketts Mold bottle (not collected) that dates to between 1820 and 1920 (Jones and Sullivan 1989:29). Up slope and to the east of the depression are two nested right angle walls (GIS database #351). It is unclear how these walls are associated with each other and with the depression below because of the changes in elevation between each one. It appears that the nested walls have been partially destroyed, likely through erosion.

Leading from the square depression south to the wheel pit is a line of seven wrought iron penstock hoops. The hoops, which are approximately 1 m in diameter are resting upright in the soil with the turnbuckle oriented upward (Figure 6-4). The wheel pit itself is a 5-x-6.5-m, 4-m deep pit constructed of massive dry-laid stones (Figure 6-5) (GIS database #353). In the northeast corner is a small stone delineated depression roughly in line with the penstock hoops that likely represents the immediate course of the water. A 50-cm sill pocket is located along the northern edge of the pit, approximately 75-cm below the lip. A wrought iron plate is affixed to the east wall of the pit. On three sides the pit is excavated into the terrace, but on the western, river facing side, the stone wall is not supported by earth. This side is likely the direction of the tailrace. Located to the east of the pit is a 2.5-m high dry-laid stone wall (see Figure 6-5) (GIS database #354). The wall consists of an 11-m N/S oriented run with a 3-m wing at a right angle to its north end. The wall is at the same orientation as the pit and the north walls of both are in line, implying that they are associated.

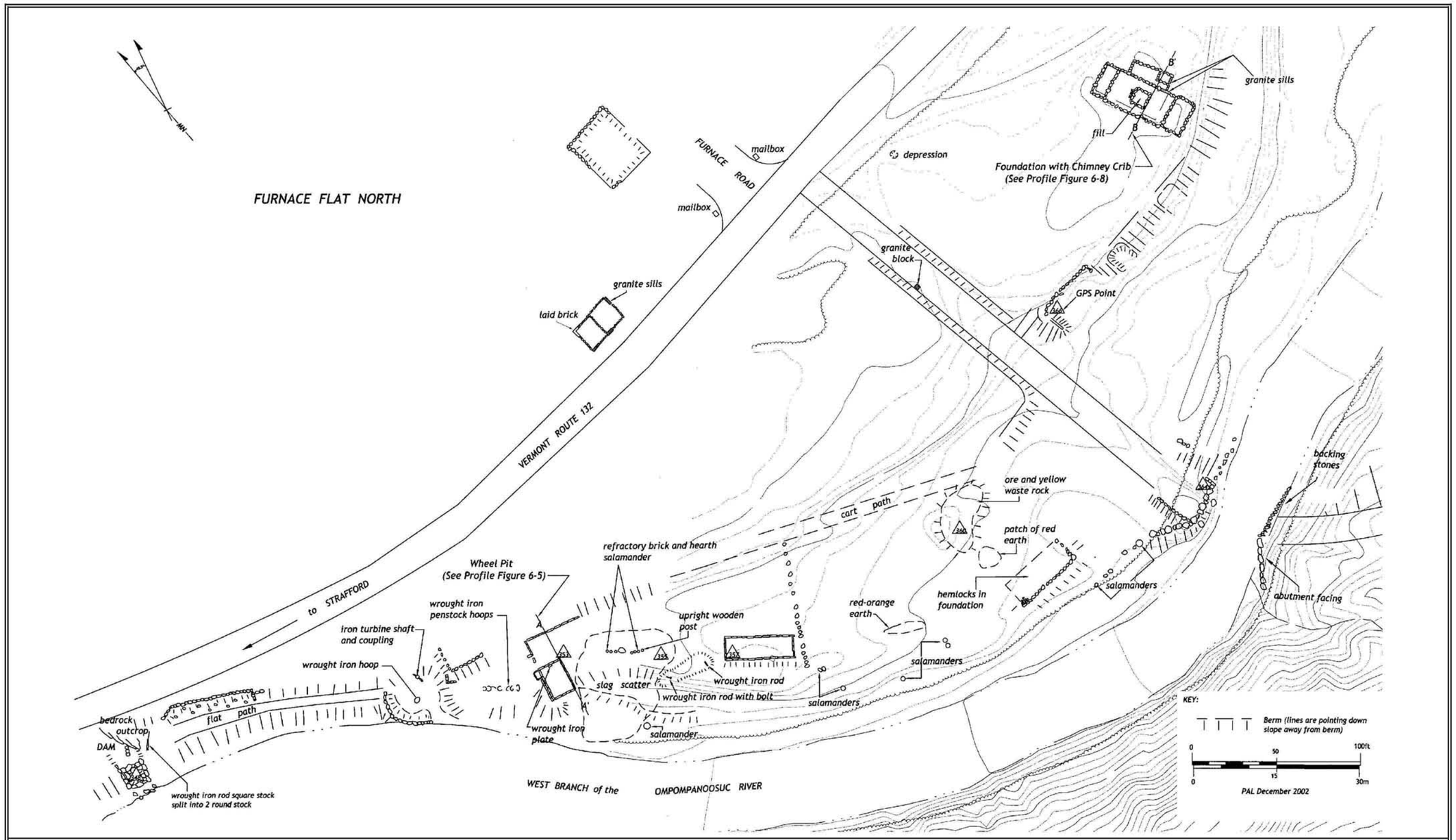


Figure 6-1. Map of Furnace Flat North Smelter Site.

Figure 6-2. Split wrought iron pole located at north end of Furnace Flat North Smelter Site, near dam.

Figure 6-3. Turbine shaft located in rounded foundation, Furnace Flat North Smelter Site.

Figure 6-4. Penstock hoops, Furnace Flat North Smelter Site.

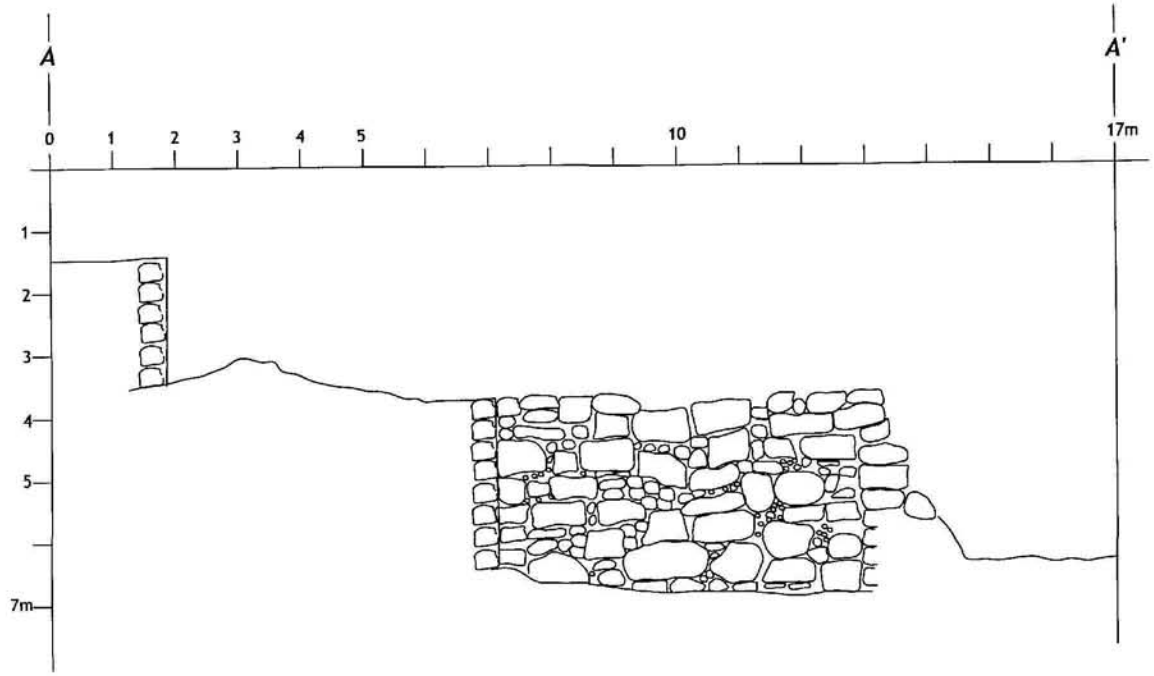


Figure 6-5. Cross-section of wheel pit, Furnace Flat North Smelter Site.

Directly to the south of the wheel pit is a flat open area that contains no foundations, but does represent the most concentrated deposition of furnace-related artifacts in the subsite. The area is littered with slag as well as a concentration of refractory brick and a hearth salamander (GIS database #554). A salamander is a conglomeration of furnace waste products that collect at the bottom of the hearth. Other salamanders are located throughout Furnace Flat North, but this is the only one that has not been redeposited along the riverbank. Additionally, within the slag concentration is an upright wood post of indeterminate age (GIS database #355). The post is approximately 10-x-10 cm. South of the slag concentration is a very slight linear rise with a wrought iron threaded rod at either end. The rise is oriented slightly off of N/S but appears to be in a similar orientation as the wheel pit. The rod at the northern end has a bolt affixed to it. Both rods are approximately 3 cm in diameter.

The slag concentration portion of Furnace Flat North represents a functional transition within the layout of the subsite. All of the features to the north of the concentration are oriented toward the water and are accessible to the water, residing on the lowest terrace of the bank. Beginning with the concentration, the remainder of the resources are located on the second terrace and are therefore insulated from the water. Functionally, water-related features are on the first terrace as indicated by the wheel pit and turbine while more water sensitive resources such as the furnace and paint factory, as will be discussed in Chapter 7, are positioned on the second terrace.

Just south of the slag concentration and located on the same terrace is the low stone wall of a rectangular foundation measuring 4.2-x-12.5-m (GIS database #357). The walls of the foundation are no more than 50-cm above the ground surface. The interior of the foundation is littered with mid-twentieth-century steel cans of various descriptions. Just south of the foundation is an east/west oriented wall of dispersed stones.

South of the rectangular foundation the terrace begins to widen. In this space are located a patch of red-orange soil, a patch of red soil, and a pile of orange and yellow waste rock (GIS database #360). No vegetation is present in any of these discolored locations. Just to the east of the waste rock pile a path leading down from the third terrace where the main road (Route 132) reaches the second terrace. West of the red discoloration and the ore pile is a second rectangular foundation with the dimensions 5-x-13 m (GIS database #365). Only the south and west walls of the foundation, which extend above the surface 50 cm, are still intact but the shape of the structure can be inferred from the copse of hemlocks that are thriving only within the foundation.

Southwest of the second rectangular foundation is a bridge abutment (Figure 6-6) (GIS database #364). The abutment is the eastern (and best preserved) part of the bridge that connected Furnace Flat North (and the predecessor road to Route 132) to the rest of the Elizabeth Mine Site. The 1830s haul road leads from the core of the site past Furnace Flat South and to this bridge, which was washed out in 1927. Based on historic photographs (Figure 6-7), one manifestation of the bridge was a fully riveted Warren truss bridge with no substruts. The only remains of this structure are two earth and rubble filled dry-laid stone abutments. The eastern abutment consists of a front wall parallel to the river and a northern wing wall at an obtuse angle to the front wall. The southern wing wall no longer exists. Inside the abutment the roadbed is defined by two parallel stone walls that fall away steeply to the north. The western abutment is more deteriorated, with much of its stone now deposited in the riverbed. However, it appears to have a similar river facing wall, and northern wing wall, with no evidence of a southern wall. Within Furnace Flat North the haul road continues easterly until it reaches Rt. 132. In order to achieve a gradual grade the third terrace was cut and filled.

Figure 6-6. Bridge abutments, Furnace Flat North and South Smelter Sites. North abutment in foreground.

Figure 6-7. Historic photo of 1906 Furnace Flat bridge taken in 1916 (source: Strafford Historical Society, Strafford, VT.)

South of the haul road a large section of the third terrace was cut and lined with stone (GIS database #366). On both ends of the 12.5-m long, 2-m high dry-laid stone wall that lines the east margin of the cut is a slight corner that quickly tapers from stone to an earth embankment. Two other 5-m square cuts, without stone linings, are located four and 20 m southeast of the stone lined cut. Also to the southeast of the stone-lined cut is a massive foundation (Figure 6-8) (GIS database #369). The foundation is 18-x-10 m and is constructed of fieldstone and cobles. The main portion of the foundation is 11-x-6-m, 2-m deep cellar foundation with a massive 3-m square chimney crib in the center. The north wall of the cell has slumped in. Attached to the east, west, and south sides of the cellar are unexcavated wings. These wings are defined by stone foundations and do not have cellars. In the southwest corner of the southern wing is a 1.5-x-2-m pier. A large granite sill is located in the southwest corner of the main cellar foundation.

Located across Route 132 from the rest of Furnace Flat North, and north of Furnace Road, are two apparently domestic foundations associated with Furnace Flat North. The southern of these is a 10-m square dry-laid fieldstone cellar foundation (GIS database #370). Only the eastern wall and portions of the north and west walls are still standing; the remainder of the structure has collapsed. The northern foundation is smaller (9-x-5-m) and divided in half along its shorter axis. The southern portion of the foundation is a cellar foundation of dry-laid fieldstone with granite slabs in southeastern and northwestern corners. The northern half is an unexcavated foundation with laid brick in its northeastern corner and a granite slab in the northwestern corner. Both of these foundations, like all of Furnace Flat North, are overgrown in such a way as to be nearly invisible from Route 132.

Furnace Flat South (Outside APE)

Furnace Flat South lies across the west branch of the Ompompanoosuc River from Furnace Flat North in a bend in the river (Figure 6-9). The majority of the site is located on the southern flood plain of the West Branch of the Ompompanoosuc River, with transportation routes and possible materials marshalling areas located farther up slope. The resources on the floodplain include a number of concentrations of slag and heat-altered soapstone and brick centered on the bend in the river. The remainder of the floodplain at the bend in the river contains a number of salamanders and piles of slag and red and yellow earth. Above the floodplain are the roast beds, and a plateau covered with black earth and charcoal.

Furnace Flat South begins at the southern mate for the bridge abutment discussed with Furnace Flat North. As mentioned above, the southern abutment is more deteriorated than the northern abutment, but it clearly marks where the haul road crossed the river. From the bridge abutment the subsite extends 275 m south and upslope along the 1830s haul road. At that point a secondary haul road branches off west from the main road and runs for 141 m to the north, ultimately diverging 30 m from the main road. Both roads have been cut by a number of washouts from small streams. Located between the roads are the roast beds associated with Furnace Flat South (GIS database #336). These beds are easily identified below the duff by their warm colors and ore ridden soils. A secondary ore storage or processing location may be located on a flat promontory to the east of the 1830s haul road. This flat spot contains similar roasted ore deposits to the roast beds but in smaller concentrations.

North of the roast beds and east of the 1830s haul road a road spur intersects the haul road from the southeast. This 32-m section road, which appears as an unnaturally flat terrace on the landscape, runs until it overlaps a second terrace. The second terrace located northeast and down

slope from the road spur appears to be related to a structure, perhaps a charcoal shed (GIS database #323). The northern edge of the terrace is squared off by a low dry-laid stone wall while the remainder of its 30-x-12-m expanse is defined only by steeply sloping sides. A poorly laid stone wall does appear to parallel the slight "L" at the southeast end of the terrace (GIS database #324). The soils on the terrace are exceptionally dark (10YR 2/1). Similar soils can be seen cascading down slope from the south east corner of the terrace. A narrow (30-cm) trench runs along the western margin of the terrace before turning east and leading to a gully in the natural slope to the south of the terrace. The gully, which appears to be either a man-made cut or the result of erosion from water flowing out of the trench descends the remainder of the slope to the floodplain below where it terminates into an excavated pit. The pit is 4.5-x-7 m, and one-half m deep. The spill of black soil that descends the slope from the terrace abuts the pit to the north.

East of the pit and partially overlapping the black soils is a fan of slag, salamanders and refractories. The refractories are of various materials including sandstone, quartzite, and soapstone. A number of other pieces of refuse are included in this area including a reproduction of a historic glass bottle (basal push-up with embossed lettering on base) (not collected). Extending to the north and east of these furnace waste products is a large fan of slag. To the west the slag pile gradually fades into natural soils, but to the north and east the pile is clearly defined by topography rising from 1 to 3 m above the natural floodplain. To the east the pile terminates in three fingers of orange and red discolored soil. To the south the pile abuts the natural slope of the river terrace. Along its northern margin there are the remains of what may have been a retaining wall designed to keep the slag pile away from the working furnace area and a salamander.

The remains of the site are located on the floodplain just above the river in an area tightly defined by a nearly 180-degree bend in the Ompompanoosuc. The majority of features in this area are poorly defined heaps of slag and burned soapstone that are associated with the furnaces that once operated on this site (GIS database #317, 318, 321, 322). These heaps include a number of approximately two-m square piles of waste materials in addition to a larger crescent shaped pile and a boot shaped pile. Because no test pits were excavated at Furnace Flat South it is difficult to tell which if any of these features are in situ. Other visible features in the area include a mass of fused common brick and a schist boulder with peripheral slag. A 12.5-cm threaded steel pipe emitting a flow of water indicates the presence of exploratory drilling in the vicinity during the twentieth century.

World War I Smelter Site (Completely Within APE)

The aboveground signature of the World War I Smelter Site is a terrace in the east flank of Copperas Hill that contains a high concentration of heavy construction materials (Figure 6-10) (GIS database # 160). Materials in the area include two pieces of slag aggregate concrete with a circular cut out, the approximate diameter of which is 1.8-m. Additionally, refractory bricks stamped "ATHERTON," iron beams set in concrete, and helically twisted square section rebar litter the site. A 2-m diameter galvanized water tank is lying on its side at the northwest corner of the site. A 34-m, 1-m deep, trench extends from the south end of the site down slope to the east with a smaller 12-m long trench extending to the south part way down the hill (GIS database #158, 159). A piece of approximately 15-cm diameter pipe with angle joints is located in the trench part way down the hill.

Eight test pits were excavated within the World War I Smelter Site to examine subsurface conditions and collect cultural materials. Each of these test pits contained a variety of soil

FURNACE FLAT NORTH

BISECTION PROFILE - FOUNDATION WITH CHIMNEY CRIB
FACING NORTHEAST

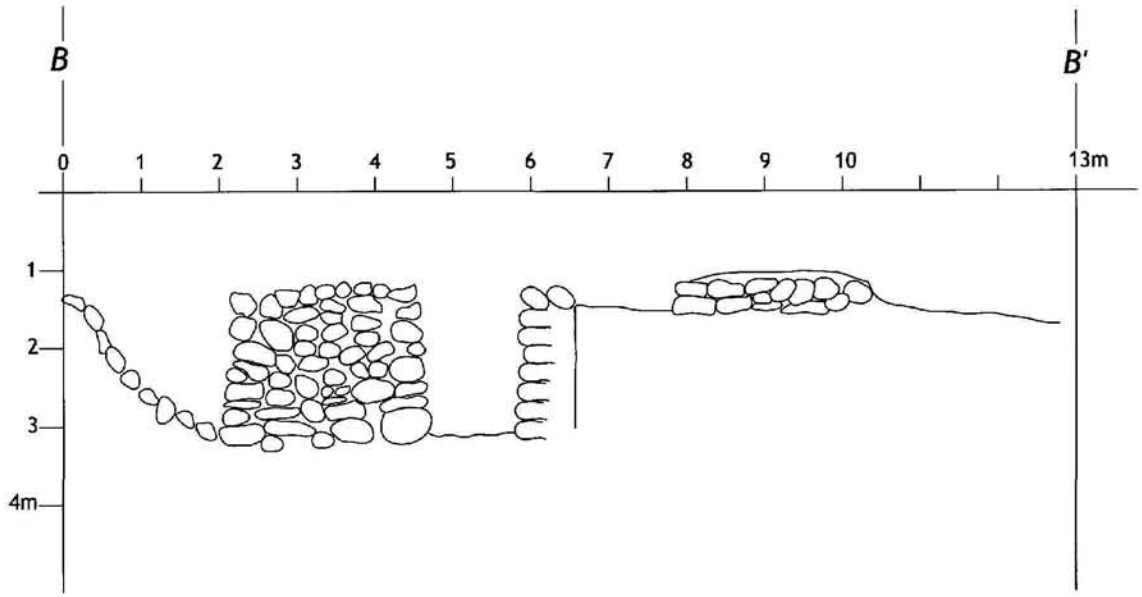


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Figure 6-8. Cross-section of large foundation with chimney crib, Furnace Flat North Smelter Site.

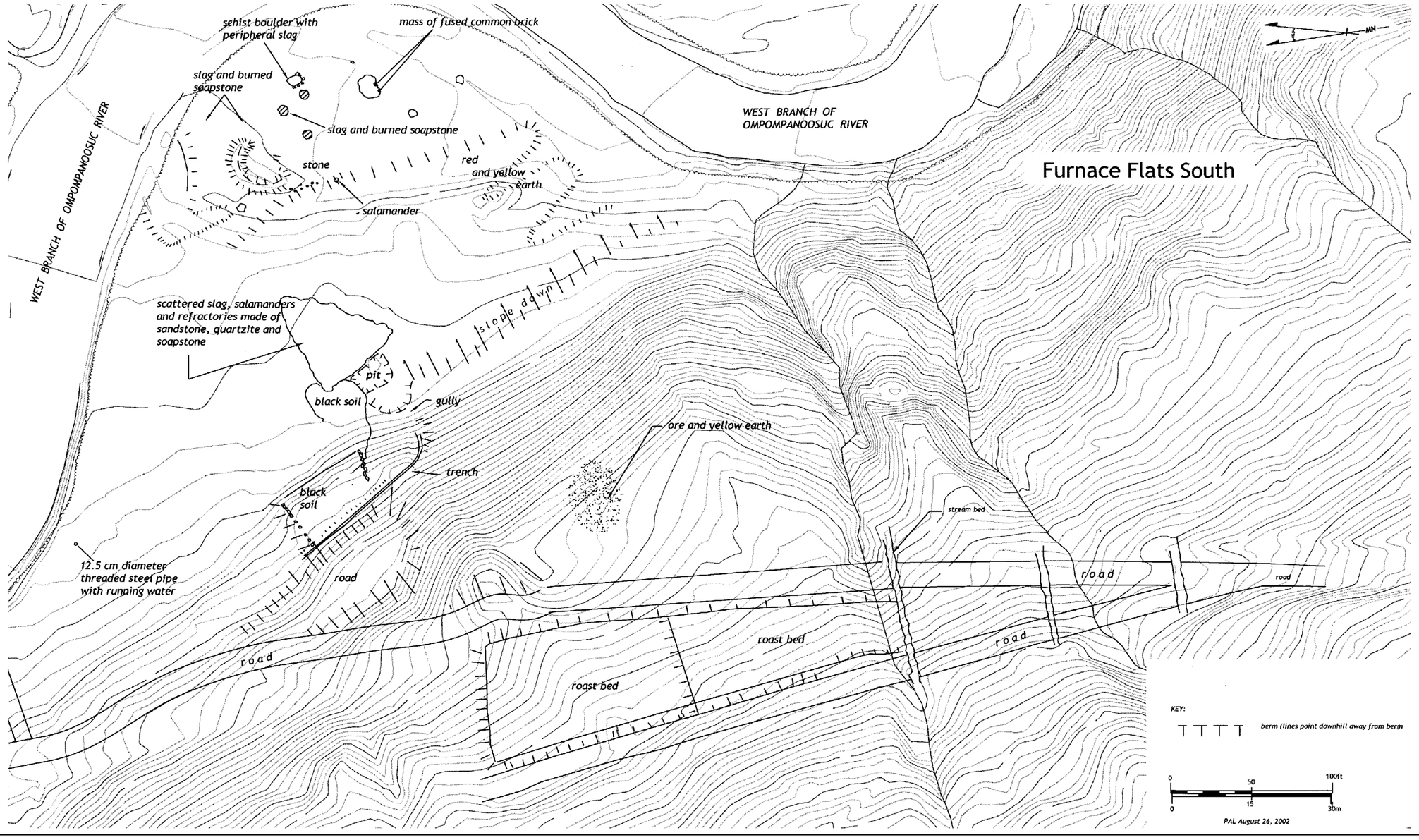


Figure 6-9. Map of Furnace Flat South Smelter Site.

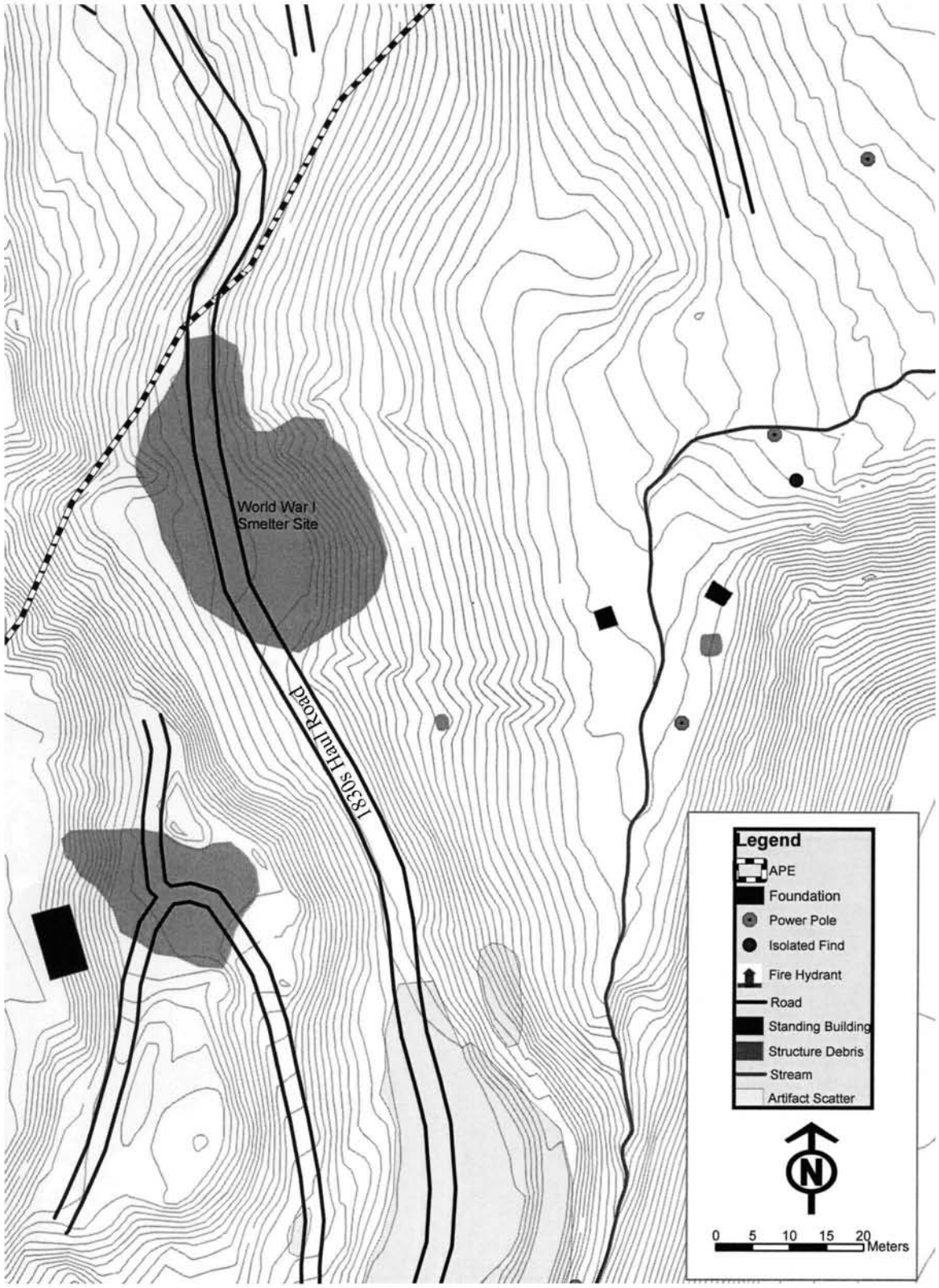


Figure 6-10. Map of World War I Smelter Site and environs.

profiles (see Figure 2-4). The most prevalent soil profile consisted of an 8-cm deep Ao, a strong brown (7.5YR 5/6) and dark gray-brown (10YR 4/2) mottled silty fill layer to 20 cm below surface (cmbs), followed by a second fill layer of very dark grayish brown (10YR3/2) sandy silt to 35 cmbs, and finally a stratum of greenish gray (Gley2 4/1) compact fine sandy silt with mica inclusion subsoil (Figure 6-11). The majority of other pits eventually reached the water table, which appears to be very high in this vicinity, or became rock impeded. Those pits that did not become rock impeded did include a substantial amount of stone, rubble, and concrete.

Cultural materials (n=30) recovered during the subsurface testing include brick, mortar, concrete, iron scraps, and slag from 0 to 40 cmbs in fill, demolition, and topsoil deposits (Table 6-2, see Appendix A). Slag, brick, mortar, and concrete were sampled because of the large number of these materials. Materials that were encountered in test pits, but not collected because of their size and depth, consist of two parallel pieces of angle iron found at the northeast corner of the terrace (TP-1), a hinged piece of iron at the northern end of the site (TO-2), and a concrete slab at the west edge of the terrace (TO-3). The pieces of angle iron were approximately 10-cm on a side and oriented north/south were encountered at 20-cmbs. The hinged piece of iron (Figure 6-12) was encountered within the first 10-cm and measured approximately 60-x-10-cm. The piece itself has a number of rivets and is firmly attached to a buried anchor by a pivot. A concrete slab was encountered at 21 cmbs in this same pit; it extended beyond the limits of testing.

Table 6-2. Summary of Artifacts from World War I Smelter Site by Stratum.

Stratum	Material				Total
	Brick	Concrete	Iron	Slag	
A	1				**1**
Demolition	9	1			**10**
Fill	3		5		**8**
Fill 2				8	**8**
Fill 2/B			2	1	**3**
Total	**13**	**1**	**7**	**9**	**30**

Tyson Mill Site (Completely Within APE)

The Tyson Mill Site is located north of TP 2 and west of TP 1 near where the 1830s haul road disappears under TP 1. It is the remains of the ca. 1899–1930 Tyson ore processing mill that once extended down the hillside (Figure 6-13) (GIS database #135). The site consists of a series of prepared terraces containing various pads and machine bases. The site is bounded by the electrical vault to the west, Tailings Pile 1 to the east, a dry-laid stone wall to the south, and a feature free area to the north. There are a number of timbers and pieces of concrete with slag aggregate scattered throughout the site, few if any of which are in situ. The only portion of the actual mill building extant is the 4-m stretch of dry-laid stone wall along the south margin of the site. The wall runs into the waste rock pile south of the site indicating that subsequent World War II era mining in the area has partially buried the Tyson Mill. The remainder of the visible evidence for the mill is in the form of a linear arrangement of internal machinery footings extending up the hill to the west. Beginning at the lower or eastern portion of the site there is a substantial 1.5-x-2-m slag aggregate concrete pier (Figure 6-14). The pier is divided into three sections with the eastern and western sections being raised. Threaded steel pins are located 10–20-cm from the edges of the two raised sections. Northeast of the pier is located a cluster of rail, an iron pin, concrete and brick as well as a concrete pad with raised lip, none of which may be in

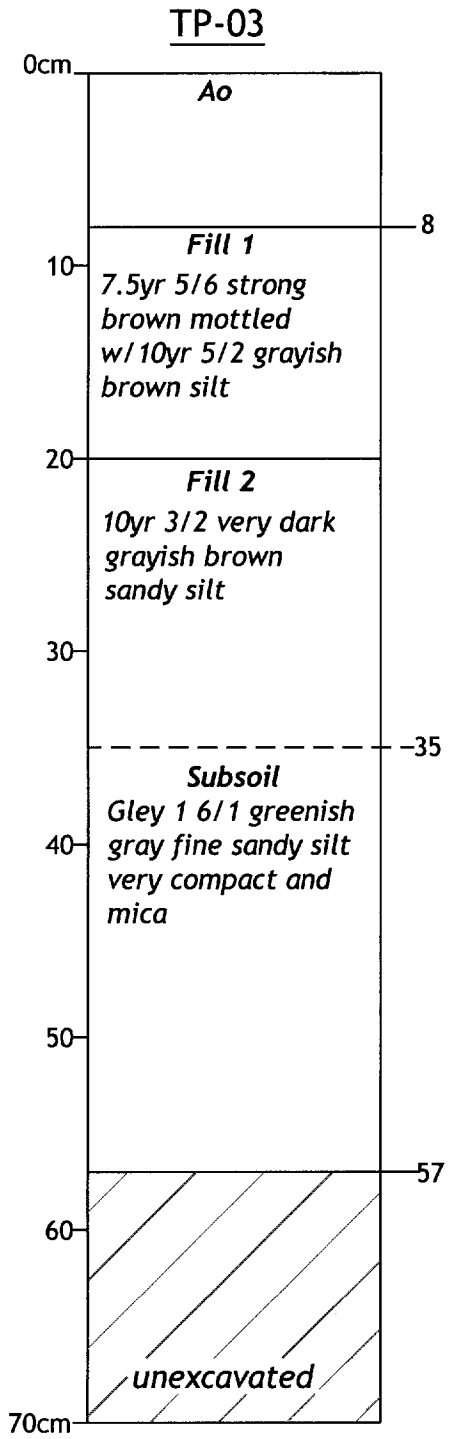


Figure 6-11. Representative soil profile excavated at the World War I Smelter Site.

Figure 6-12. Hinged iron artifact, excavated but not recovered from the World War I Smelter Site.

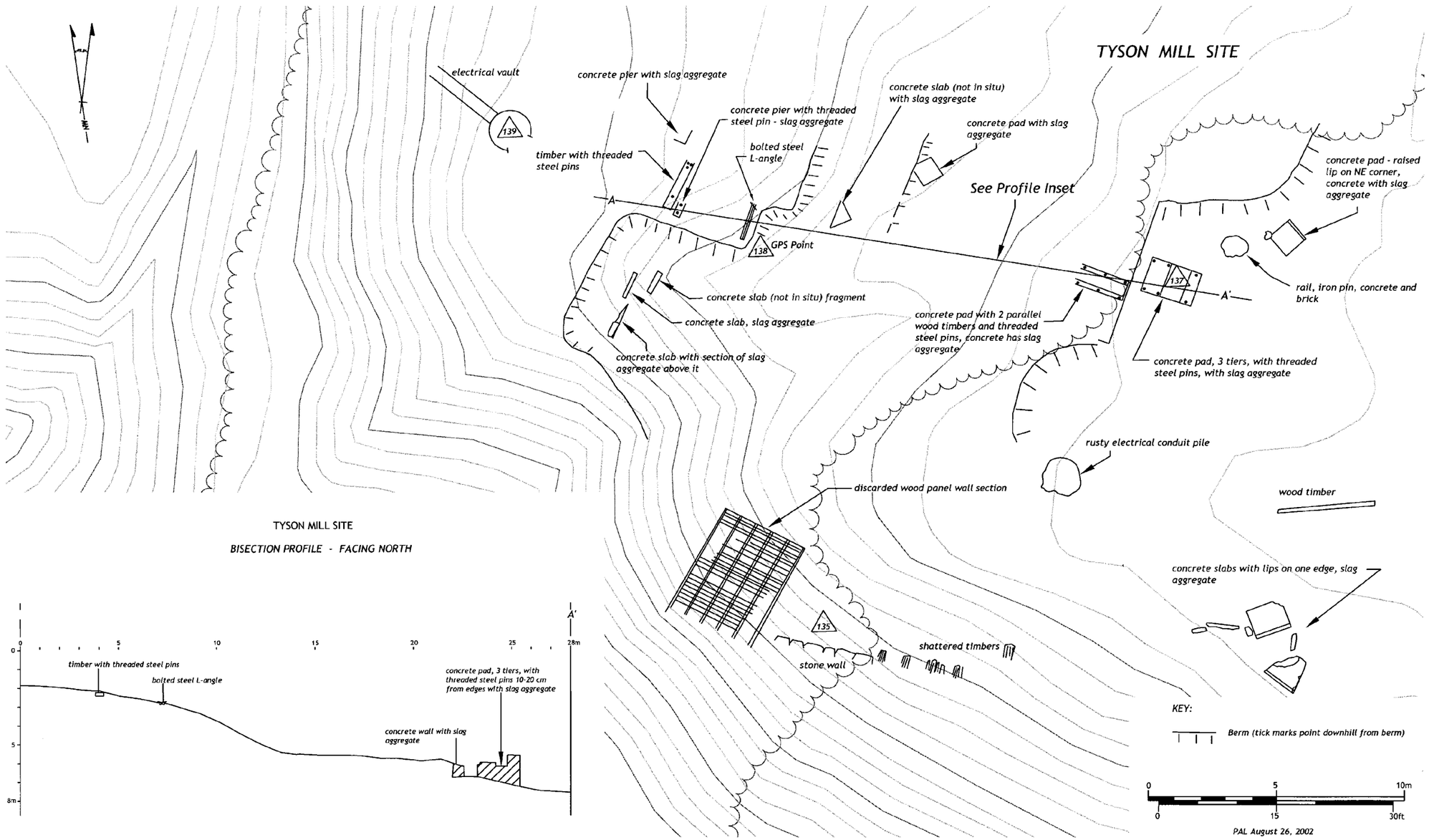


Figure 6-13. Map of Tyson Mill subsite with cross-section east-west across the site.

Figure 6-14. Concrete pier with slag aggregate used as a machine base at Tyson Mill subsite, note machinery mounting pins.

situ. West of the pier is a slag aggregate concrete wall that in conjunction with human landscaping creates the first of a number of tiers that define what was once the inside of the Tyson Mill. Lying on the ground surface atop this wall is a slag aggregate concrete slab with two parallel timbers (running east/west) affixed to it. Protruding from the timbers 10–20-cm are a number of threaded steel pins. Farther to the west, but still on the same terrace a 1-m square concrete pad is situated. Another pad of similar dimensions is located just up slope.

From there the site proceeds up another tier. Atop this tier are located a number of machine bases including a section of bolted angle iron, a slag aggregate pier with threaded steel pins, a slag aggregate pier without pins, and a timber with threaded pins in either end. The tier is indented at its south end forming a gully containing a series of fallen concrete slabs or sills. West of the other resources on this tier is the electrical vault (GIS database #139). The vault is a 1.5-m diameter, 2-m high, circular tower constructed of high fired, glazed, ceramic blocks. The door faces southeast and is framed by angle iron. Wires protruded into the vault from pipes leading into its upper section from a concrete conduit. The conduit runs northwest from the upper portion of the vault disappearing into the next tier up, which is the terrace that contains the administrative buildings for the World War II mine.

North of the Tyson Mill Site is a wide abandoned roadway that leads up the hill from the 1830s haul road to the administrative center. This road appears to have been actively used during the World War II period based on the near total lack of tree growth on it. It is unclear if the road predates that period. North of the road is the remains of an electrical substation measuring 7.3-x-3-m with transformer pits in the center and six cut power poles at equal intervals around the pad (GIS database #143). Other resources such as the flotation cells approximately 45-m northeast of the subsite, steel drums, and a wooden framed wall section south of the subsite (GIS database #136) date to the World War II period or later.

Subsurface testing in this area consisted of 12 test pits concentrated east of the main mill structure in a location where historic map and photographs indicated a blacksmith shop was located (see Figure 2-4). Similar to the World War I Smelter Site, the soil profiles encountered in these test pits greatly varied. In general, the profiles were highly stratified with a number of layers of tailings or tailings-like fill on top of burned earth and charcoal/coke layers (Figure 6-15). The depth of the tailings overburden tended to decrease with increased distance from TPs 1 and 2. The presence of burned earth increased in the northern test pits, while the presence of charcoal and coke was neither ubiquitous nor systematic. However, JTP-7 and TI-2 on the west side of the 1830s haul road may have been excavated into Tyson Mill related stratum. JTP-7 encountered two slabs of concrete, one at 10 cmbs and the other at 15 cmbs, with a piece of wood resting on top of the lower of the two (see Figure 6-15). TI-2 contained a layer of burned planks between 19 and 33 cmbs.

The majority of the cultural materials (n=46) recovered from these pits consist of industrial debris (concrete, brick, cinder, coke, slag, and flat glass) from 0 to 70 cmbs in tailings waste deposits (Table 6-3, Appendix A). Concrete, brick, slag, coke, and cinders were sampled because they occurred in such large quantities. Additionally, two electrical insulators, a single piece of coarse red-bodied earthenware and a number of bottle fragments were recovered from the area. Additionally, a number of pieces of iron stock and two steel ball crusher mill balls were excavated from pits at the northern end of the site. None of these artifacts have title dated temporal affiliations, with the exception of the ball mill balls, which date from the 1910s–1950s period.

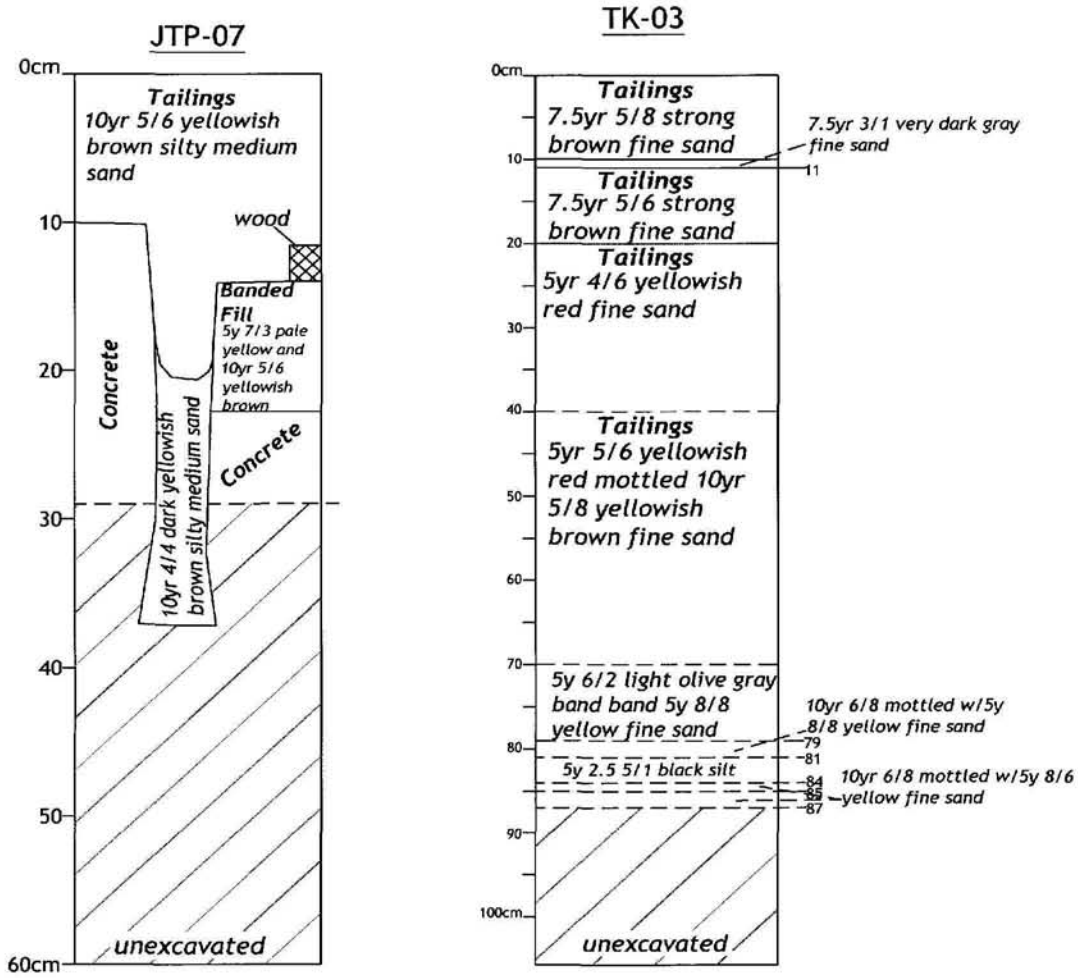


Figure 6-15. Representative soil profile excavated at the blacksmith shop site east of Tyson Mill.

Table 6-3. Summary of Artifacts from Tyson Mill Site by Stratum.

Stratum	Material													Total
	Brick	Concrete	Glass	Glass, Molded	Iron	Lithic	Metal	Porcelain	Redware	Slag	Textile	Unidentified	Wood	
Coke Layer												1		**1**
Fill		1	1			1		1						**4**
Fill 1	2		1	1										**4**
Fill 1/2			1											**1**
Fill 2			1	2					2				1	**6**
Tailings			9	2	1	2	1	1		4	3			**23**
Tailings 1				1										**1**
Tailings 2			1	1										**2**
Tailings 3			1		2									**4**
Total	**2**	**1**	**15**	**7**	**3**	**3**	**1**	**2**	**2**	**4**	**3**	**1**	**1**	**46**

Sargent Brook Smelter Site (Outside APE)

The Sargent Brook Smelter (1882–1890) is located at the western extreme of the Elizabeth Mine Site study area. The core of the site occupies two adjacent plateaus on the west side of Copperas Hill. The upper plateau contains a set of roasting stalls, a small foundation, an earth berm reservoir, and an earth-berm structure. The upper features are covered by piles of downed trees from recent logging. These features are situated in a line that terminates at the charging ramp. The charging ramp is located directly above two short stone walls, and a brick floor on the plateau below. A furnace hood and binder rods are also located in this area. The remainder of the second plateau consists of the slag deposit, much of which has been removed. There are two short parallel walls west of the slag deposit.

This subsite is linked to the core of the site by way of a tramway berm (GIS database #183) running from the north end of the north open cut west over the crest of the hill where it terminates at a set of threaded pins projecting from the ground and a number large ore piles (GIS database #249). From there a haul road now used for logging extends northwest into the smelter site.

Beginning from the south end of the site (and at the beginning of the smelting process), the smelter site includes a dispersed area of poorly defined roast beds (GIS database #378). The roast beds run in a northeast-southwest orientation and are characterized by discolored earth and patchy vegetation. At the southwestern extreme of the beds there are a number of channels that may have been intended to divert water away from the roasting ore, or may be the result of subsequent disturbances in the area. East of the roast beds is a small (3.5-m square) cellar hole of dry-laid fieldstone, and a possible quartz quarry (GIS database #374). The quarry, like similar resources along the ridgeline to the southeast, exploits a naturally exposed lens of quartz in the schist bedrock.

North of the roast beds along the haul/logging road is a raised foundation formed of earth berms littered with fine-grained, hand-struck firebrick (Figure 6-16) (GIS database #379). The foundation is 5-x-7-m with a maximum height above the ground of 1.5 m. Just past this foundation the haul/logging road forks with one branch running down the hill toward Sargent Brook, while the other branch continues north along the Sargent Brook subsite. Just inside the fork is a series of four stalls made of dry-laid stone (GIS database #380). These stalls are possibly copper matte roasting stalls, or some sort of storage structure. Beginning at the northwest corner of the stalls and running north a stone wall defines the edge of a plateau until it reaches a reservoir possibly used for blast furnace hearth cooling water (GIS database #384). The reservoir is a 9-x-6.5-m, 1.5-m deep earthen feature with an upright intake pipe with filter screen hardware, located off center at the bottom (Figure 6-17). Between the possible roasting stalls and the reservoir is a small cellar hole (GIS database #382). The dry-laid stone foundation is 5-x-2 m with a slight extension, possibly for a doorstoop, midway on its west side. Near the northeast corner of the reservoir there is a scatter of blast furnace hearth salamanders and hand-struck fine-grained firebrick.

North of the reservoir and foundation is the smelter building remains, which represent the industrial heart of this smelter site. This area begins with the charging ramp, which appears as a mound fill structure built of slag with timbers protruding from its face (GIS database #385). The timbers appear to be parallel to one another near the center of the ramp indicating that they are in situ or nearly so. Directly below the charging ramp are two sections of stone wall (GIS database #387). The eastern section has a corner at its south end while the western section runs directly into the charging ramp. Between the two walls rests the hood of the smelting furnace and a number of binder rods (Figures 6-18 and 6-19). The hood is a cone formed of riveted rolled iron.

The door is now missing but was formerly attached with strap hinges. The binder rods are of wrought iron with cast iron heads. It would appear that while the hood and rods are mobile they have remained very nearly in situ. Just north of the hood is a 1.7-m square brick floor (GIS database #386). An erosional gully has cut next to the floor revealing a cross-section of the subsurface construction of the floor (Figure 6-20). The floor consists of two courses of common brick beneath what may have been a capping course of firebrick. Below the common brick is a layer of rubble above a foundation layer of stone. The brick floor was evidently engineered to be a stable base designed to bear a significant load.

The area surrounding the brick floor is littered with common and fire brick, roof slate, coke fuel, crushed quartz flux (possibly mined from the uphill quarries), sheet metal, slag, and scrap iron. Surrounding the brick floor at a larger radius, especially to the north and east is the slag dump from the furnace (GIS database #388). In recent years this deposit has been mined for fill and road metal, but there is still a substantial amount of slag remaining including layers that show the pouring stratigraphy and the hemispherical impression of the shape of the slag bucket used to transport them from the furnace (Figure 6-21).

West of the furnace core are two parallel stone walls that may represent the foundation of an unidentified structure. Down slope from the walls is a timber crib dam. The dam consists of two large timbers lying in the stream bed. The upstream timber has a number of 0.75-m uprights mortised into it, which are in turn mortised into a top timber. The lower downstream timber has an angled timber mortised into each end. The angled timbers run into the upper timber of the upstream set acting as braces. The lower downstream timber also has a number of additional mortises along its top edge indicating possible reuse or the former presence of additional structure. The space behind the upstream cribbing is filled with large stones and rubble. Just downstream of the dam is a modern bridge constructed of a riveted sheet iron pipe, likely scavenged from elsewhere on the site, with rubble and dirt fill surrounding it to form the roadbed.

Tailings Pile 1 (Completely Within APE)

TP 1 is an approximately 455-x-490-m nearly flat, triangular plateau of mine waste that inundated the valley between Copperas Hill and Gove Hill during the twentieth century. The pile extends from near ground surface at its south margin where stone walls can be seen disappearing into the waste material to a height of approximately 80 m above the natural ground surface at its northern toe. The outer exposed crust of the waste rock has oxidized to a yellowish brown (10YR5/6). The pile is primarily formed of pulverized rock ejected from the mill as a slurry and deposited on the pile by launders supported by trestles after all of its marketable components had been removed. While plants do not naturally grow in such material, dumping of organic waste on the top of Tailings Pile 1 has resulted in a grassland environment with small trees. The launder trestles are still visible on the faces of the pile. The vast majority of the pile was laid down during the World War II through Korean War, though the Tyson and/or Heckscher mining campaigns may have deposited a small portion of it.

Tailings Pile 2 (Completely Within APE)

TP 2, located at the southwest corner of TP 1, is an approximately 150-x-140-m triangular, flat-top pile of mine waste deposited the same manner as TP 1. Similar to TP 1, TP 2 blends into the hillside along its southwest edge, but is approximately 40-m above TP 1 along its northeast margin. A deep trench is located along the southern section of the pile where the culvert used to confine Copperas Brook collapsed and the brook eroded the tailings pile. The predominate color

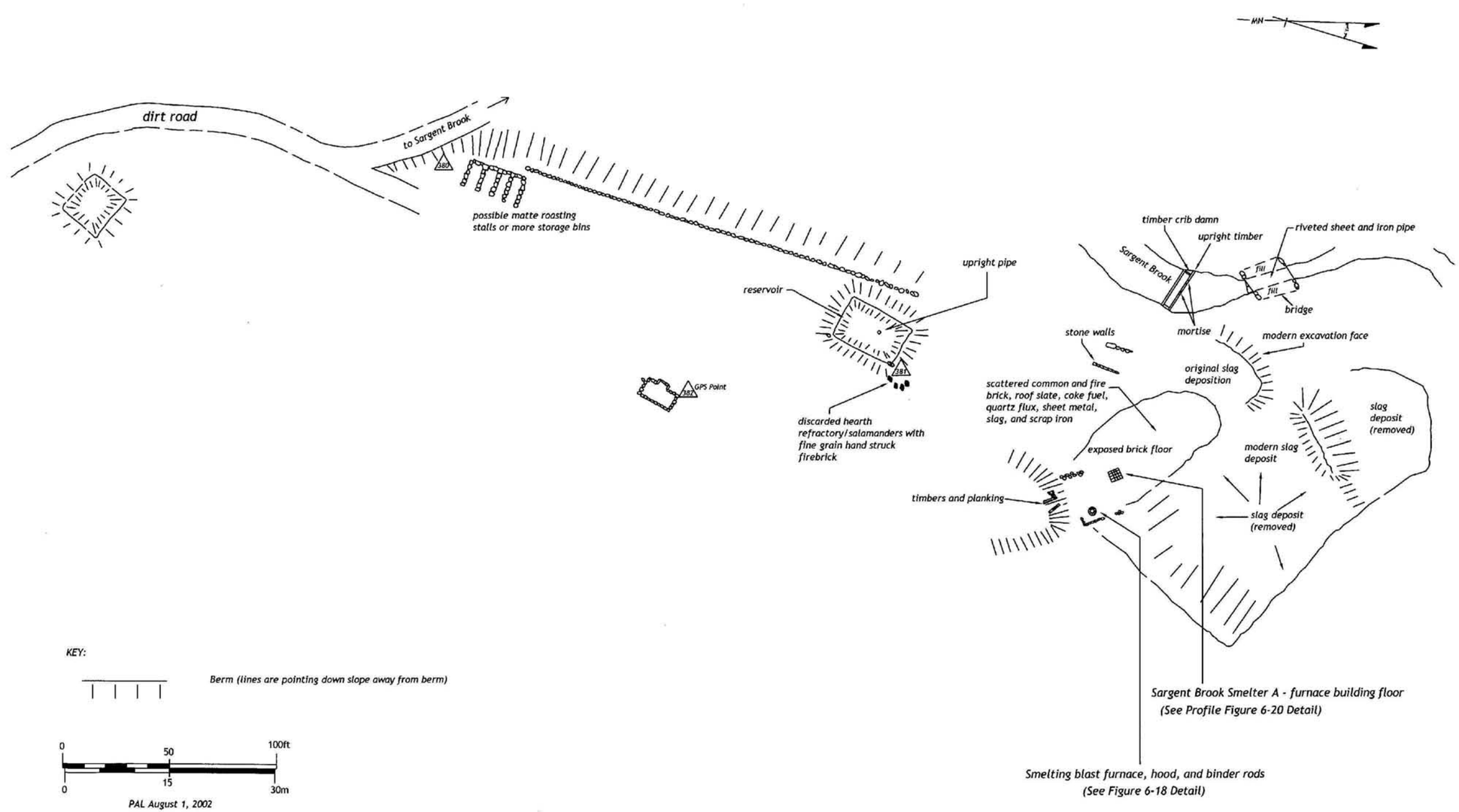


Figure 6-16. Map of Sargent Brook Smelter Site.

Figure 6-17. Upright pipe in reservoir at Sargent Brook Smelter Site.

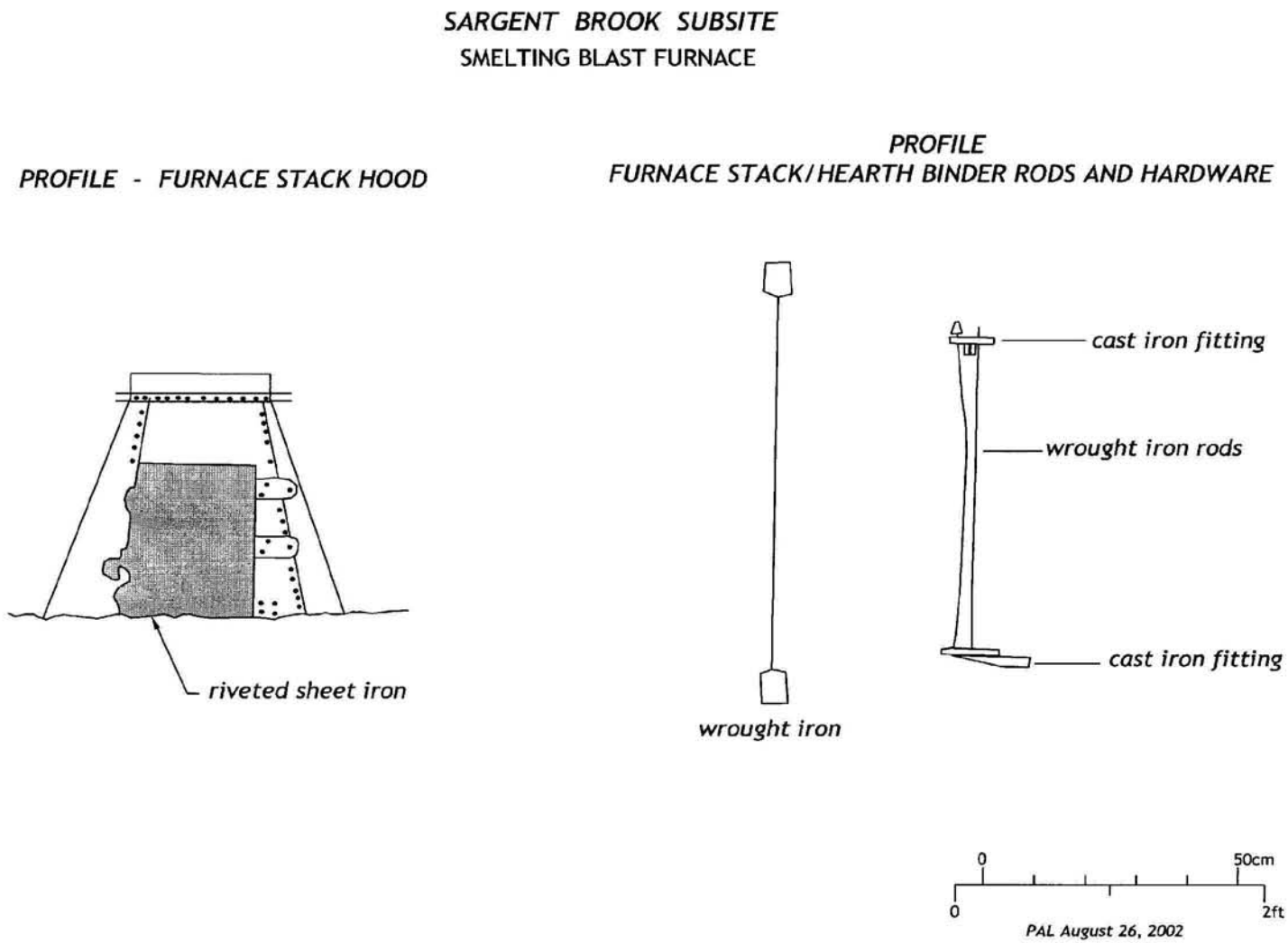


Figure 6-18. Smelter hood and binder rods identified but not recovered from Sargent Brook Smelter Site.

Figure 6-19. Smelter hood identified but not recovered from Sargent Brook Smelter Site

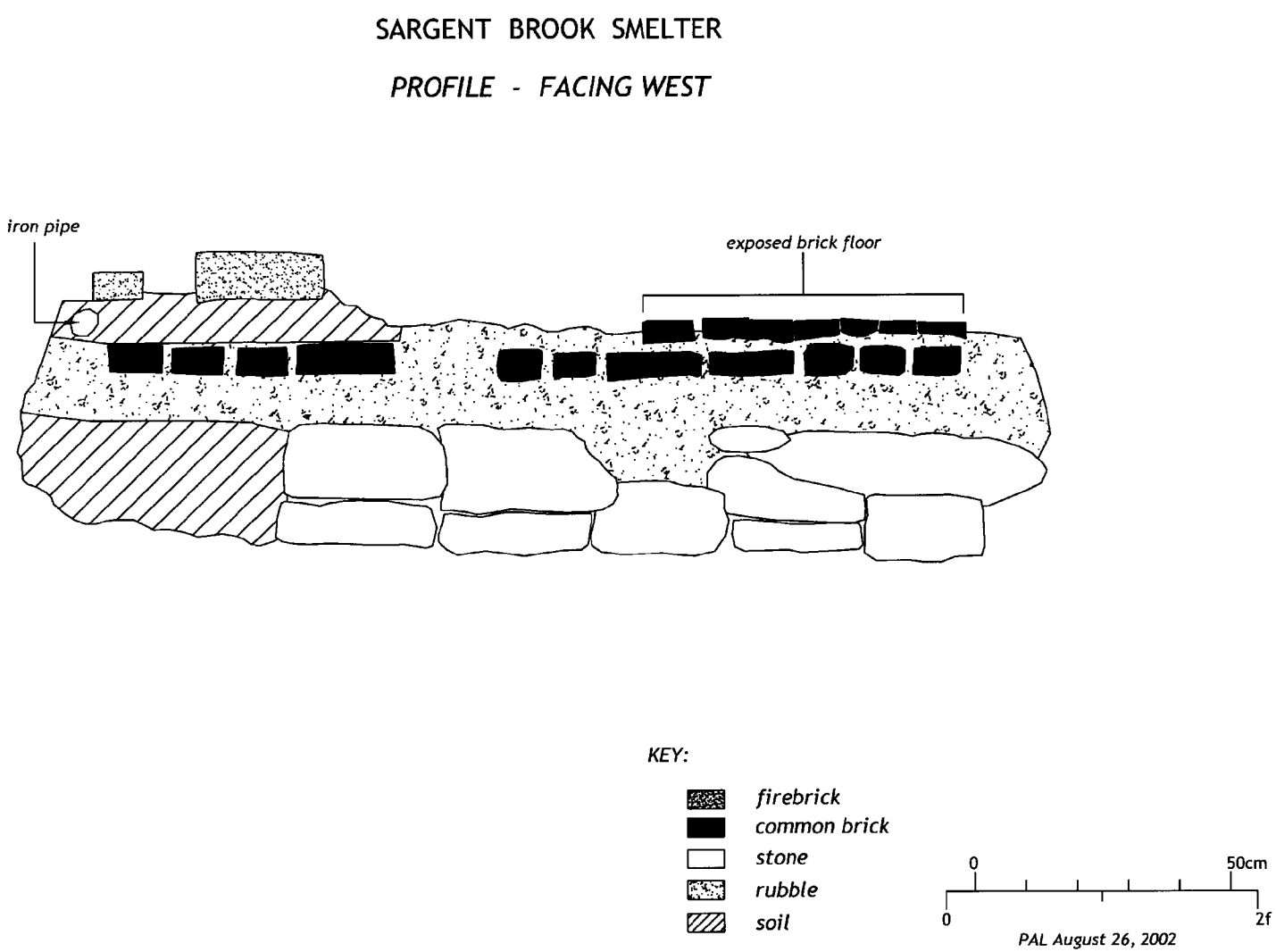


Figure 6-20. Profile of furnace building floor, Sargent Brook Smelter Site.

Figure 6-21. Partially machine excavated slag dump at Sargent Brook Smelter Site, note slag bucket molds in dump.

of the tailings pile is yellowish brown (10YR 5/6). The majority of TP 2 was deposited later in the World War II to Korean War era mining operations. However, a base layer of waste rock was likely laid down by the Tyson and Heckscher operations at the Tyson Mill.

Tailings Pile 3 (Completely Within APE)

TP 3 is one of the major cultural and technological landscapes included within the boundaries of the Elizabeth Mine Site (Figure 6-22, Back Pocket). TP 3 is a steeply sloped (25 percent grade), barren hillside that extends from the east edge of the North Open Cut to a series of terraces just west of Mine Road. The soils range in color from purple to red to yellow to black. The various soil colors, which tend to cluster into discrete areas, represent different human activities within the landscape. All of the soils evident today originated from material dug from the North Open Cut or from the underground workings that was deposited on the hillside either as waste rock or for further processing. The yellow soils that overlay much of the hillside appear to represent now-decayed rock that was extracted from the bedrock, sorted from the sulfide ore, and deposited as waste rock. The red and deep orange soils appear to be the remains of roasted and leached ore associated with the copperas process. The heaps of black and dark purple soil located at the east end of the tailings pile appear to be burned ore fused from over roasting.

Spread throughout the hillside are a number of features including timber arrangements, stone walls, foundations, and prepared surfaces. Associated with the leaching of the ore are significant number of exposed and partially buried timbers and planks (Figure 6-23) (GIS database #3195, 198, 211 etc.). These large pieces of wood are dispersed across the hillside in a number of broken linear patterns. These features appear discontinuous because they are only clearly evident in the erosion gullies that score the hillside. They are not visible where this red ground surface is covered by ca. 1880s Tyson-era waste rock and World War II-era talus. However, based on the ubiquity of these resources in the areas where they are exposed, the wood preserving qualities of the soil, and their organized distribution on the hillside it can be inferred that the timber and planking structures extend across the entire landscape. These wooden features take a number of forms on the hillside ranging from simply the ends of planks and timbers protruding from beneath the roasted ore to large sections of arranged timber and stone cribbing supporting perpendicular timber floors. The timbers are roughly circular in cross-section with approximately 30-40-cm diameters, and run east-west (perpendicular to the slope of the hill). The planks are approximately 7-cm thick, 25-cm wide, and of varying lengths. It is difficult to distinguish the stones that have washed into the gullies around the cribbing from those that were intentionally placed beneath the timbers. In some cases it appears that the timbers were placed directly on bedrock. No fasteners were noted in the cribbing. Another soil retention feature on the TP 3 landscape is a retaining wall west of Copperas Road one-third of the way up the hillside. This 15-m stone feature runs along the hillside and is represented by a number of discrete clusters of stones. Additionally, on the lower portion of the hill there are the remains of a number of timber ore corrals. These features consist of semi-circular arrangements of upright timbers projecting from the soil. In the northern portion of the site, just upslope from Copperas Road, a short section of bedrock is exposed in an erosion gully, the bottom of which is partially lined with a 1-x-3-m area of common brick laid in a chevron pattern (Figure 6-24) (GIS database #232). Similarly, another possibly prepared surface is located 50-m northeast of the brick courses (GIS database #206). This feature consists of timber and plank crib resting directly on blue-gray C soil clays, implying that the overlying soils had been excavated away prior to the construction of the cribbing.

Figure 6-23. Representative wooden structure, Tailings Pile 3.

Figure 6-24. Brick-lined channel, Tailings Pile 3.

TP 3 also encompasses a number of building foundations and structural remains. The northernmost of these, situated just west of, above, Copperas Road across from the North Village, is an "L" shaped section of a low dry-laid fieldstone foundation measuring 4-x-7 m. Inside the foundation there is a scattering of wrought iron fittings and plates as well as a broken drive wheel (Figure 6-25). East of the foundation is a wet depression representing either a spring or a septic outflow. South of this foundation are two short sections of wall partially imbedded in the hillside (GIS database #228). The eastern of these walls appears to be a retaining wall designed to support the western wall that likely represents a foundation. Directly south and slightly upslope from these sections of wall is a third foundation defined by sections of wall at its northwest and southeast corners. The walls are constructed of large stones, apparently waste from mining operations, and represent a 7-x-10-m building. At the southern end of the structure the east wall continues past the south wall, suggesting that the south wall may in fact be an interior wall and the true southern end wall is no longer extant. A retaining wall similar to that, which supports the middle foundation, is evident to the east. To the east of these two foundations is a scatter of stone, light gauge rail, timbers, and planking. To the west a stone wall extends well up the hillside. West of the southern foundation and just south of the stone wall is a gully that may represent the collapsed mouth of the upper adit (GIS database #233). The gully 5-m long, 1.5-m deep does not appear to be a natural erosional feature. Just east of the gully is a flat area containing a number of low stone walls. Other indications of foundations on TP 3 include the presence of a brick scatter near the center of the subsite (GIS database #210) and a timber scatter near the North Open Cut (GIS database #205). Finally, a 4-m section of stone wall is visible, projecting from beneath the large pile of yellow Tyson period waste rock near the bottom of the hillside (GIS database #223).

The North Open Cut itself is a 295-x-45-m chasm excavated north/south along the ridge of Copperas Hill. Excavation of the cut began with the early copperas works at the site in 1809 and continued intermittently throughout the history of the site, though additional mine works were driven north from the cut to north of the West Branch of the Ompompanoosuc River. The cut took on its current appearance during the World War II era when the hanging wall was blasted out and the cut was widened to near its current dimensions. Collapses of the walls during modern times, attested to by the presence of fallen rubble at the bottom of the cut, have increased its width. Despite the collapses, mining features are still visible in its walls, including at least one small adit that intersects the west wall of the cut and the large tunnels that originate from its north end. Additionally, the manway, located just beyond the north edge of the cut is an open access point to the mine workings below.

Located at the bottom of the hillside, at the eastern extreme of TP3, is the Upper Copperas Factory and its associated Copperas Brook features (GIS database #1066). The features within Copperas Brook appear to have been designed to channel the flow of the brook, likely as a means of transporting copperas liquor on its course down the hillside (Figure 6-26). The most substantial wooden construction in this part of the site is a massive (20-m long and 1.5-m in diameter) round timber with other shorter timbers and sections of planking abutting it, and additional upright timbers protrude from between them (GIS database #224). A second large timber with attached planking lies north of the massive timber at an oblique angle. Whether these timbers are for copperas liquor storage or represent a structural foundation is unclear. The remaining clusters of timbers are in the streambed proper. In general these take the form of timber cribs supporting plank floors. Most of these features have been partially buried and damaged because of water flow. However, there are a substantial number of in situ parallel timbers and at least one 1.5-x-3-m section of in situ planking. Additionally, the level of preservation in the streambed is

Figure 6-25. Possible line-shaft belt drive wheel recovered from blacksmith shop foundation on Tailings Pile 3.

TAILINGS PILE - 3

BISECTION PROFILE - FACING NORTHEAST

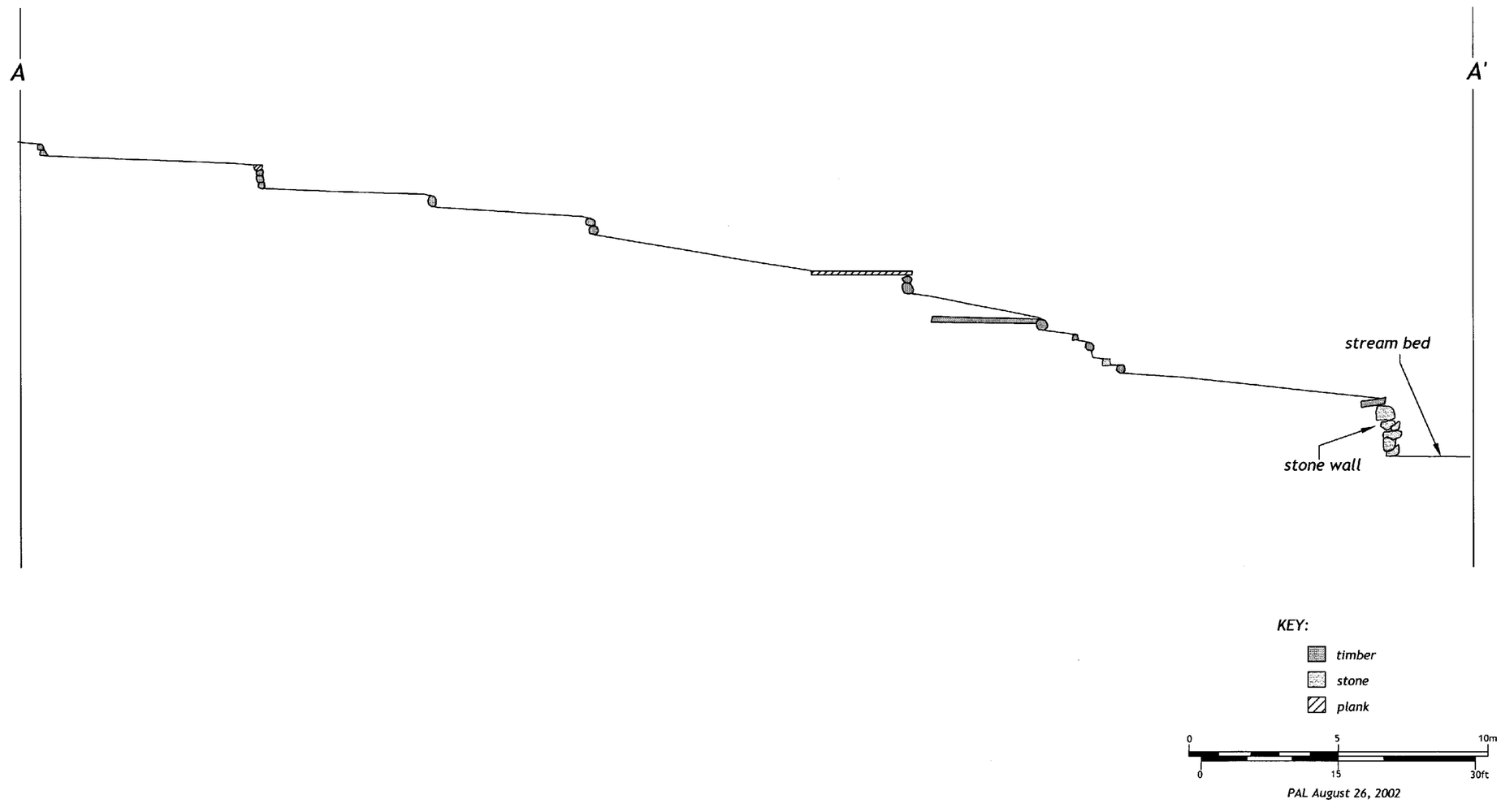


Figure 6-26. Cross-section of chanelized Copperas Brook, lower Tailings Pile 3 (see Figure 6-22 back pocket for plan view).

impressive with some timbers retaining adze marks and evidence of mortises still apparent in upright timbers. Near the eastern extreme of the site are two drops in the bed of the brook. The westernmost of these is an obviously engineered feature consisting of a 1.5-m boulder retaining wall with timbers and planking lying on top. The downstream, eastern, drop is less clearly engineered. It appears to be a 1.8-m fall with in situ timbers on top and a number of other possibly in situ timbers in and around the drop.

Just north of Copperas Brook is the Upper Copperas Factory itself. The clearest evidence of the factory is at its southwest end, which consists of a massively built 6-m long stone wall with 90 degree corners. Along the long side of the foundation, 19-m from the southeast corner of the factory, are located an upright and fallen cast iron stanchion (Figure 6-27), and a section of upright rail (ca. 1850s). The factory is built into the hillside with the southeast corner rising 2 m above the ground and the southwest corner at approximately ground level. Beyond these corners it is difficult to distinguish the factory foundation from the other retaining walls in the area, as the walls have been jumbled and are washed out in a number of places. However, 29-m north of the wall is a very distinct bend in the wall possibly representing the end of the copperas factory. The wall then extends for an additional 21 m. East of the factory and running parallel to it, including the bend, is a terrace with evidence of a retaining wall along its eastern margin. This terrace possibly represents a road. A second, less well-defined flat area is located directly east of the terrace. The stone walls and terraces of the Upper Copperas Factory run directly into the Office area (see North Village below).

Located west of the North Open Cut, just below the crest of Copperas Hill is a chevron shaped dam and associated reservoir (Figure 6-28) (GIS database #914). The two wing walls of the dam, constructed of dry-laid field stone measure approximately 7-m each and stand 0.75-m high. The reservoir is 17-x-11-m in plan. A small stream issues from the reservoir and runs down slope through an apparently natural course toward the North Open Cut. A northeast/southwest oriented stone wall breaks on either side of the reservoir indicating that the reservoir was likely excavated after the wall was constructed, or possibly that the wall was built around the reservoir.

Archaeological investigations on TP 3 were limited to three test pits placed in the foundations west of Copperas Road, one test pit in the brick scatter west of Copperas Road, and five test pits in the Upper Copperas Factory area (see Figure 2-4). The testing in the upper portion of the hill, near the documented blacksmith and cob shops, focused on the southern two foundations. The cultural material (n=29) found in these pits from 0 to 60 cmbs in tailings, roasted ore, and waste rock deposits was limited to window glass, brick, and industrial by-products (see Appendix A and Table 6-4: Transect E). None of these pits reached natural soils below the roasted and leached ore overburden indicating that the foundations may have been built on top of existing

Table 6-4. Summary of Artifacts from Upper TP-3 by Excavation Unit.

Unit	Material							Total
	Brick	Glass	Iron	Lithic	Mortar	Slag	Wood	
JTP-01	3		5	1				**9**
JTP-02	1				1		4	**6**
TE-01	1	5						**6**
TE-02	3	1		3		1		**8**
Total	**8**	**6**	**5**	**4**	**1**	**1**	**4**	**29**

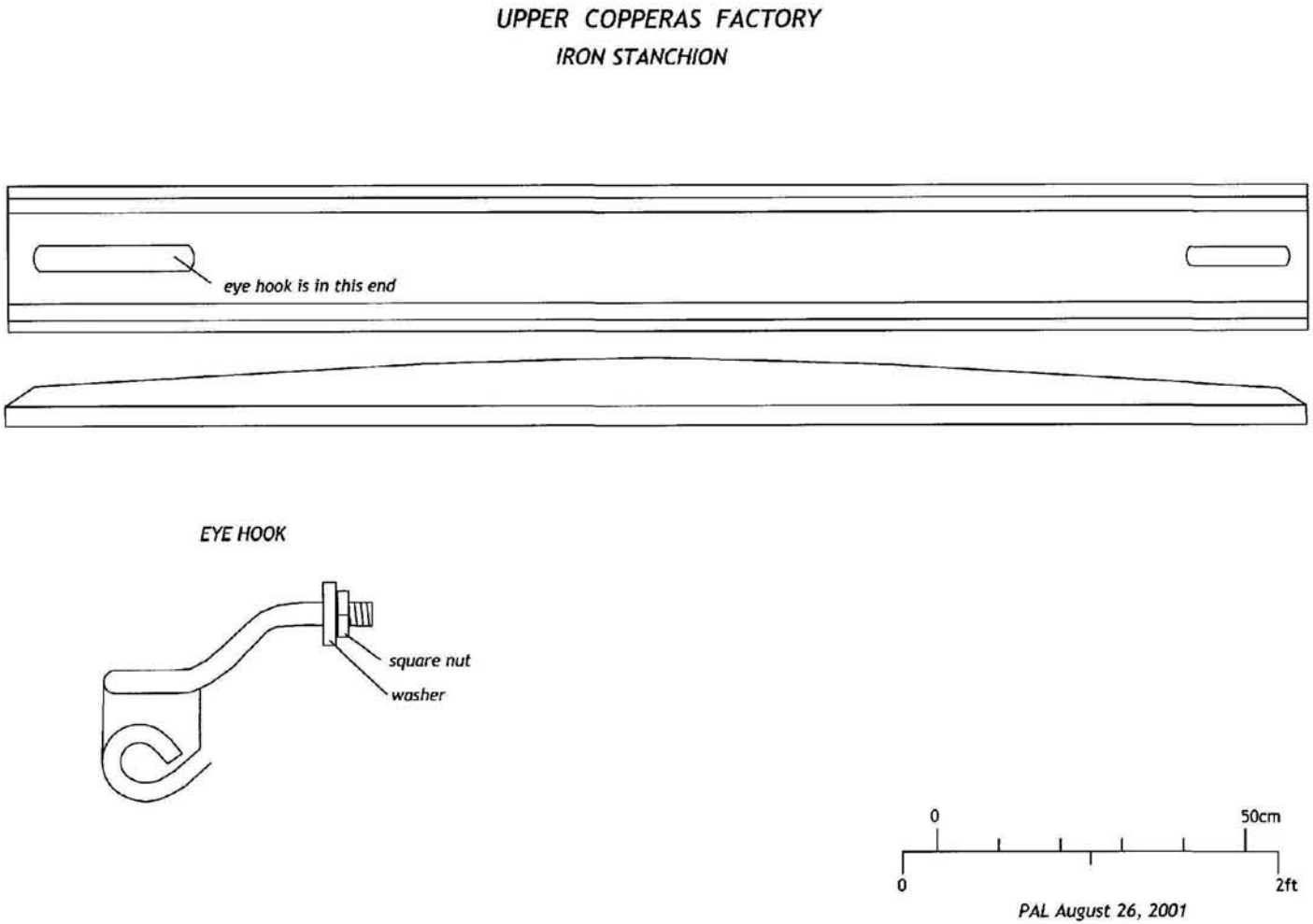


Figure 6-27. Iron stanchion, Upper Copperas Factory at Tailings Pile 3.

Figure 6-28. Chevron shaped dam and associated reservoir, west of the North Open Cut.

mine waste. However, JTP-2 (Figure 6-29) was excavated through 80-cm of roasted ore before reaching two strata of different colored roasted ore that overlaid a plank floor, likely a leach bed. The only cultural materials recovered from this pit were brick and mortar, both of which were sampled.

In the vicinity of the Upper Copperas Factory test pits were placed west of the foundation, within the foundation, and on both terraces east of the foundation, in addition to one pit on the first terrace north of the foundation. The majority of these pits were excavated through fill layers that appear to be the result of human activity and erosion from upslope (see Figure 6-29). However, JTP-24 encountered a plank at 88 cmbs (see Figure 6-29), and JTP-27 unearthed a burned wood plank feature at 60 cmbs. JTP-26 (see Figure 6-29) contained evidence of the demolition of the copperas factory in its upper stratum and a jumble of planks between two layers of finely laminated soils beginning at 58-cmbs. The laminated soils imply that this portion of the site was routinely flooded, likely by Copperas Brook, depositing thin layers of sediments. A total of 62 cultural materials was recovered from 0 to 70 cmbs in various fill and disturbed subsoil deposits in these test pits (see Appendix A). The majority of the materials consists of common and fire bricks (stamped 'Boston Firebrick Company'), some handmade, which were sampled, and flat glass (Table 6-5). Additionally, JTP- 25 produced one yellow ware ceramic sherd, and JTP-28 yielded a substantial amount of American stoneware and earthenware.

Table 6-5. Summary of Artifacts from Upper Copperas Factory Area by Excavation Unit.

Unit	Material								Total
	American Stoneware	Brick	Earthen-ware	Glass	Iron	Mortar	Slag	Yellow-ware	
JTP-24		4			1				**5**
JTP-25				2				1	**3**
JTP-26		6				3			**9**
JTP-27		5							**5**
JTP-28	4	33	2				1		**40**
Total	4	48	2	2	1	3	1	1	**62**

Lower Copperas Factory (Completely Within APE)

The Lower Copperas Factory is located just south of the bend in Mine Road and consists of a large stone foundation and associated features (Figure 6-30) (GIS database #1065). The factory is 40-m long by 5.8-m wide the long north and short west walls still standing and there are a number of artifacts and a concentration of structural debris throughout the area. The foundation is constructed of large fieldstones and boulders with occasional tabular quartzite stones used to give the structure integrity. These stones are particularly evident in the corner quoins in the west wall of the foundation (Figure 6-31). Similar to the Upper Copperas Factory the Lower Factory is built into the hillside with the north edge extending 2-m above the ground while the south end is at ground level. Within the factory there are a number of divisions. The first division is a transverse stone wall 9-m from the west end of the building that defines the edge of a slight platform. The platform is covered with a scatter of common and fire bricks with the common bricks extending south of the foundation. Another transverse wall, located 24.5 m from the west end of the building defines the second division of the building.

The third section of the structure is essentially the center of the building. In this space there are two standing cast iron stanchions nearly identical to those found at the Upper Copperas Factory, a

1.04-m long iron tie rod, and a brick scatter. To the east of the center section is the fourth division of the building. This division is formed by a 2-x-2.4-m depression lined with stone on its south and west margins. Within the depression there is a cast iron arch and associated support with affixed bricks (Figure 6-32). Both pieces show reddening, melting and flaking, evidence of having been repeatedly exposed to high heat. A second 1-x-1.6-m depression is located just east of the depression containing the arch. The final section of the building consists of the southern end. Located in this area is a scattering of rolled wrought iron plates and cast iron chutes (Figure 6-33). The chutes have brick attached to the outside of the chute itself, perhaps as insulation, and a sliding door at the outflow of the chute. There is no clear east end wall of the factory. However, just past the chutes the stonework bends slightly before ending in a berm that continues at the same arc. It is likely that the building ended at the bend if not the end of stonework.

Outside of the building are a number of associated features. East of the factory, leading up to or perhaps into it, is a dirt road that connects the factory to the East Village. North of the factory, between it and Mine Road are two stone walls (GIS database #847). The closer wall is parallel to the foundation at a distance of 4 m. The outer foundation runs at a slightly acute angle to the foundation at a distance of approximately 6.5 m. The near foundation is partially buried by one of the many large piles of brick that litter the area north of the factory. It is unclear if these piles represent waste from the factory or are the result of later activity. No subsurface testing was conducted in the subsite, but a fire-brick and iron bracket were surface collected from the visible foundation remains. The iron bracket appears to have once held wood together.

To the west of the copperas factory foundation is the Inter-Copperas factory area. At distances of eight and 30-m west of the copperas factory are two discrete stone on stone features (GIS database #63). It is unclear if these are the remains of foundations or not. North and west of the stone features are a series of six mounds and square berms, three of which have depressions in their centers (GIS database #65, 67). These features are arranged in no particular order and some are more clearly defined than others. However, they are the result of human activity in the area. It is unclear if they are associated with the copperas process or some other aspect of the site. No test pits were excavated at the Lower Copperas Factory, but a tree fall in the immediate vicinity has brought up quantities of brick and fire-reddened earth.

Old South Mine (Outside APE)

The Old South Mine, located to the south of TP 3 outside of the project APE, was not recorded beyond the GPS survey. The most notable features of this area are the two open cuts oriented roughly north/south along the ore body. The larger cut is 120-x-22-m and the smaller located less than 5 m to the southeast is 36-x-10-m (GIS database #415, 418). Both are approximately 10 m deep with water at the bottom. The larger cut includes a number of native rock pillars at its southern end that serve to support the roof of the cut as it plunges underground following the ore. To the east of the open cuts are a number piles and fans of waste rock. Additional evidence of the extractive landscape are the prospect pits and trenches and the roads that litter and interlace the surrounding area (GIS database #402-404, 411, 414, 417, 427, 566, 567, 426-429). The prospect pits are located primarily to the north and south of the cuts while the roads encircle the entire complex. A collapsed adit opening is located 33 m south of the smaller cut providing evidence of further underground workings (GIS database #412). The remains of a shaft are located just west of Copperas Road 30 m north of the larger cut. Also present are a short (4 m) section of dry-laid

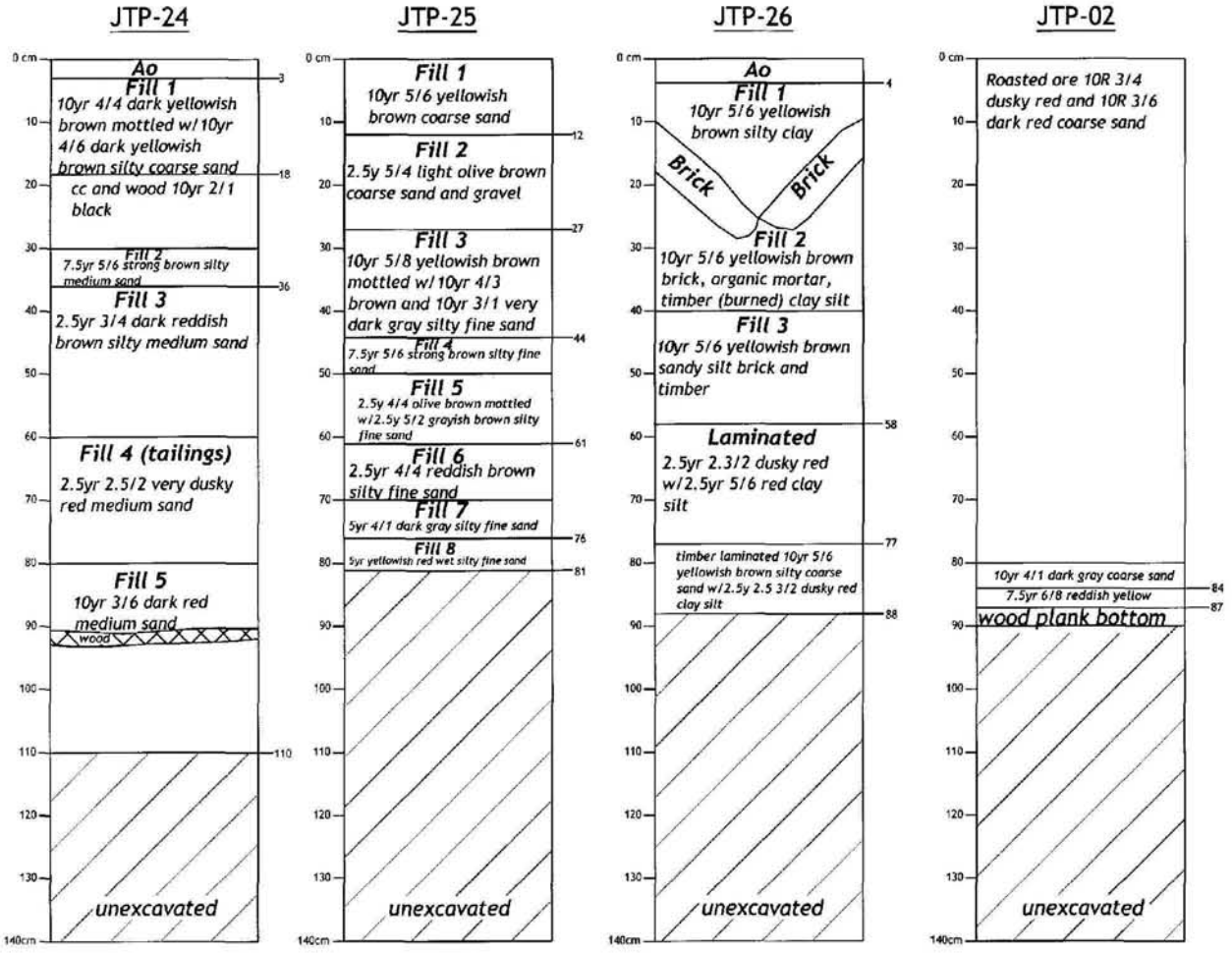


Figure 6-29. Representative soil profiles excavated at the Upper Copperas Factory, Tailings Pile 3.

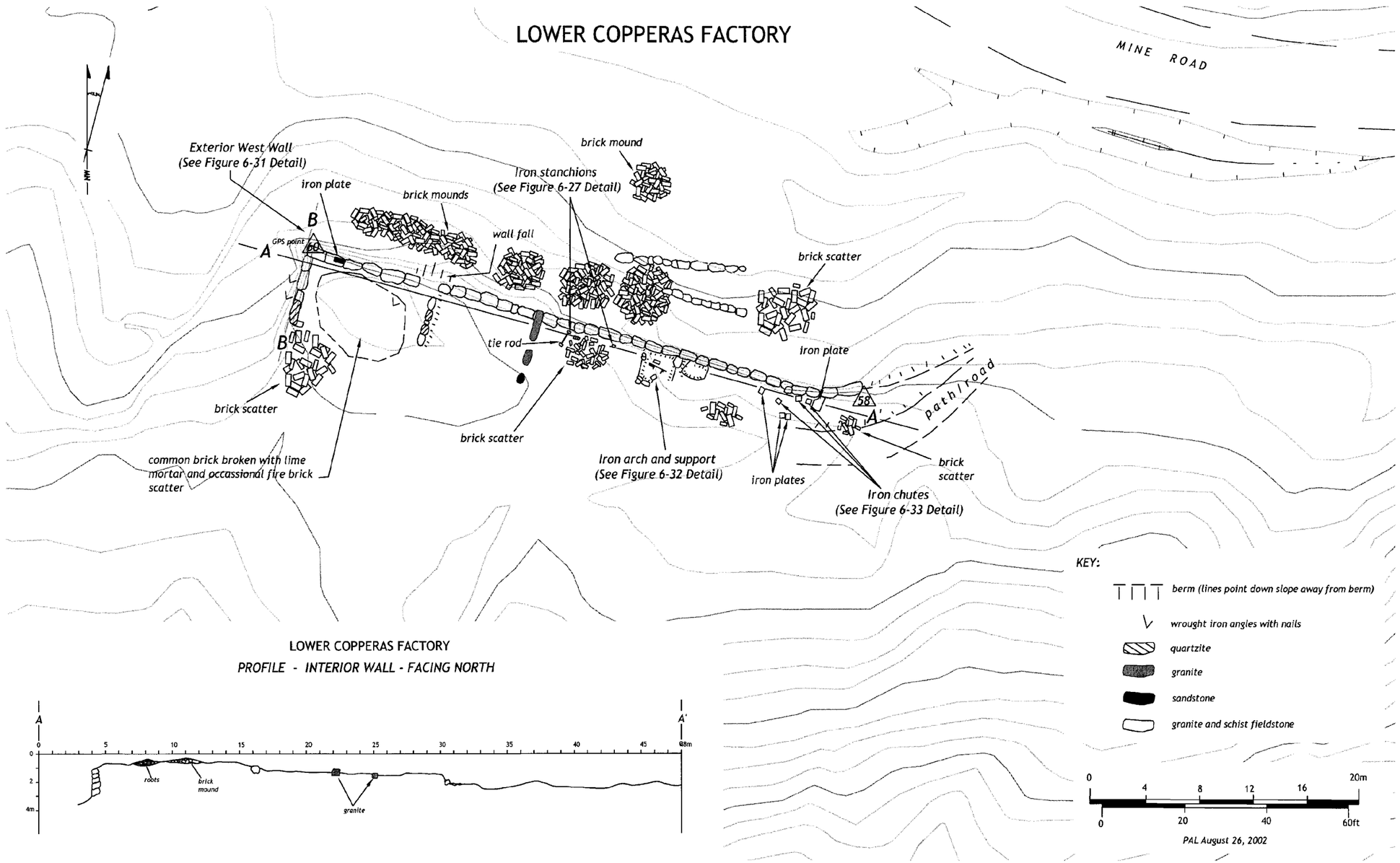
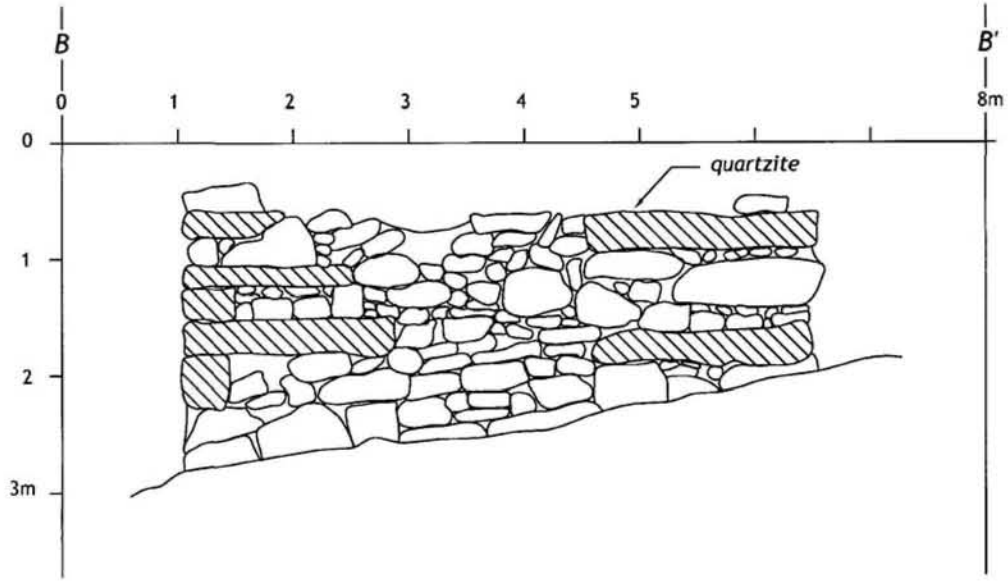


Figure 6-30. Map of Lower Copperas Factory and inter-copperas factory resources.

LOWER COPPERAS FACTORY

PROFILE - EXTERIOR WEST WALL - FACING SOUTHEAST



PAL August 26, 2002

Figure 6-31. West wall of Lower Copperas Factory.

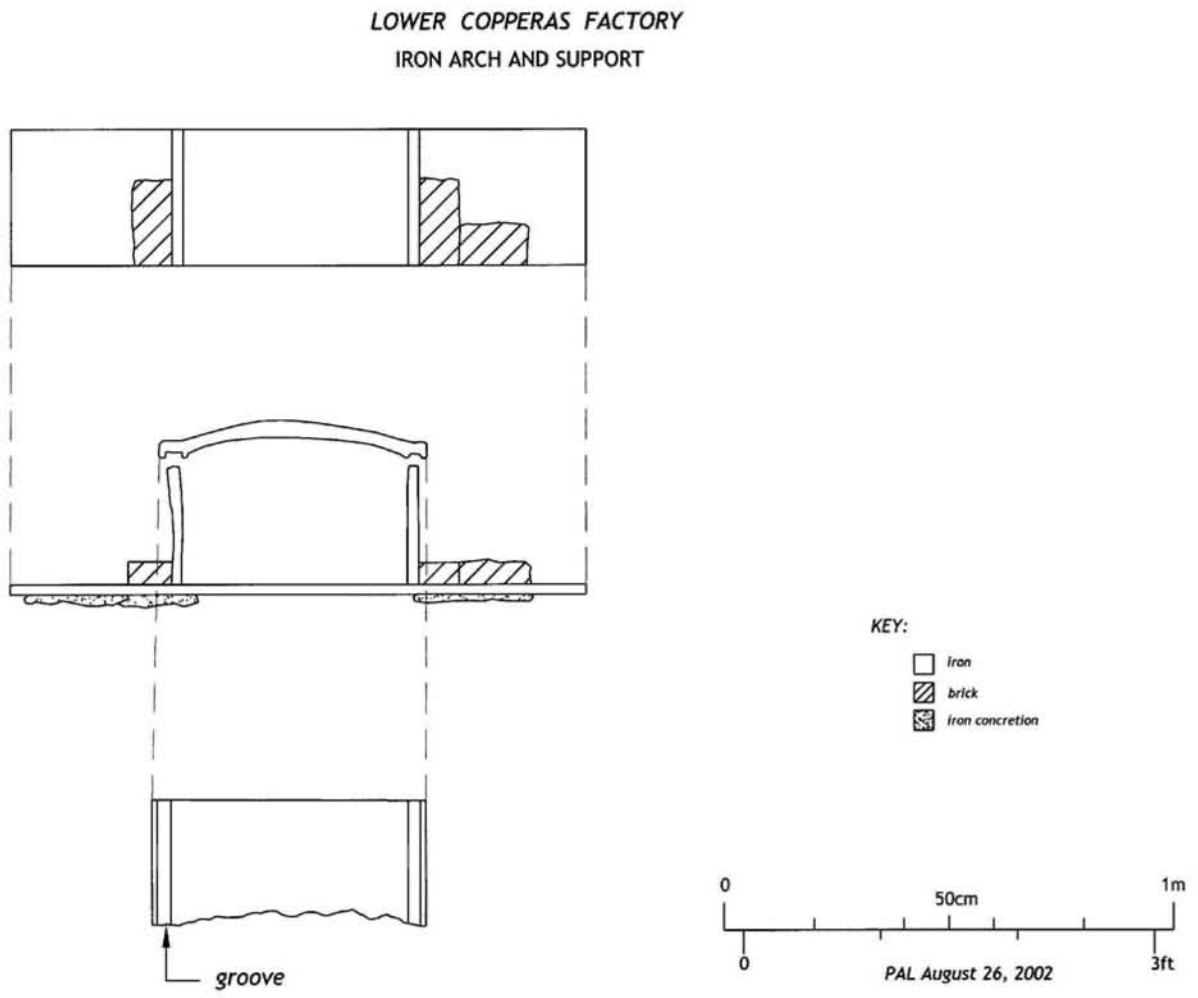


Figure 6-32. Iron arch and support identified but not recovered from central depression of Lower Copperas Factory.

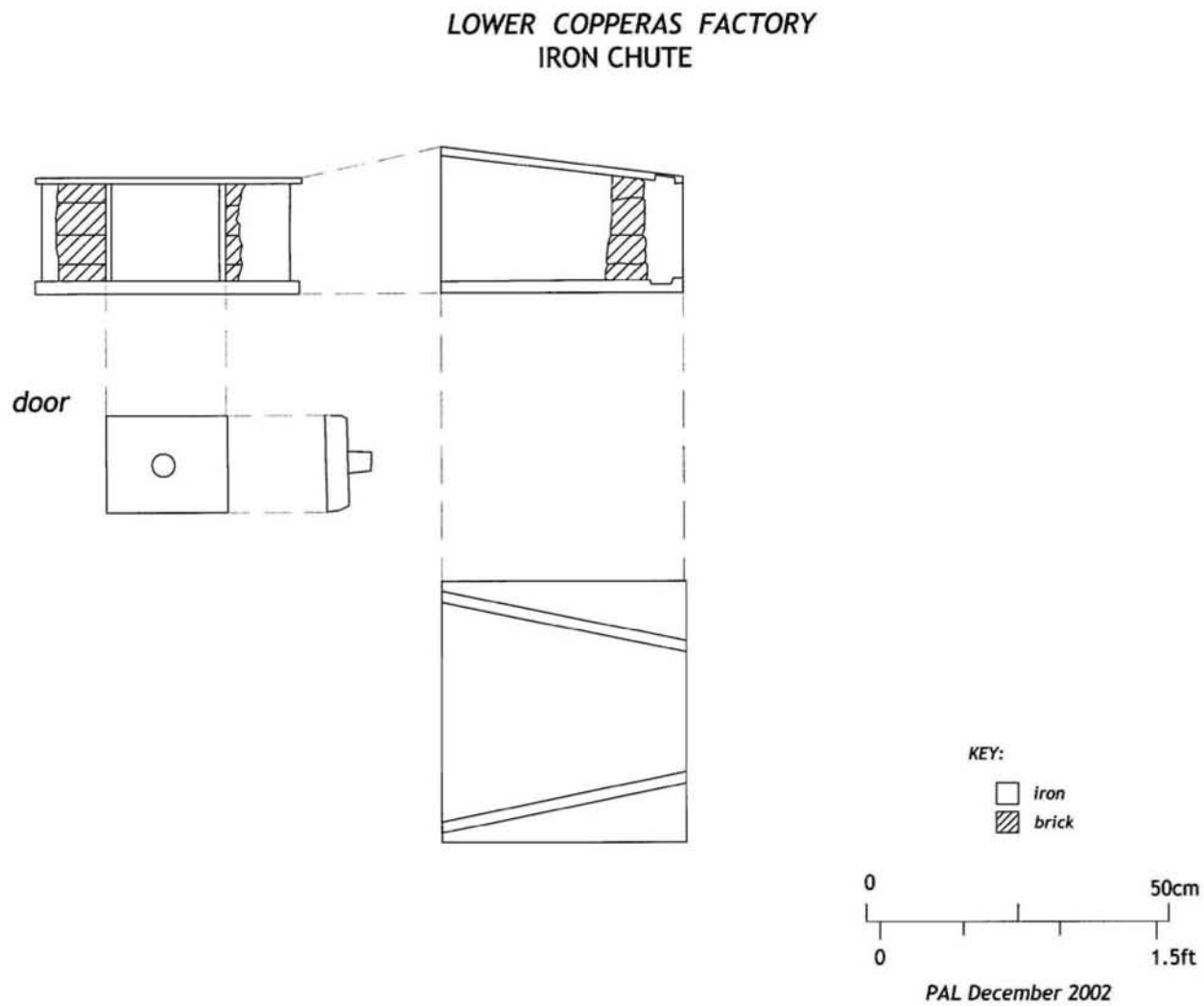


Figure 6-33. Iron chute identified but not recovered from eastern end of Lower Copperas Factory.

stone wall midway up the west margin of the larger cut (GIS database #431) and a substantial foundation 136 m northeast of the larger cut (GIS database #277). The foundation is 17-x-6-m and of dry-laid fieldstone. Two cross walls bisect the interior space of the foundation at distances of 4 and 9 m from the north end of the foundation. Attached to the south side of the northern most of these divisions is a 2-m square chimney foundation. Later activity in this portion of the site is indicated by the presence of an exploratory drill casing 49 m northeast of the larger cut.

South Open Cut (Outside APE)

The South Open Cut is an approximately 500-x-40-m excavated trench located 125-m south of the North Open Cut (GIS database #903). At its south end the cut is roughly 5-m deep, while the depth at the north end is unknown because of the fact that it is filled with green-tinted water, but is substantially deeper. One-quarter of the way from the south end to north on the eastern side of the cut is a haulage-way excavated into the hillside. This truck route permitted vehicles to access the South Open Cut from Copperas Road. On the other side of Copperas Road is a pile of waste rock associated with the haulage-way. At the north end of the cut is a large tunnel leading north toward the North Open Cut. Just north of the cut is a 2-m square capped shaft that connects to the tunnel below (GIS database #18). Drill steels driven into the rock are apparent north and south of the shaft. The hillside to the east of the South Open Cut is criss-crossed with remnant roads likely associated with the hauling of ore from the cut. Down slope, closer to the mining road there are a series of exploratory drill casings. At least one automobile has been abandoned in the watered north portion of the cut.

Other Industrial Resources

The following visible structural remains were subjected to GPS mapping and survey, but were not physically associated to the industrial subsites discussed above.

Coke Storage Area (Completely Within APE)

A corner section of dry-laid stone wall is visible at the northeast toe of TP 1 (GIS database #174) (Figures 6-34 and 6-35) in the vicinity of at least one historic road and one currently utilized and possibly historic unpaved road. This feature may represent a foundation, but the excavation of four test pits within and in the vicinity of the wall recovered no cultural remains. Historic maps (ca. 1910, 1918) storage structures in the vicinity, but these appear to have been located west of the wall. The surrounding area is obscured by the deposition of TP 1 and culverting of Copperas Brook.

World War Era Pump Houses (Outside APE)

The World War Era pump houses are situated on the south bank of the Ompompanoosuc River, well outside of the project APE (Figures 6-36 and 6-37) (GIS database #312, 313). The now collapsed World War II era structure and the foundation of its ca. 1907 predecessor previously supplied the mine with the water necessary for separating the ore from the waste rock. The later pump house consists of the collapsed remains of an expedient structure similar to the other World War II era structures on the site resting on a 7-x-8-m concrete foundation. The majority of the pumping apparatus has been removed. The earlier structure is represented only by a 3-x-4-m slag aggregate concrete foundation just to the east of the earlier building. These pump houses are included in the architectural resource evaluation presented in Chapter 7.

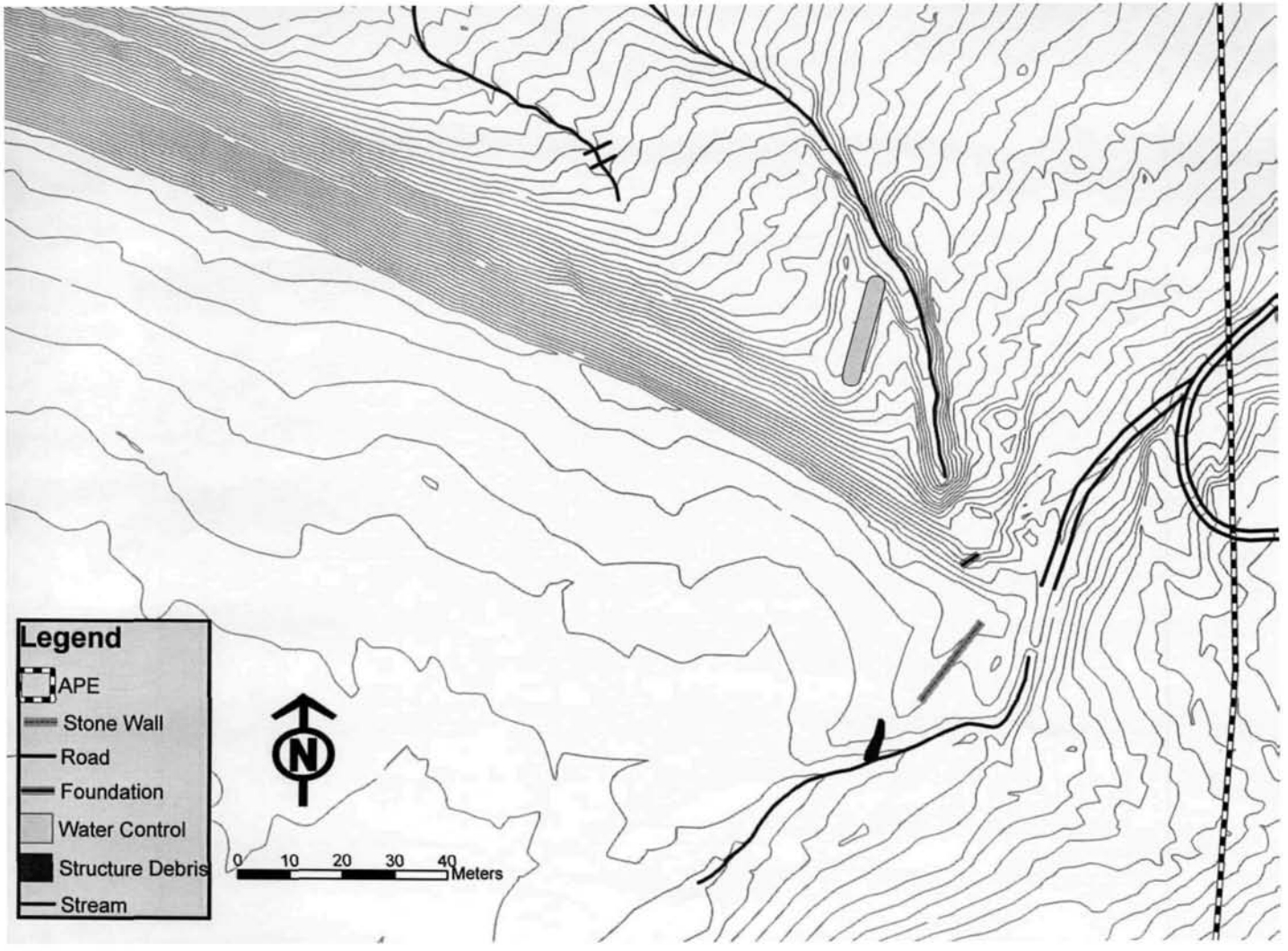


Figure 6-34. Map of historic resources located near the northeast corner of Tailings Pile 1.

Figure 6-35. Corner of granite wall located at northeast tip of Tailings Pile 1.

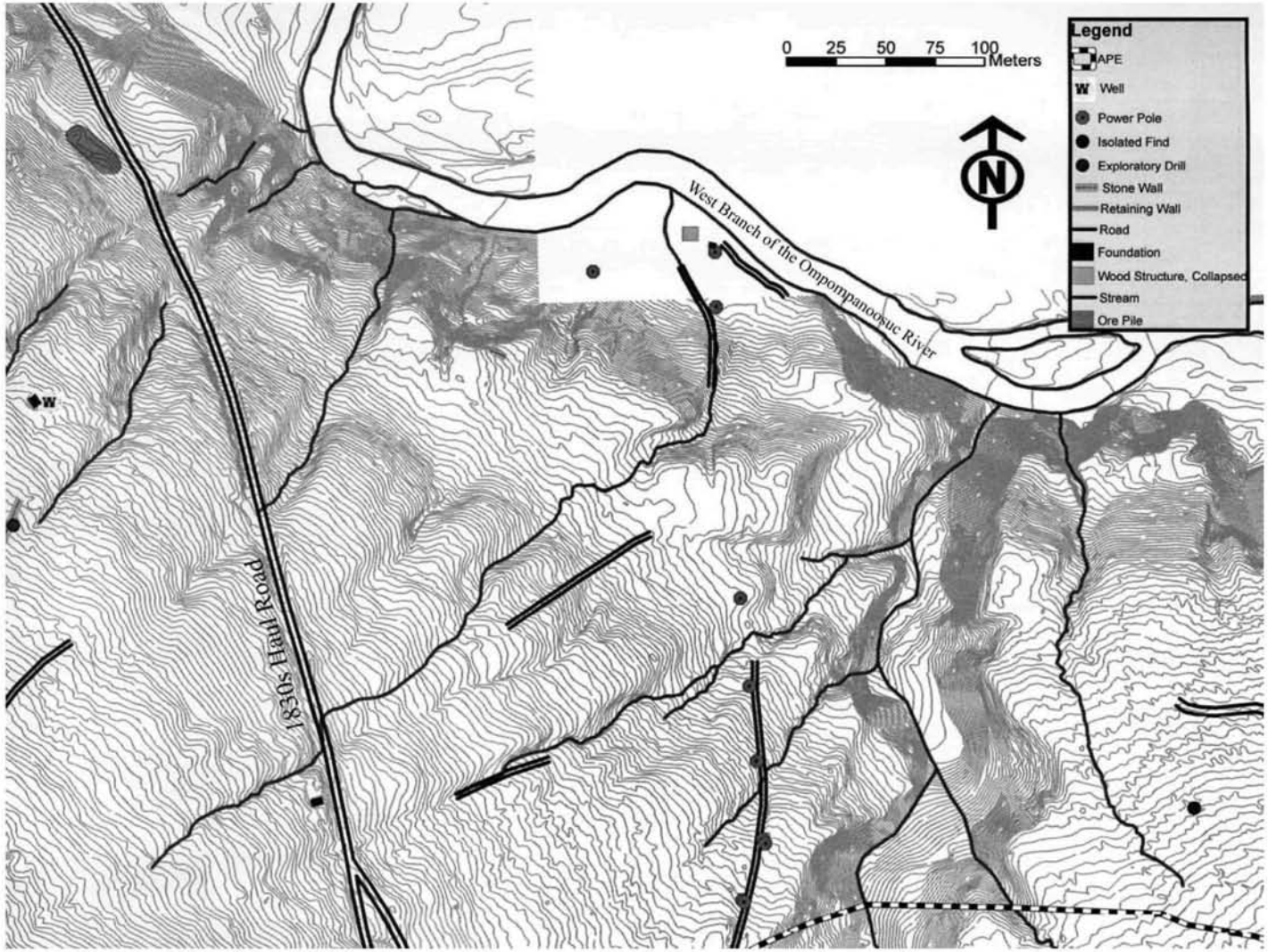


Figure 6-36. Map of pumphouses and surrounding environs. Pumphouses are located in the bend in the river near the center of the image. Note the Teamster's House foundation in lower left and unnamed foundation at far left.

Figure 6-37. Heckscher pumphouse in foreground, collapsed World War II era pumphouse in background.

Teamster's Foundation (Outside APE)

The Teamster's foundation is located along the west side of the 1830s haul road (Figure 6-38), outside the project APE (GIS database #446). This foundation, also locally known as the Everrett House or Wagonmaster's House (C. Abbott, personal communication 2002), is a 6-x-4-m dry-laid fieldstone and earth berm structure. The foundation is clearly visible, but has deteriorated and been overgrown to the extent that its structural characteristics are not currently discernable.

World War II Era Cluster (Outside APE)

A cluster of World War II era resources are situated midway up the east face of Copperas Hill along the strike of the ore, outside of the project APE (Figure 6-39). These resources include (from north to south) the 1948 shaft, the idler tower foundation (GIS database #437), the hoist house foundation (GIS database #440), and the upper water tank foundation (GIS database #903). There are also a number of exploratory drill casings and a fire hydrant in the vicinity (GIS database #446). The upper water tank foundation is an approximately 11 m square (m sq) concrete pad (Figure 6-40) that formerly supported a water tank and its shelter. North of the water tank foundation is the foundation of the hoist house. This 8-x-6-m concrete foundation has a number of raised platforms to support the hoist machinery as well as electrical wires emanating from a pipe in the foundation (Figure 6-41). Both the hoist house and water tank foundations rest on filled terraces. North of the hoist house foundation, across a clearing currently occupied by a number of derelict vehicles, are the remains of the idler tower. All that remains of the tower are the footings and a number of timbers on a partially excavated terrace. The two exposed footings consist of two iron plates sunk into a concrete footing (Figure 6-42). The plates are positioned so that they form an "L" shape with each plate pierced by a bolt and washer that would have originally held the timber leg in place. The timbers themselves, which generally consist of 20.3-x-20.3-cm (8"-x-8") and 2.1-x-20.3-cm (2"-x-8") pieces of wood, are lying in a jumble around the footings. Finally, north of the idler tower debris is the shaft itself, the head of which rests on its own filled terrace. The shaft opening of concrete is 6-x-2.5-m and is capped with a concrete pad. The shaft still appears to be open beneath this concrete pad, since a cool breeze can be felt issuing from several holes. The footings for the head-frame are located approximately 7 m south of the shaft.

Buildings and Structures (Within and Outside APE)

The Hartgen report (October 2000) contains descriptions, brief histories, conditions assessments, and functions for architectural resources identified at the Elizabeth Mine Site. The current investigations consisted primarily of evaluating these resources in terms of their architectural integrity, historic research value, and associated archaeological resource potential (see Table 7-3). For the purposes of the current study, the architectural resources are grouped according to two main temporal periods: nineteenth century and World War II Era. There are four standing nineteenth-century buildings associated with the mine that are presently private residences on Mine Road: Buena Vista (outside APE), the Copper Castle (within APE), the Infirmary/Carpenter Shop (within APE), and the Club House (within APE). The Infirmary or the Club House may have been the school indicated on the 1874 map (Vermont Copperas Company). The World War II standing structures constructed during the Vermont Copper Company (1941–1958) occupation of the site are all included within the project APE. They consist of administrative, laboratory, and mechanical support buildings as well as ore storage, crushing, milling, and shipment preparation structures. Besides the core industrial and administrative buildings, the dormitories and dormitory sites along Mine Road are included in this grouping (Figure 6-43), as are the warming hut and pump house remnants along the west edge of TP 1.

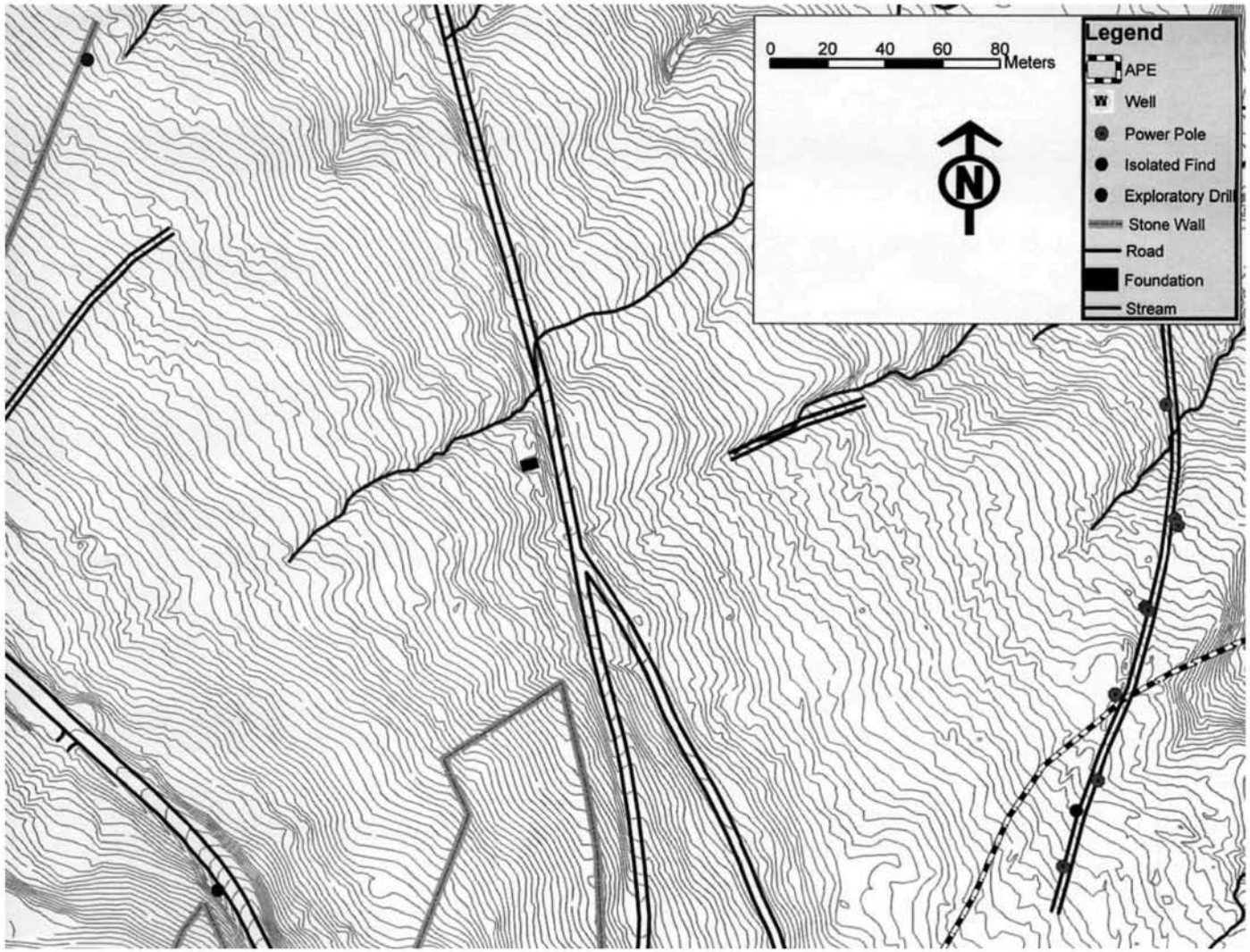


Figure 6-38. Map of Teamster's House foundation area. Teamster's House foundation is located in the center of the image, just west of the 1830s haul road.

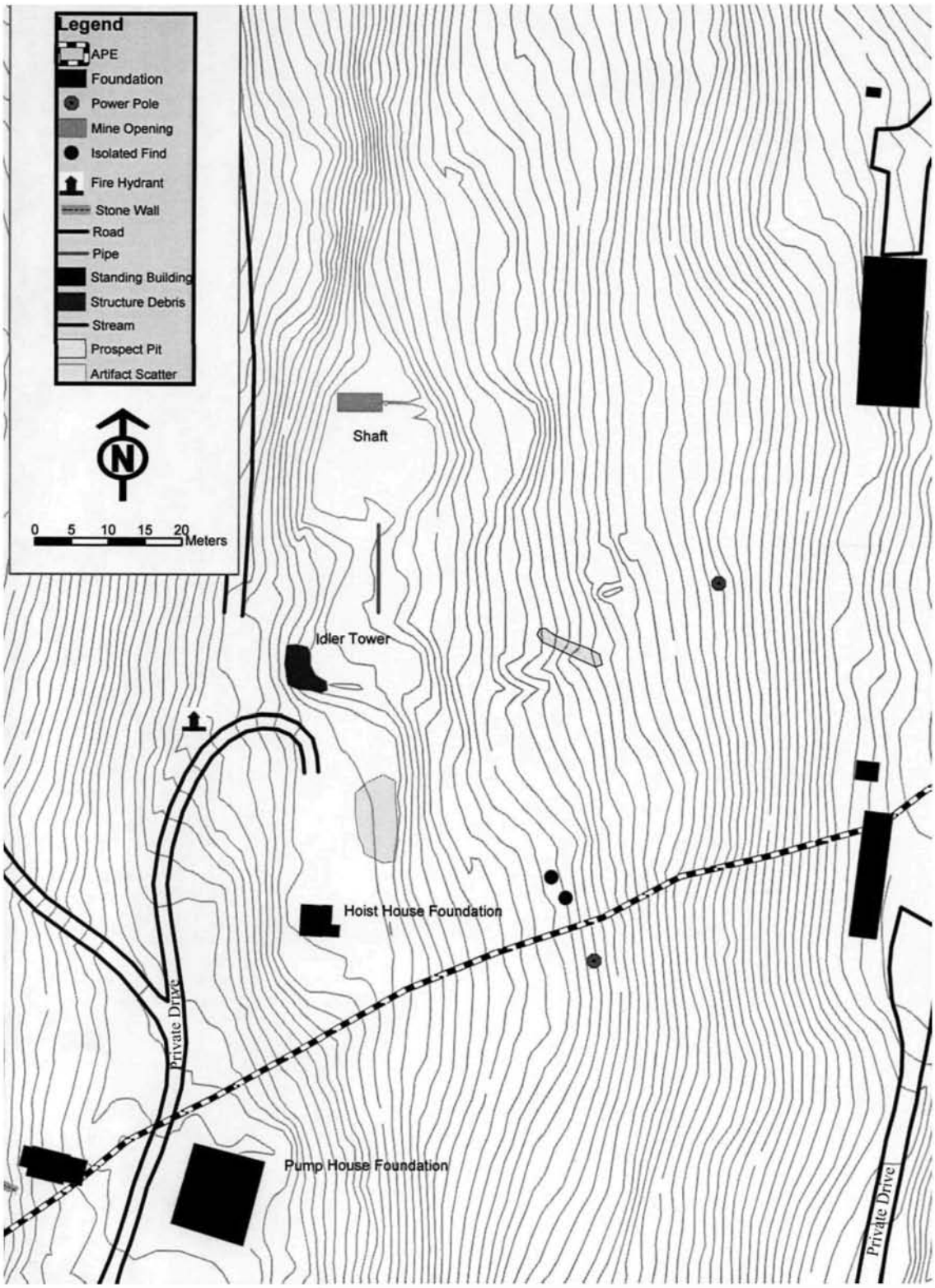


Figure 6-39. Map of World War II resources located on the upper east side of Copperas Hill.

Figure 6-40. Water tank foundation associated with World War II upper Copperas Hill resources.

Figure 6-41. Hoist house foundation associated with World War II upper Copperas Hill resources.

Figure 6-42. Idler tower footing associated with World War II upper Copperas Hill resources.

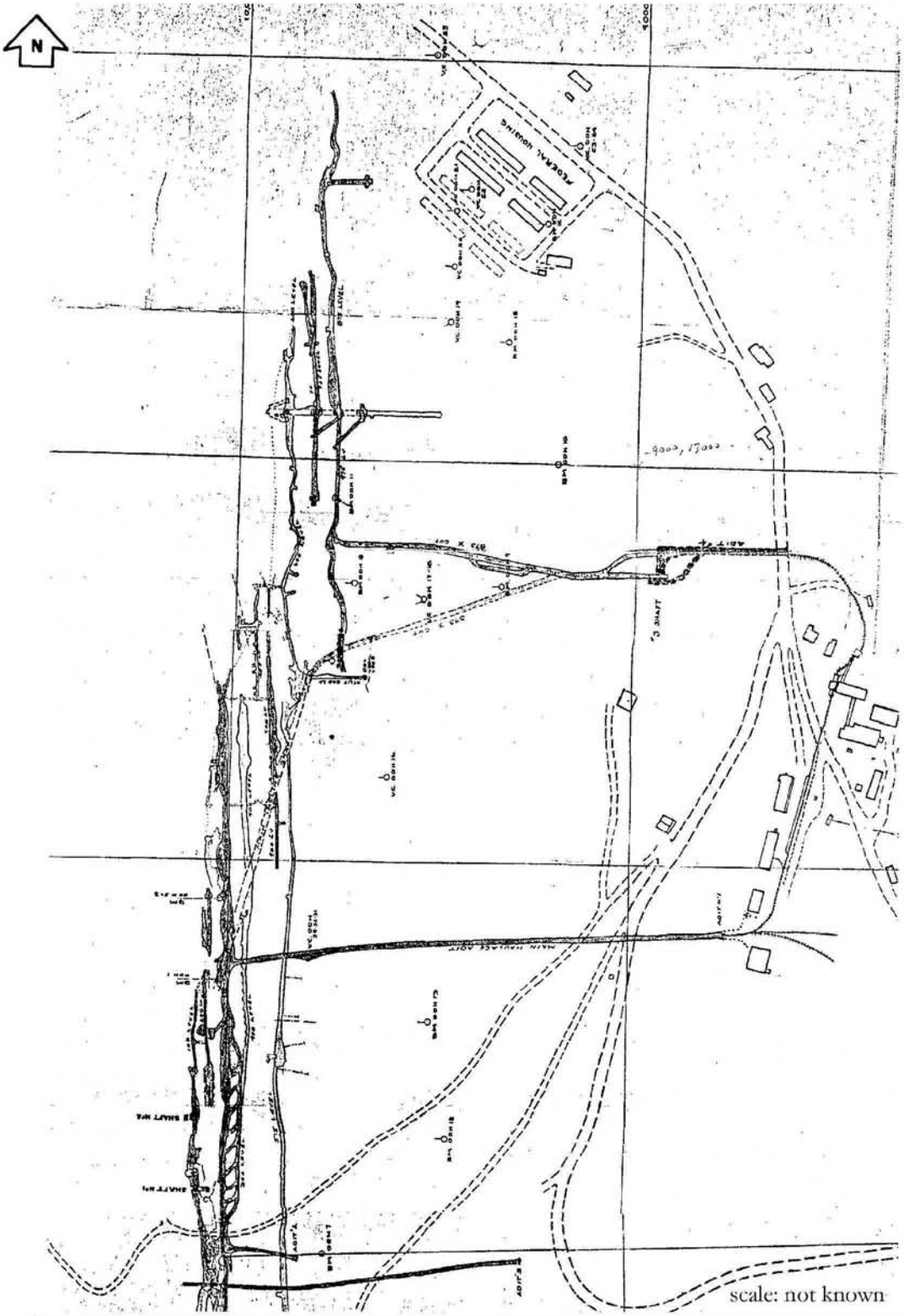


Figure 6-43. Vermont Copper Company 1949 Map (source: Strafford Historical Society, Strafford, VT).

Inter-Site Features (Within and Outside APE)

There are a number of industrial-related inter-site resources present throughout the Elizabeth Mine study area. They include modern debris and dumping episodes dating from the abandonment of the mine to the present-day. The smaller and more isolated of these resources consist of vehicles, ore buckets, an electric mine car (Figure 6-44), small/disturbed historic artifact scatters, unassociated structural remains, utilities, ore piles, and roads, which generally serve to link the subsites to one another or represent the dispersed land-use patterns throughout the historic period. For example, the 1830s haul road leading from Furnace Flat North and South toward the core of the site, the road from East Village to the lower copperas factory, and the network of roads dispersed across the hillsides indicate physical links across the site. Analogously, the networks of utilities (power poles, substation, and fire hydrants) (Figures 6-45 and 6-46) join the World War II era structures into a cohesive unit. The primary evidence of dispersed land-use is the nearly ubiquitous exploratory drill casings (Figure 6-47) located along the eastern margin of the ore body for the majority of its course through the site. The presence of numerous stone walls, wells and stacks of wood attests to recurrent subdivision of the overall site property for mining rights and utilization of the landscape for agriculture and husbandry during different time periods.

Historic Period Domestic Resources

Blaisdell Farm (Completely Within APE)

The Blaisdell Farm (Figure 6-48) is located west of the north end of the North Open Cut on a small plateau near the summit of Copperas Hill. The visible remains of the farm consist of a number of standing foundations and prepared surfaces. The main block of the site is four conjoined foundations, with a prepared platform to the south and a large, but poorly defined foundation to the north. There is a depression directly up-slope, west of the main block, and there are a number of artifacts that date to the historic period distributed within the foundations and in the surrounding area.

The main house foundation is a 4-x-5.3-m, 0.5-m deep cellar hole (structure 4) (GIS database #241). Attached to the southwest end of the cellar is a flat "L" shaped area defined by an unexcavated stone foundation (structures 2 and 3) (GIS database #242). The southwest wall of this area is cut into the adjacent prepared terrace. The flat area is divided into two sections by an internal wall. The "L" shaped space extends into another foundation that is at least partially excavated into the hillside (Structure 1). This foundation is represented by a stone cellar hole/foundation. All combined, these foundations appear to form the house block of the farm and may represent a connected farmstead with a number of interior spaces or numerous periods of rebuilding on the site.

Abutting the southern walls of the house is an approximately 12-x-22-m prepared platform. This platform was created by cutting and filling the soil on the hillside. West of the house and platform is a depression, likely a well. Northeast of the house is the remains of the barn foundation. The barn appears to have been cut into the hillside and at one time it rested on at least a partial dry-laid stone foundation. Only the north and west walls of the barn are still evident. A historic road runs by the south and east margins of the farm.

Six test pits were excavated at the Blaisdell Farm (see Figure 2-4). The testing revealed soil profiles characterized by a dark gray-brown (10YR 4/2) silty medium sand over a dark-gray

Figure 6-44. Electric Ore Cart located east of the 1898 Adit.

Figure 6-45. Standing power pole at northwest corner of Tailings Pile 1.

Figure 6-46. Fire hydrant and hose house northwest of World War II era mill.

Figure 6-47. Exploratory drill casing located east of South Open Cut.

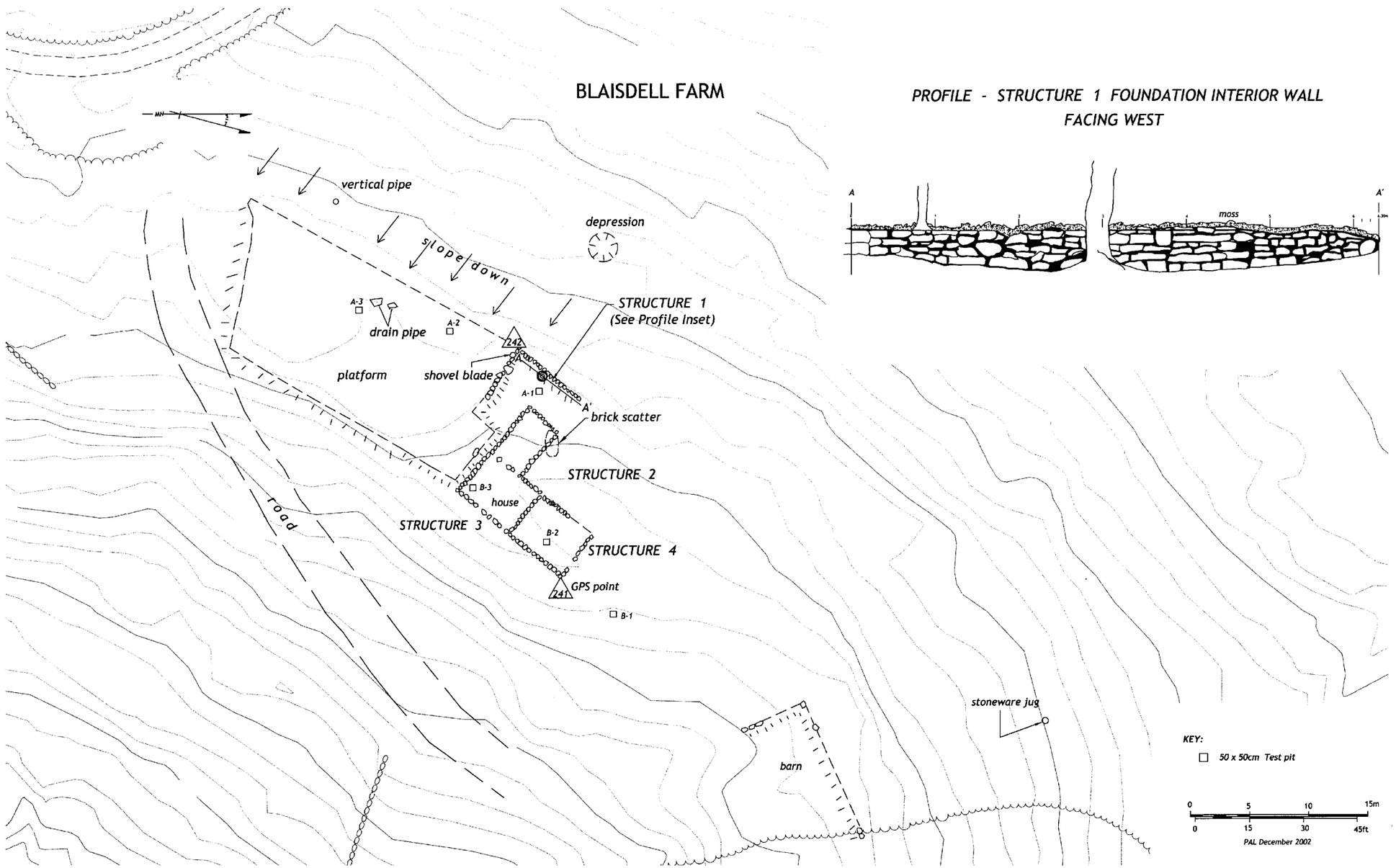


Figure 6-48. Map of Blaisdell Farm and profile of the west wall of Structure 1.

(10YR4/1) silt with various layers of fill inside the different foundations (Figure 6-49). All but one of these test pits contained cultural materials. A total of 123 artifacts, mostly nails and flat glass, some of which was melted, was recovered from 0 to 50 cmbs in topsoil and fill deposits (Table 6-6, Appendix A). The majority of the nails were machine cut, with a few wire nails. The majority of the ceramics recovered from the site were various stonewares (almost exclusively from TB-2) in addition to one piece of whiteware. A number of the test units produced charred wood as well. The only other artifact of note was a clay pipestem and bowl fragment recovered from the A_1 stratum of TB-1.

The Farm (Completely Within APE)

Located north of the North Open Cut and 186-m northeast of the Blaisdell Farm is the Farm subsite (Figure 6-50). The Farm is connected to the rest of the site by a historic road trace running along the shoulder of Copperas Hill from the upper portion of TP 3 past the Farm. Prior to reaching the Farm, the road is a narrow terrace worn into the hillside. However, in the vicinity of the Farm the terrace expands. The expansion is because of the fact that the Farm foundations were constructed using a cut and fill method. The northern and western portions of the foundations were cut into the hillside while the eastern and southern walls are supported by berms constructed of fill (see cross-section B-B', Figure 6-50). The southwestern foundation is a 5.5-x-9-m, 1.5-m deep dry-laid stone foundation (GIS database #259). The stonework of the foundation is primarily fieldstone with a few large rough-cut quartz pieces, but it is particularly well laid with a timber sill or pocket running along the entire upper inner edge. A piece of cut granite, possibly a sill, is located in the southeast corner. The northeastern foundation is a 5-x-7-m, 1.5-m deep cellar hole with only three walls (GIS database #260). It appears that the southern wall never existed, with that section of the foundation serving as an entrance. Approximately 32-m southeast of the site, downslope, is located a well-built, 1-m high stone retaining wall (GIS database #262). The wall runs from a corner at its northern extreme, where it meets a stone wall, for 94 m before terminating at the chassis of a ca. 1920 automobile (GIS database #263).

Two test pits were placed immediately upslope of the retaining wall (see Figure 2-4). These pits contained a relatively natural soil progression of A0, A_1 (very dark gray-brown (10YR 3/2) silty medium sand), A_2 (brown (10YR4/2) silty medium sand), and B_1 (olive-brown (2.5Y 4/3) silty medium sand) (Figure 6-51), the upper strata of which yielded charred wood and seven pieces of sheet iron (see Appendix A and Table 6-7). Conversely, the four test pits placed along Transect D across the farm itself yielded a large number of artifacts (n=234) from 0 to 60 cmbs in topsoil, fill, and plow zone deposits (see Figure 2-4, see Appendix A). This assemblage was largely dominated by machine-cut nails (some wire nails were also present) and window glass, much of which is melted. Other construction-related materials include charred wood (sampled), brick (sampled), and a hinge. Additionally, a few pieces of earthenware, ironstone, and glass bottle fragments were recovered. The only other artifact of note was a schist whetstone recovered from the upper levels of TD-4. The soil profiles in this portion of the site consisted of fill beneath an A0 on the berm, and a formative A_1 (black (10YR2/1) silty sand), beneath an A0, overlying an ash layer and B_1 (dark gray-brown (10YR 4/2) silty medium sand) inside the main foundation (see Figure 6-51).

North Village (Completely Within APE)

The North Village subsite consists of two sets of terraces, two domestic foundations, and the foundation of the mid-nineteenth century era company office (Figures 6-52 and 6-53). The site runs nearly east/west and is framed by two sets of terraces. Between the terraces are two

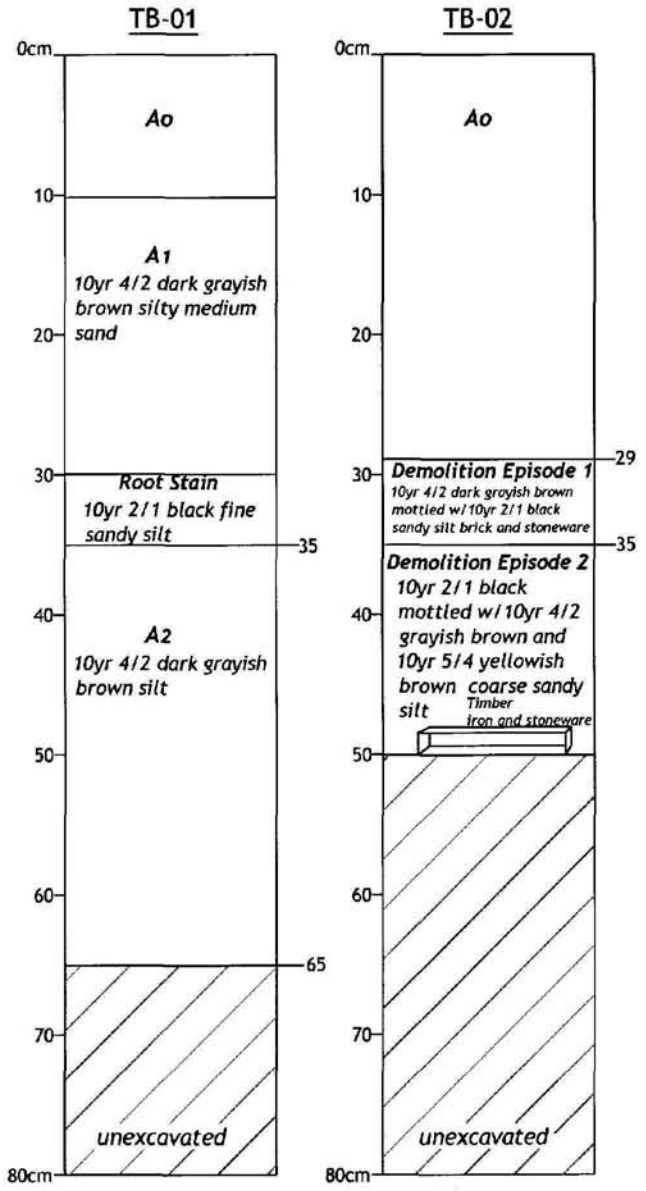


Figure 6-49. Representative soil profiles excavated at the Blaisdell Farm.

Table 6-6. Summary of Artifacts from Blaisdell Site by Excavation Unit.

Unit	Material											Total
	American Stoneware	Brick	Charred Wood	Clay	Copper Alloy	Glass	Glass, Molded	Iron	Stoneware	Whiteware	Wood	
Surface	1							1				**2**
TA-01			4					21				**25**
TA-02					1	15	1	13		1		**31**
TB-01		2		1		5		1				**9**
TB-02			6			2		13	14		2	**37**
TB-03			2			5		12				**19**
Total	**1**	**2**	**12**	**1**	**1**	**27**	**1**	**61**	**14**	**1**	**2**	**123**

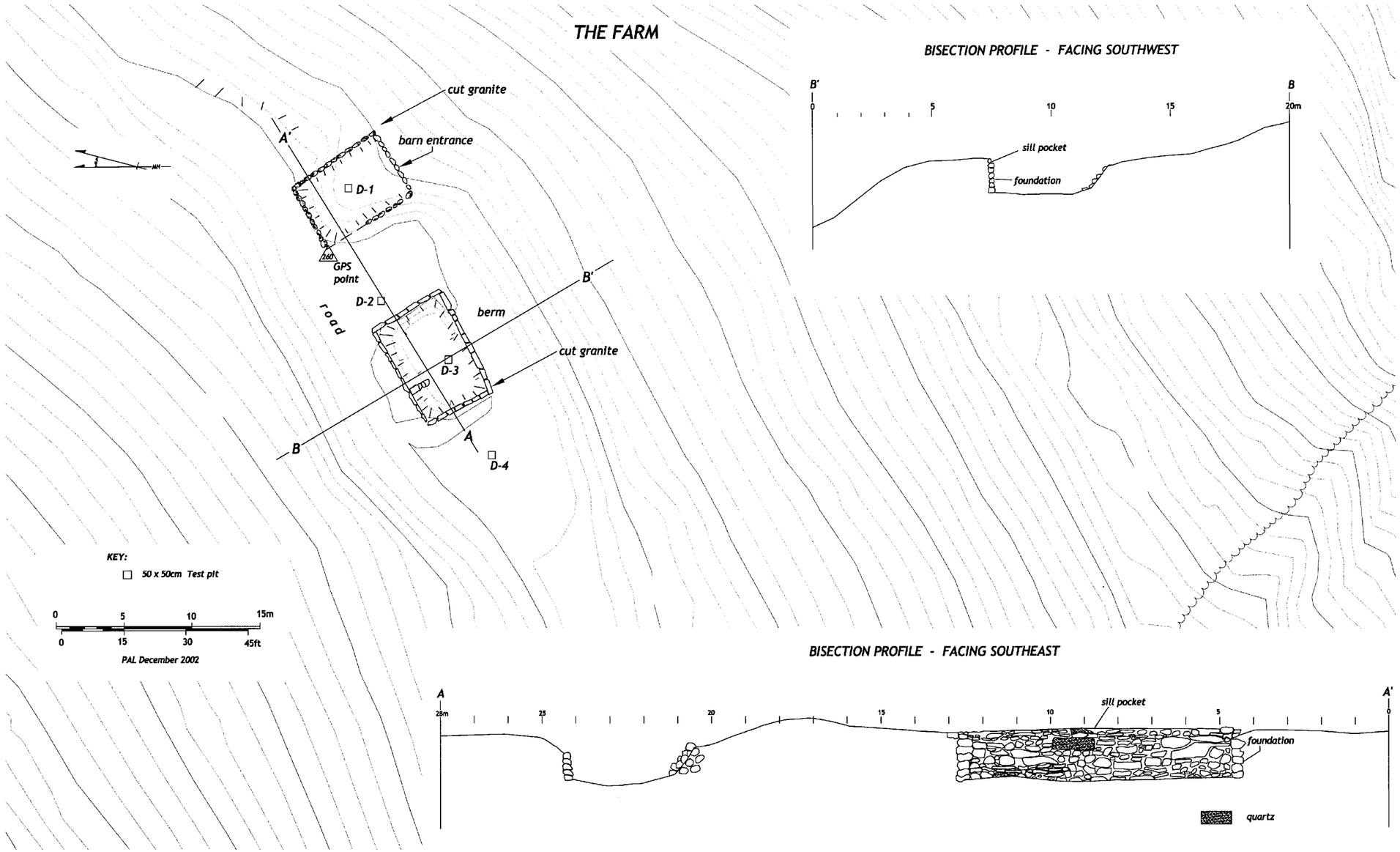


Figure 6-50. Map of The Farm with cross-sections looking southeast and southwest.

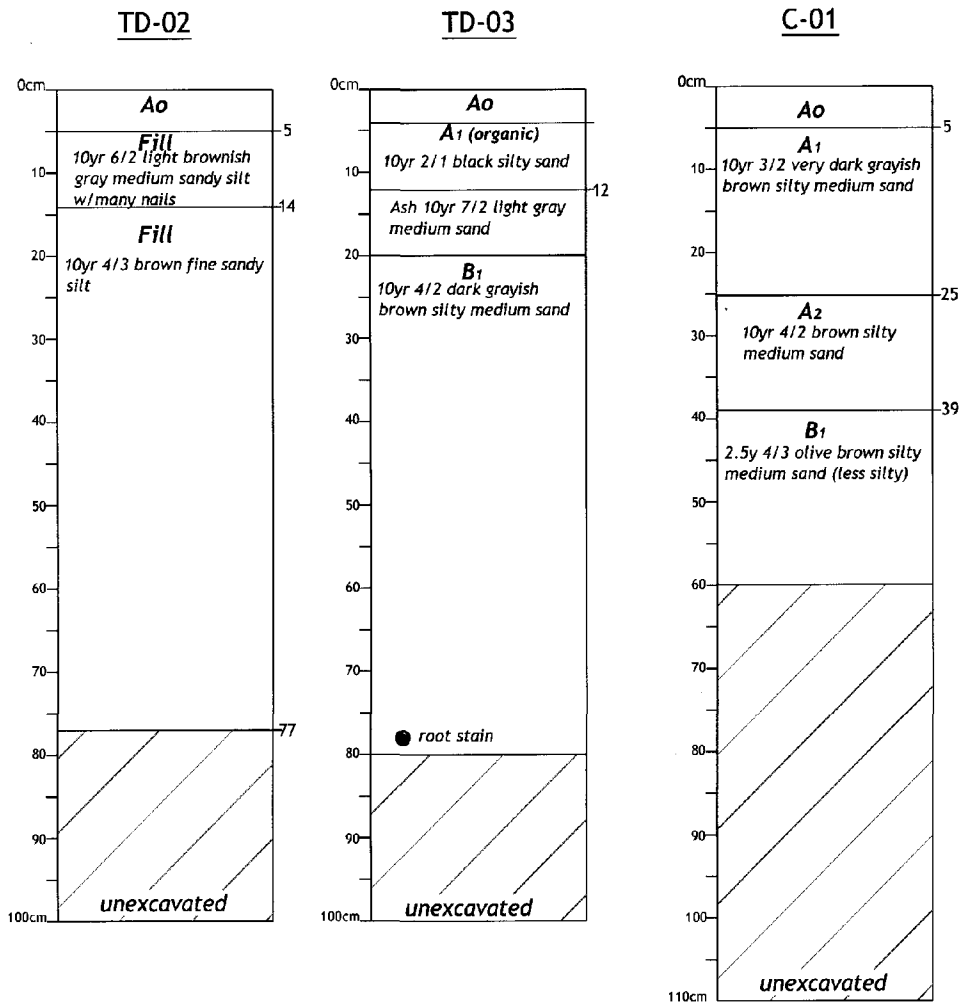


Figure 6-51. Representative soil profiles excavated at The Farm.

Table 6-7. Summary of Artifacts from the Farm by Excavation Unit.

Unit	Material											Total
	Brick	Charred Wood	Earthenware	Glass	Glass, Molded	Iron	Ironstone	Lead	Paper	Rubber	Schist	
TC-01						7						**7**
TC-02		1										**1**
TD-01				3	5	12	1					**21**
TD-02		5	3	29		101			1			**139**
TD-03	1			2	3	47	2	3		2		**60**
TD-04					2	3					1	**6**
Total	**1**	**6**	**3**	**34**	**10**	**170**	**3**	**3**	**1**	**2**	**1**	**234**

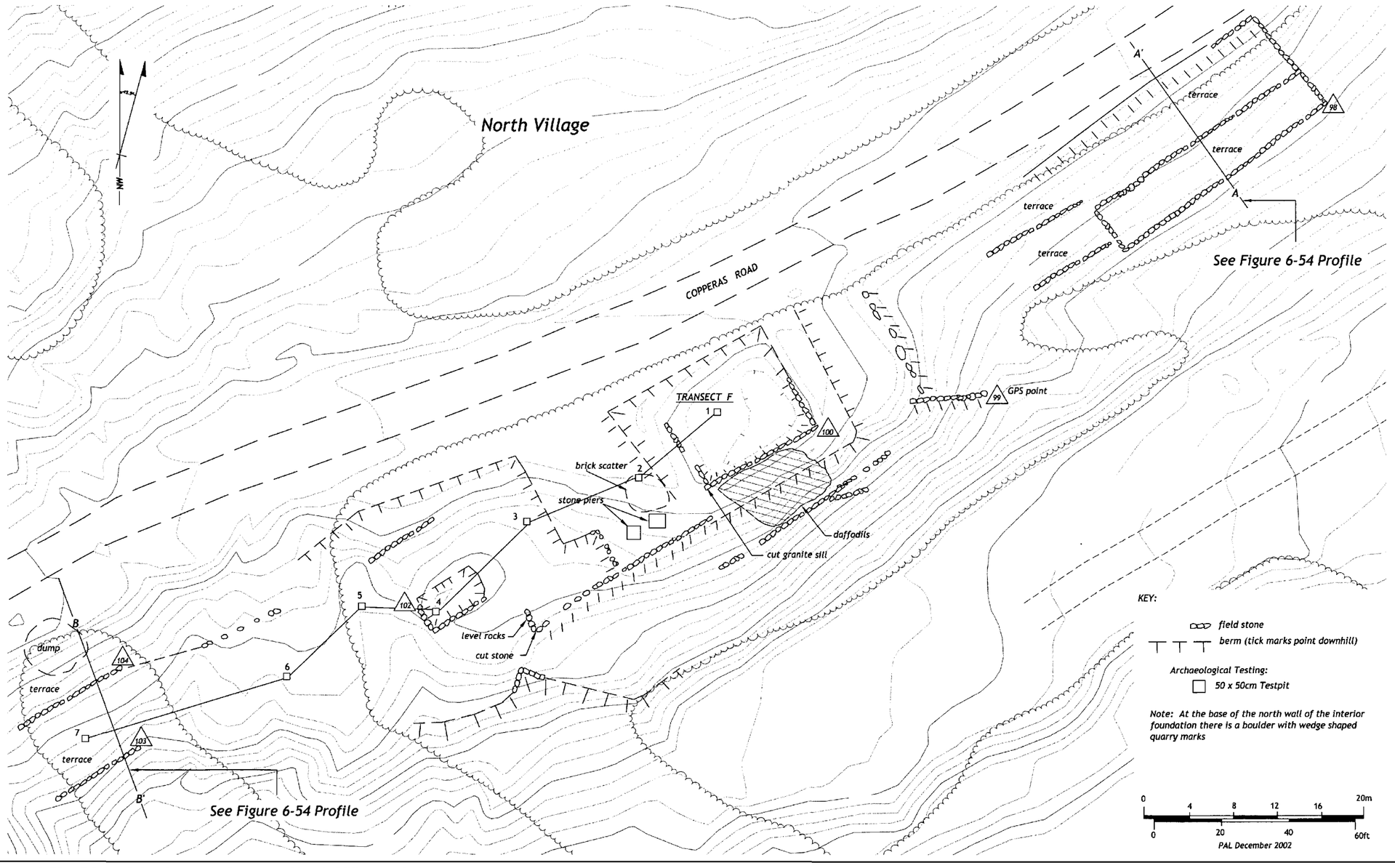


Figure 6-52. Map of the domestic features, North Village subsite.

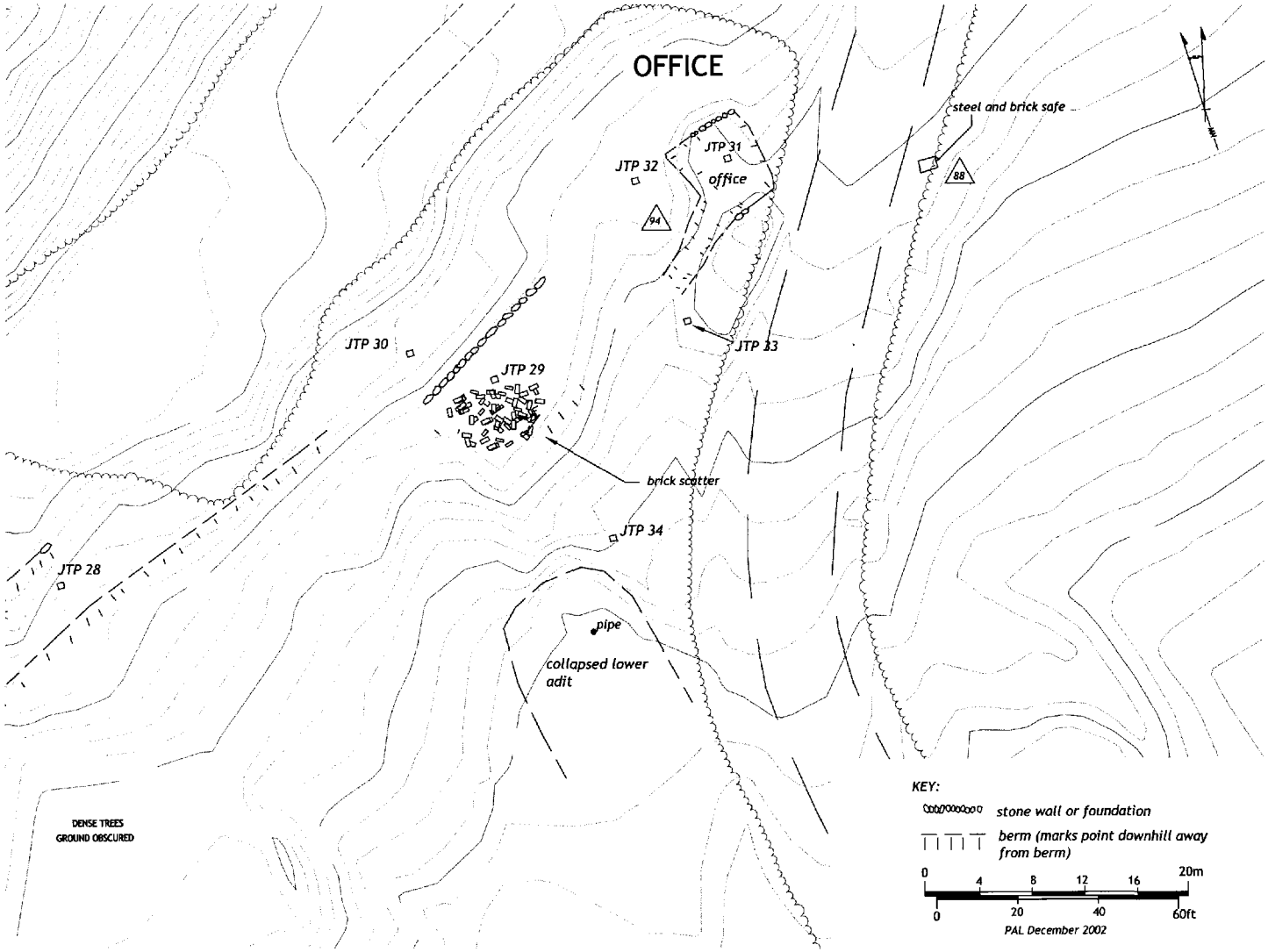


Figure 6-53. Map of office and agent's house foundation portion of the North Village subsite.

identifiable foundations and a number of stone walls that may represent other foundations. In addition to the stone walls associated with the foundations the site is defined by cut-and-fill landscaping, in some cases supported by retaining walls. A twentieth century dump is located just up-slope from the southern set of terraces. Southeast and down-slope of the line of terraces and foundation is the "L" shaped agent's house foundation. A number of terraces are located to its west.

Beginning at the north edge of the North Village includes two terraces approximately 30-m long (GIS database #98). Measured from Copperas Road just to the north the terraces represent a 4.5-m drop in elevation over a horizontal distance of 3.5-m (Figure 6-54). The eastern end of the terraces is boxed by a stone wall. At 23-m from the eastern end a second north-south stone wall encloses the lower terrace, while the upper, northern terrace, which is more deteriorated because of road construction, is open. Picking up from this point the terraces continue for an additional 8 m at the same angle but shifted slightly up slope. Neither of the continuation terraces have end walls. A footpath separates the northern terraces from the remainder of the site.

Just southwest of the footpath is a stone wall with a slightly obtuse intersecting wall at its south end (GIS database #99). These walls mark the beginning of the berm that surrounds the main foundation (GIS database #100). The main foundation is constructed very similarly to the house foundation at the Farm, with its north, upslope, wall cut into the hillside while berms surround the other three walls of the cellar hole. The foundation itself measures 11-x-9-m with clearly defined stone walls on three sides, the north wall being defined only by a cut in the hillside. The eastern and western walls are somewhat deteriorated and suffer from slumping. However, a possible bulkhead door is still visible in the west wall. At the base of the east wall of the foundation is a split boulder with wedge shaped quarry holes possibly formed by a cape chisel (Gage and Gage 2002:42). West of the main foundation is a depression running the length of the foundation. It is unclear if this depression represents slump from the collapsed wall or possibly an attached structure. South of the foundation, supporting the berm, is a dry-laid stone retaining wall. Partway along the wall a second wall intersects it at a very acute angle. Between the foundation and the retaining wall is a patch of daffodils, continuing evidence of the human occupation at the site. While bricks are scattered throughout the site, a particularly dense concentration of them is located just west of the foundation in the vicinity of two stone piers. The original function of the piers is unclear.

A retaining wall extends in line with the berm from the corner of the main foundation southwest to the next portion of the village site. This area is defined by excavated areas and short sections of stone wall. The area is a roughly 14-x-20-m leveled area excavated into the hillside. The cut nearest the main foundation is "L" shaped with stone partially lining the foot of the "L." The southern margin of the "L" is defined by an extension of the aforementioned wall that connects this portion of the subsite with the main foundation. There is a slight return at the end of this wall that has a number of level stones on its top edge indicating that a structure may have once stood on these walls. The north wall of the depression roughly parallels the contour of the hill. A stone wall runs along this slope as well. To the west the depression opens out onto TP3. In the center of the depression is a 5.5-x-2.5-m probable cellar hole (GIS database #102). The hole is demarcated by stone walls on its south and west sides and changes in elevation on the north and west margins. South of the depression along the crest of the terrace before the natural steep hillside resumes is a "V" shaped section of wall open to the south. The function of this wall is unknown.

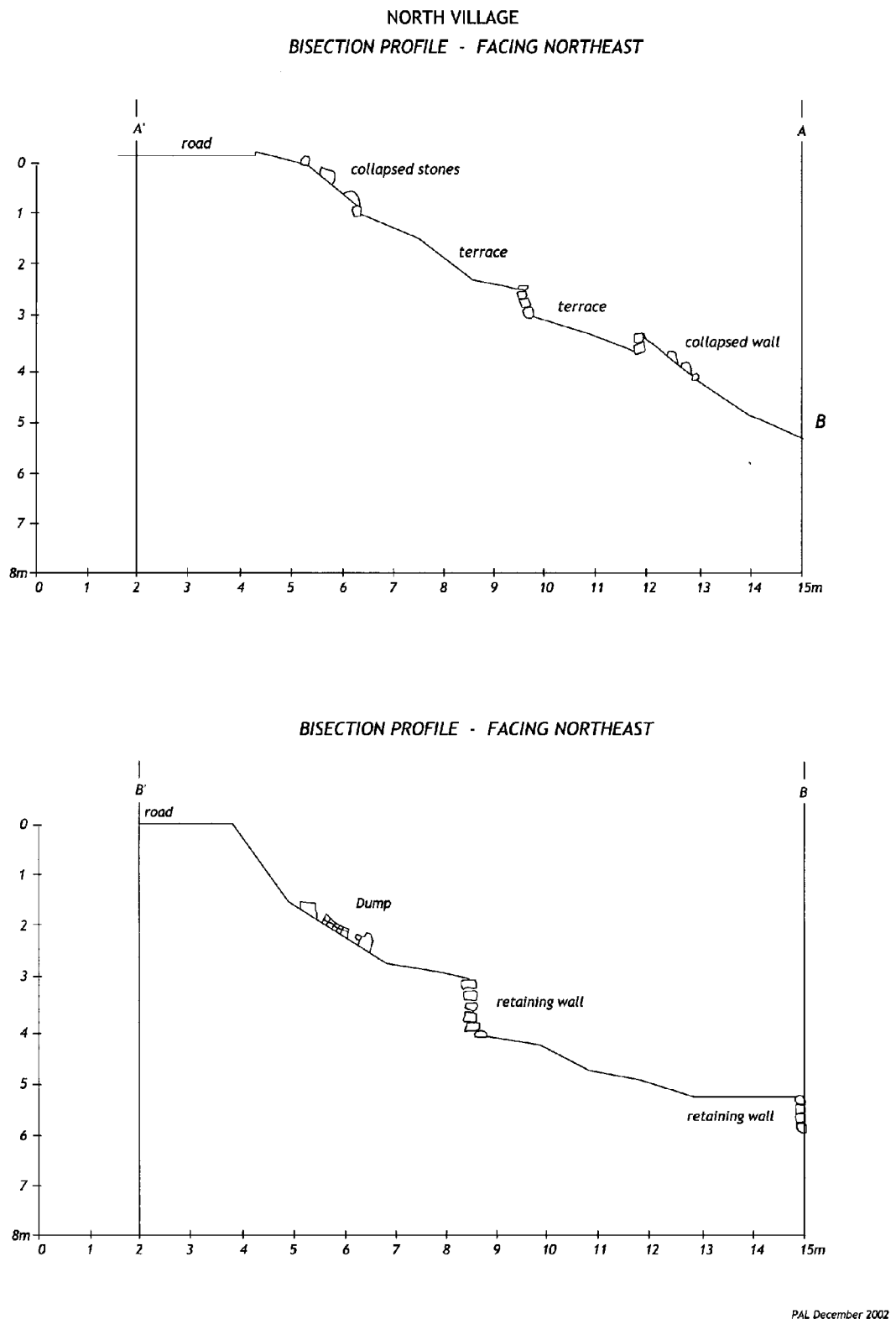


Figure 6-54. Cross-sections of the terraces north and south of North Village.

Continuing south and west the final portion of the domestic section of the site is a pair of terraces similar to the set that began the site description (GIS database #104). The primary difference is the greater height and increased level of preservation of the western terraces. The retaining walls of the terraces extend approximately 10.5 m. The terraces extend 15.5 m from Copperas Road with a change in elevation of nearly 8 m over that distance. There is evidence that the terraces formerly extended farther to the east in the form of a dispersed line of stones in line with the northern retaining wall, possibly the washed-out remains of the same wall. The western end of the terraces is clearly defined by end and corner stones. A twentieth-century dump, likely a result of proximity to the road, is located on the upper terrace (GIS database #105).

The North Village complex also includes the remains of the Office, located 50-m downslope to the east and slightly south of the main foundation. This structure is connected to the Upper Copperas Factory by the road terracing described in that section. However, being administrative/domestic and not industrial the office is associated with the North Village rather than the Upper Copperas Factory. The oddly shaped foundation that is visible in this area is the agent's house, rather than the office itself (GIS database #94). The main block is 9-x-5.5-m, but it is deteriorated and the angles and sides of the structure are no longer square. This state is partially because of work on Mine Road and impacts from the modern trailer that was until recently located north of the office. A sewer pipe believed to be associated with the trailer was encountered in JTP-30, just northwest of the office. The berm that defines the south wall of the cellar hole extends west of the foundation and is joined by a second berm extending from the west wall to form an enclosed walkway into the foundation. These berms taper and terminate 9 m from the foundation. Approximately 15-m east of the office, on the other side of Mine Road, is located the iron and brick remains of a safe believed to be associated with the office. West of the agent's house cellar hole is a triangular shaped platform with a scatter of bricks around its top. The platform leads into the terrace that runs in front of the Upper Copperas Factory. The north side of the platform is defined by a stone retaining wall (GIS database #96). The collapsed entrance to the Lower Adit (1854) is just south of the platform (GIS database #93). The tongue of waste rock associated with the adit is located directly across Mine Road.

Eight test pits were excavated across the North Village, with an additional six pits placed around the Office. In general, the baseline soil profile for the area is a deep A0 or very dark brown (10YR 2/2) soil, over an A_1 of dark yellow-brown (10YR 4/4) silty medium sand, overlying an A_2 of brown (7.5YR 4/3) silty medium sand, which in turn caps a B stratum of very dark green gray (3/5 gray) sandy clay (Figure 6-55). TF-1 excavated inside of the large northern foundation contained a substantial amount of fill overlying an excavated B_1. However, TF-4, excavated in the smaller southern foundation, contained only a thick (34 cmbs) duff layer over a possible B_1 stratum before reaching the water table at 47 cmbs. The test pits excavated into the southern terraces confirmed the hypothesis that they were constructed of fill. Timber flooring was encountered at 38 cmbs in TF-6 and a possible living surface of very compact silty clay was excavated from 20–43 cmbs in TF-3. In the lower office portion of the subsite the soil stratigraphy consists of a thin (4 cm) duff layer over a brown (7.5YR 4/3) silty fine sand A, which overlies a gray-brown (10YR 3/2) silty medium sand B (see Figure 6-51). Test pits dug within the office foundation demonstrated that it had been excavated into the hillside rather than being completely mounded. Within the foundation proper, natural subsoils were encountered under multiple layers of fill at 67 cmbs, while in the ell B_1 soils emerged at only 10 cmbs suggesting the overlying soils had been excavated away. JTP-32 was partially excavated into the fill of a sewer line trench.

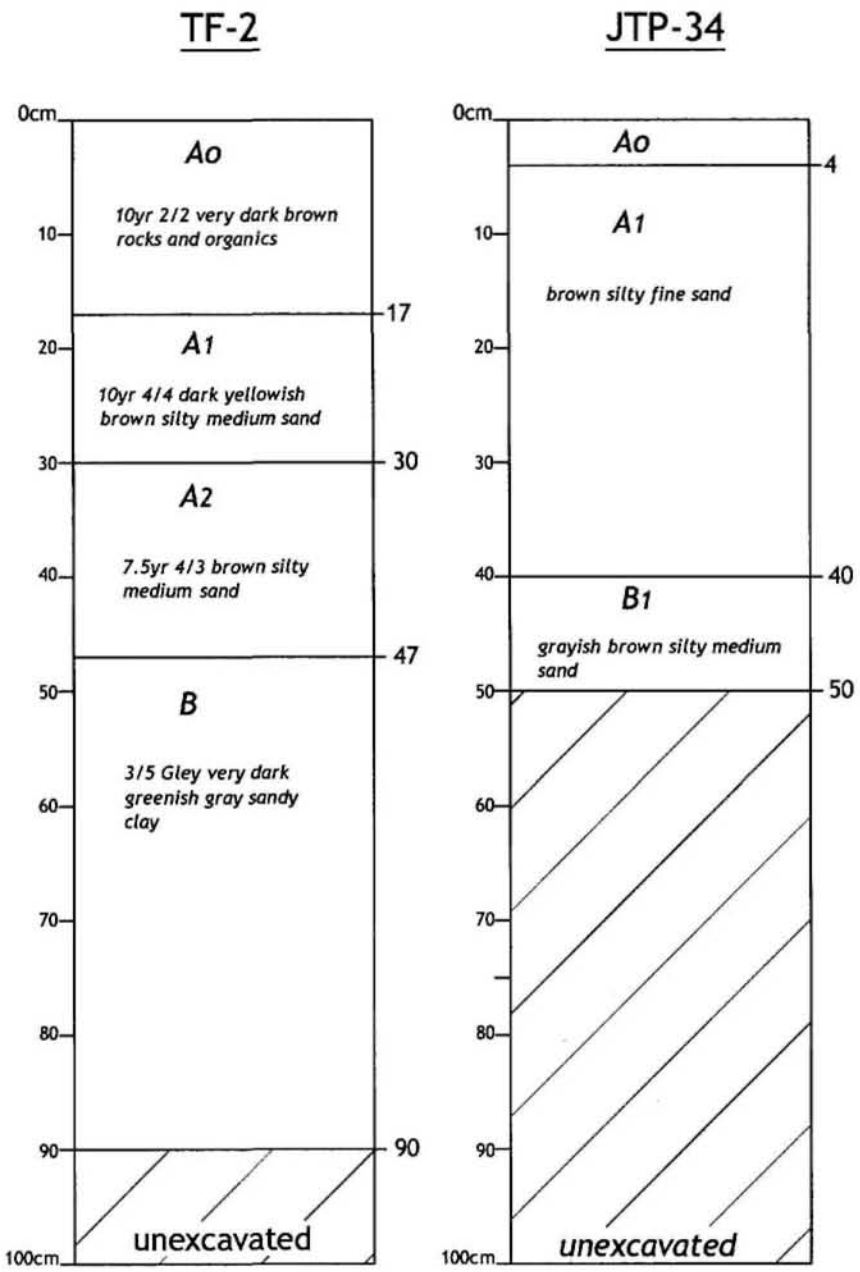


Figure 6-55. Representative soil profiles excavated in the North Village subsite.

Cultural materials (n=102) were recovered from all but one of the eight test pits (TF-4) in the upper domestic portion of the village site (see Figure 2-4). The absence of materials from TF-4 is odd because of the fact that it was excavated inside a visible foundation. The majority of these artifacts were structural debris consisting of brick (sampled), window glass, and nails (primarily wire or unidentifiable) from 0 to 80 cmbs in fill, rock, living surface, and tailings deposits (see Appendix A and Table 6-8). Fewer nails were recovered from this subsite than from elsewhere in the project APE. Additionally, charred wood was recovered from the compact possible living surface stratum in TF-3. Ceramics recovered from this area included creamware, whiteware, redware, ironstone, and generic earthenware. The artifacts (n=64) recovered from 0 to 70 cmbs in the six test pits excavated in and around the office remains were slightly more unique (see Figure 2-4). Brick, which was sampled, was still a major component of the assemblage but window glass and nails were less prevalent (see Appendix A and Table 6-9). The majority of the iron artifacts from the area were wire and flat sheets of metal, though nails were still present. Additionally, a nearly complete glass bottle and a number of fragments of a stoneware crock were recovered.

South Village (Completely Within APE)

South Village is located at the south edge of TP 3 within the project APE. It consists of a string of foundations west of Copperas Road and a single larger foundation east of the road in addition to a number of walls on the west side of the road just south of the main subsite (Figures 6-56 and 6-57). To the west of Copperas Road are two roughly parallel lines of foundations and two foundations with slightly different orientations. The westernmost line consists of four foundations with little or no evidence of cellars, while the line closer to the road consists of two cellar holes. The northern foundation in this line is partially surrounded with a retaining wall and has the foundation of an outbuilding to its west. North and south of the line of cellar holes are two additional foundations. The northernmost foundation is poorly defined while the southernmost foundation is a cellar hole with a substantial chimney crib. The western margin of Copperas Road has been cut below the natural grade of the hill. There are two exploratory drill casings located within the South Village, west of Copperas Road. East of the road is a complex foundation with a number of internal divisions and a retaining wall to its north and east. A number of stone walls are located south of the main portion of the site on either side of Copperas Road.

The west portion of the subsite consists of a minimum of four foundations arranged on terraces that decrease slightly in elevation to the north. The southernmost foundation is 15.5-x-11-m with partial stone walls supporting the platform on the north, east, and west sides (GIS database #30). The west wall is a retaining wall built to keep the slope from crushing the structure. There is an "L" shaped depression in the center of the platform with a brick scatter nestled in its crook. Extending north from the large platform is a 26-m long berm with a few section of dry-laid stonework interspersed along its length. This berm forms the eastern wall of the rest of the foundations in this portion of the subsite. A dirt and stone wall intersects the berm at a distance of 8.5-m from the large platform. A depression in the corner formed by this intersection demarcates the cellar hole of the second foundation (GIS database #31). Approximately 2 m north a second stone wall intersects the berm creating the foundation of the third structure (GIS database #32). At a distance of 17 m from the main platform a third wall intersects the berm. Again a small depression is located in the corner formed by this intersection, likely representing the cellar of the fourth foundation. The end wall of the line of structures is a dry-laid retaining wall that supports the platforms and intersects the berm at a right angle.

East of the line of foundations, on the other side of what is believed to be the historic path of the road now referred to as Copperas Road, is a fifth foundation (GIS database #29). The main portion of this foundation measures 10.5-x-6-m and is approximately 1 m deep. The majority of the cellar walls are intact, though the south wall has collapsed and all of the walls have suffered from some slumping. Located in the center of the foundation is a massive chimney crib of rubble and earth supported by stone walls measuring just over 4 m square. At the north end of the foundation is a slight depression partially defined by stonework on its west side and at its northwest corner. This depression may represent an attached shed or porch structure.

North of this structure and east of the line of structures is another grouping of foundations. The southernmost of these is a 5.5-x-4-m stone-lined cellar hole (GIS database #35). Just east of this foundation is a depression formed by an extension of the terrace above Copperas Road and a number of stones that appear to be the remnants of a foundation (GIS database #36). The depression measures approximately 5-x-3-m. The berm that forms the west wall of the small depression extends north and becomes a larger berm that retains the east wall of the main foundation in this portion of the subsite (GIS database #34). The actual cellar hole of this structure is 6-x-7-m and completely stone-lined. However, stone retaining walls associated with the structure are located to the north, south, and east, defining a 11-x-9.5-m platform. One m to the west of the cellar hole is a 3-x-2-m stone foundation, without cellar, that likely represents an outbuilding (GIS database #33). The stonework for all three of these foundations as well as the retaining walls is relatively massive pieces of unfinished iron bearing stone that appears to be waste rock generated by the mine. To the north of these foundations and a different angle is another foundation (GIS database #189). This foundation is poorly defined with only the south, east, and west walls being visible and these only defined by low berms and generally discontinuous stonework. Just north of this foundation is an additional possible foundation. This feature is only indicated by southeast and southwest corners and may not actually be a foundation. North of this foundation a secondary road intersects Copperas Road. This road winds its way up the slope toward the North Open Cut. Additionally, two twentieth-century exploratory drill casings are located around these foundations, one located 13-m northwest of the large foundation 13-m and the other close to its southeast corner.

The next foundation is located on the other side of Copperas Road (GIS database #41). Similar to a number of the foundations identified within the overall mine site study area, this one was built using a cut and fill method with the west side cut into the hillside and the east side supported by a berm. However, unlike the other foundations the berm for this one extends around all sides giving additional height to the upslope walls. The only stonework supporting the relatively steep berm is along its north edge and at the northeast corner. The foundation itself is divided into three sections. The western section appears to be the true cellar hole. This portion is 10-x-3.5-m and nearly 2 m deep. A possible entranceway is located on its south end. The eastern section is divided from the cellar by a stone wall that splits the majority of the foundation longitudinally. This portion is recessed but not nearly as much or as regularly as the cellar and may represent slumping rather than a true excavated cellar. The southern section of the foundation is enclosed only on its north, south, and east side, and is defined only by lines of stones on the surface. This portion of the foundation shows no evidence of excavation and may represent an open-ended pen. In general the stone work of the structure is dry-laid cobbles and glacial boulders, which is different from the structures on the other side of the road. The foundation rests on a large flat area east of Copperas Road. Given the generally sloped nature of the site and the abrupt transition back to hillside beyond the terrace it is likely that the area around the foundation was created or modified by humans.

Table 6-8. Summary of Artifacts from North Village, Domestic Portion, by Excavation Unit

Unit	Material													Total
	Brick	Charred Wood	Creamware	Earthenware	Glass	Glass, Molded	Iron	Ironstone	Lithic	Metal	Redware	Slag	Whiteware	
JTP-03					4									**4**
JTP-04	1				2		3							**6**
Surface							1							**1**
TF-01	18						6			1			1	**26**
TF-02	23		3	1	1		1	4			1	2	3	**39**
TF-03	5	3				1	3						1	**13**
TF-05												1		**1**
TF-06	3			1	5	2			1					**12**
Total	**50**	**3**	**3**	**2**	**12**	**3**	**14**	**4**	**1**	**1**	**1**	**3**	**5**	**102**

Table 6-9. Summary of Artifacts from North Village, Office Portion, by Excavation Unit.

Unit	Material										Total
	American Stoneware	Brick	Copper Alloy	Glass	Glass, Molded	Iron	Porcelain	Slag	Stoneware	Wood	
JTP-21		1				7					**8**
JTP-30		1									**1**
JTP-31	3	3		5	13	16	1	2	5	1	**49**
JTP-32			1					1			**2**
JTP-33		4									**4**
Total	**3**	**9**	**1**	**5**	**13**	**23**	**1**	**3**	**5**	**1**	**64**

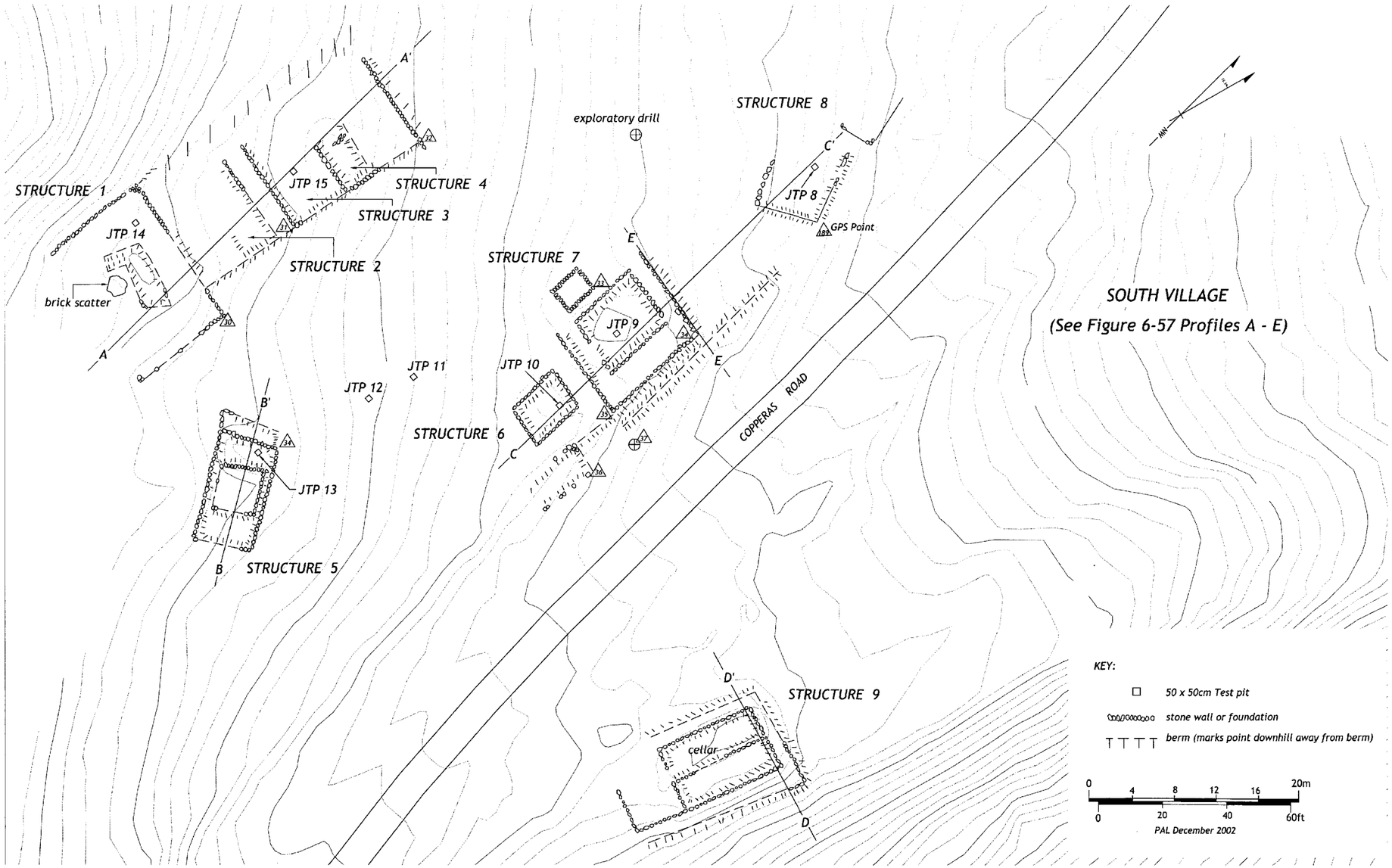
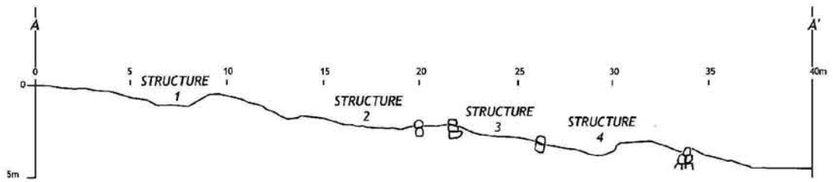


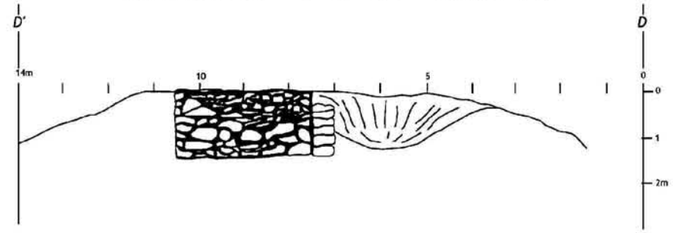
Figure 6-56. Map of South Village subsite.

SOUTH VILLAGE PROFILES

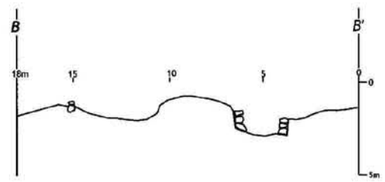
BISECTION PROFILE - STUCTURES 1-4 - FACING WEST



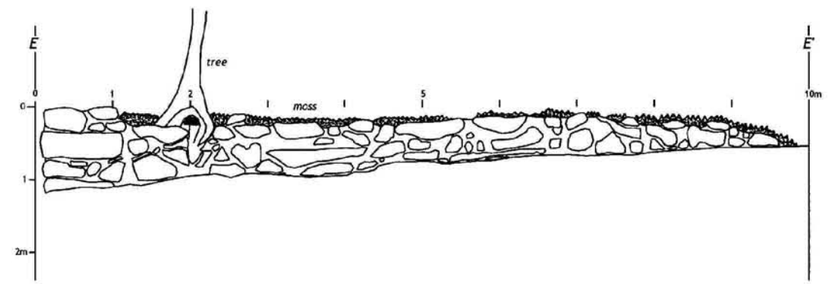
BISECTION PROFILE - STRUCTURE 9 - FACING SOUTH



BISECTION PROFILE - STRUCTURE 5 - FACING SOUTHWEST

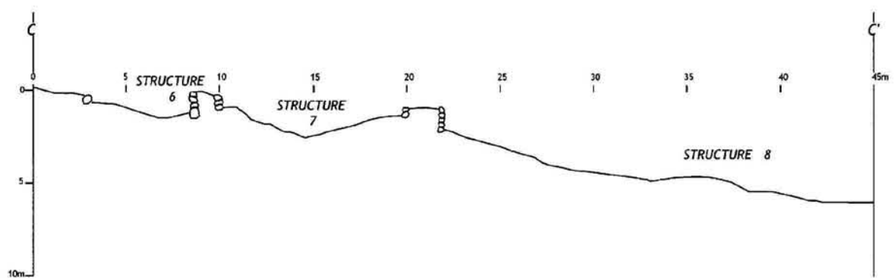


PROFILE - STRUCTURE 7 - FACING SOUTH



note:
the wall is made of sulfidic metamorphic schist
(possibly mine waste rock)

BISECTION PROFILE - STRUCTURES 6-8 - FACING WEST



PAL August 26, 2002

Figure 6-57. Cross-sections of South Village subsite.

Three similarly aligned stone walls, two east of the road and one to the west, are present 80-m south of the three foundations described above (GIS database #272-274). The eastern walls both have corners on both ends and the western of the two measures 32 m and nests within its 35-m mate. The wall west of Copperas Road measures 33 m long and has no corners. It is possible that these walls are the remains of a structure bisected by Copperas Road.

Eight test pits were excavated in and around the foundations on the west side of Copperas Road (see Figure 2-4). All of the pits contained cultural materials (n=366) recovered from 0 to 70 cmbs in various fill deposits below ground surface (see Appendix A and Table 6-10). Construction materials (nails, brick (sampled), and window glass) dominated the artifact assemblage. The majority of the nails were machine cut in addition to a few wire nails; similarly the bricks were a mixture of hand and machine-made. A number of pieces of wood, charred and unaltered, and a piece of roofing slate were recovered as well. However, unlike many of the subsites a substantial amount of other cultural material types were recovered during the subsurface testing. These types include a wide variety of ceramic sherds (American stoneware, generic stoneware, creamware, pearlware, redware, yellow ware, whiteware, and generic earthenware), along with two kaolin or kaolin-like pipe fragments. One of the fragments, a bowl, is decorated with the image of a ship (Figure 6-58). Decoration motifs on the ceramics consist of flow black, hand-painted, slip, sponge, and transfer print. Other artifacts of note include an iron escutcheon, numerous glass bottle fragments, and flat pieces of iron, lead, and copper alloy. Additionally, unlike any other subsite in the study area, the test pits placed in the South Village subsite yielded a sizeable faunal assemblage. Of the 24 bones recovered, 17 were identifiable in terms of species, including bird, pig, one large mammal, and three unidentifiable mammals (Table 6-11). Nine cat bones were also found in a fill deposit between 20 and 30 cmbs, probably representing the remains of a household pet or a feral intrusive.

The soil stratigraphy in this subsite was varied, but uniformly consisted of fill deposits (Figure 6-59). JTP-11 and JTP-12 were excavated along a possible roadbed and revealed deep fill (75->100 cmbs) over a green-gray (4/5 gley) silty medium sand B stratum. The remainder of the pits, with the exception of JTP-8 were rock impeded at various levels, possibly suggesting rock-lined floors or the natural state of the soils. JTP-8 was excavated to 76-cmbs with what appears to be a fill/B interface at 68-cmbs.

Twin Foundations (Partially Within APE)

The Twin Foundations subsite extends downslope to the east of South Village and consist of two foundations, an associated surface artifact scatter, a depression, and a flat area (Figure 6-60). These two foundations are nearly identical in layout but vary slightly in scale. The western foundation is 5.5-x-3-m while the eastern foundation is 5-x-3-m; both are approximately 1 m deep (GIS database #42, 43). Similarly, both foundations are stone-lined cellar holes with approximately three-quarter m wide berms on their north, east, and west sides. The hillside supports the south cellar wall. The east and west berms of both foundations extend 4 m beyond their south wall. The extensions on the east foundation contain some stone, both berms taper into the hillside. These berms represent either extensions of the structures without cellars or porches. The only other distinction between the two foundations is a large flat stone in the east wall of the western foundation that projects at an angle from the rest of the wall. There is a degree of slumping under the stone but it appears that it was laid at this odd angle. The intent of the mason is unknown. An unnatural flat spot is located 17-m south of the foundations and a watered depression, possibly a well, is situated 42-m north of the foundations (GIS database #45, 46, 47).

No test pits were excavated in this subsite because of its peripheral position relative to the APE (the APE bisects the foundations) and the abundance of surface evidence for cultural remains in the area (GIS database #44). Just south of the foundations in a ravine formed by the south berm of the south foundation and a natural rock outcrop is a 2-x-10-m dense surface scatter of artifacts. The majority of the artifacts appear to date from the mid-nineteenth century and cover all materials classes, except wood and bone. Iron is underrepresented because of the acidic nature of the soils, but multiple bottles and ceramic tableware are evident. Similarly, large fragments of an earthenware chamber pot are apparent on the surface.

East Village (Partially Within APE)

The East Village subsite is located just east of the bend in Mine Road, primarily on the south side of the road, but with a number of significant resources extending north of the road (Figure 6-61). The resources south of Mine Road consist of three foundations, roughly in line running east-west. Two of these cellar holes are similar square features, while the easternmost is rectangular structure with a half-cellar hole. A number of man-made depressions extend up-slope to the south of these foundations. North of Mine Road are two foundations that appear to be the remains of a farmstead. Artifacts associated with modern dumping along Mine Road are distributed throughout the site, but are concentrated in the eastern foundation, north of Mine Road. Artifacts possibly associated with the occupation of the site are visible on the surface and in the roots of a tree-fall south of Mine Road.

East Village includes three foundations south of Mine Road. The easternmost of these foundations is a deteriorated 10-x-6-m stone cellar hole (GIS database #54). The northern portion of the cellar is clearly excavated, though the walls have slumped in. However, the southern section appears to have never been excavated. The excavated portion of the cellar appears to have an entrance on its east side where there appears to be the remains of a stone bulkhead entrance. Two pipes located upright 2.5-m from the northern corners of the structure may have supported a porch roof or other structure. There is a scatter of bricks in the southwest corner of the foundation and there are patches of day lilies north and east of the foundation. South of the foundation is a retaining wall that serves to keep the hillside from impacting the structure. The retaining wall bends northwest and then tapers into a berm as it passes west of the foundation. Located 21-m west of the foundation is a second foundation, this one measuring nearly 7 m square, with collapsed stone walls making close measurement difficult (GIS database #55). Large cut granite sills are located at the northeast, northwest, and southwest corners; the northern two are fire reddened. Finally, west of this foundation is a third foundation (GIS database #56). The third foundation measures approximately 8-x-7.5-m with discontinuous stonework and an excavated cellar defining its extent. Two cut granite sills are located in the northeast corner and one in the northwest corner. The granite in the northwest corner exhibits a number of flat triangular quarry holes 6-cm long, 1-cm wide, and 8-cm deep. These marks may have been created by the use of a cape chisel (Gage and Gage 2002:42). South and upslope from this foundation is a line of depressions with back dirt and waster rock piles nearby (GIS database #49, 50, 505). The one farthest from the foundations has steel iron angle brackets at the corners, suggesting that the depression may be a covered well.

Directly north across Mine Road are the remains of a historic farmstead consisting of a house, barn, and a number of associated resources. The eastern structure in the complex appears to be a barn and measures 9-x-6-m and 1.5-m deep. The north and west walls of the cellar are supported by a berm, while the road terrace/hillside support the other two. There is a possible entranceway

Figure 6-58. Fragment of smoking pipe bowl recovered from South Village subsite, note the ship image on bowl.

Table 6-10. Summary of Artifacts from South Village by Excavation Unit.

Material	Unit									Total
	JTP-08	JTP-09	JTP-10	JTP-11	JTP-12	JTP-13	JTP-14	JTP-15	Surface	
American Stoneware									6	**6**
Bone		1	16	6	1					**24**
Brick	5	21	9	3	7	27	3	1		**76**
Charred Wood				1	2					**3**
Clay				1	1					**2**
Copper Alloy				1						**1**
Creamware					1					**1**
Earthenware					1					**1**
Glass	1	6	27	2	19	4	5			**64**
Glass, Molded				7	1					**8**
Iron		9	29	17	8	21	6	2		**92**
Iron Ore					1					**1**
Lead				1						**1**
Lithic					1					**1**
Mortar		3								**3**
Pearlware				2	3					**5**
Pyrite				1						**1**
Quartz					1					**1**
Redware				1	7					**8**
Slate							1			**1**
Stoneware					6					**6**
Whiteware		1		11	39	1				**52**
Wood	1	3			1					**5**
Yellowware				3						**3**
Total	**7**	**44**	**81**	**57**	**100**	**53**	**15**	**3**	**6**	**366**

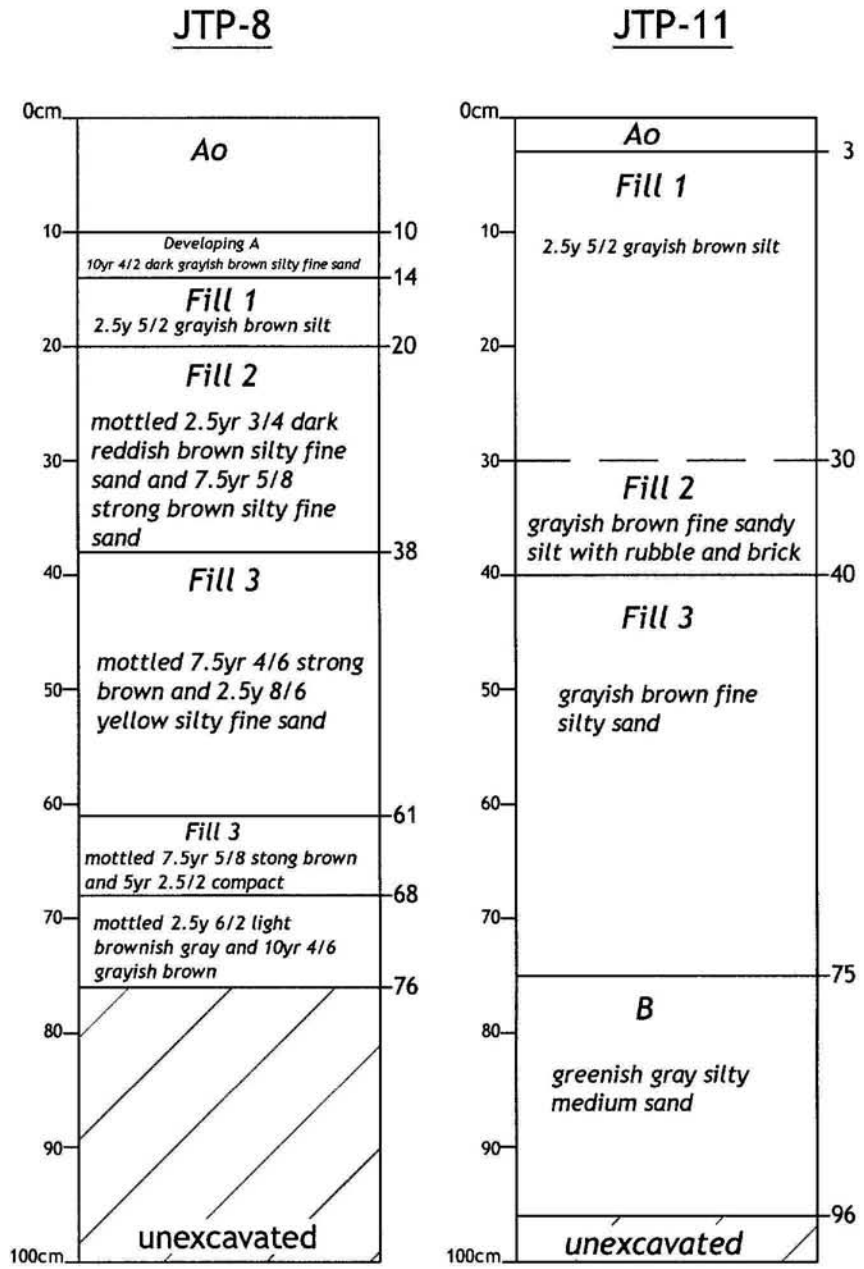


Figure 6-59. Representative soil profiles excavated at the South Village subsite.

Table 6-11. Summary of Faunal Remains from South Village by taxa.

Taxa	Element-Portion	Element Name											Total
		Femur	Humerus	Radius	Scapula	Tibia	Ulna	Carpometacarpus	Mandible	Tooth	Vertebra	Misc-Long Bone	
Aves	Long Bone-Distal end							1					**1**
Felis sp.	Long Bone-Nearly Complete		2										**2**
	Long Bone-Distal articular condoyle	1											**1**
	Long Bone-Distal end					1							**1**
	Long Bone-Proximal end			1			1						**2**
	Scapula-Glenoid fossa and incomplete blade				2								**2**
	Vertebra-Nearly Complete										1		**1**
Mammalia	Long Bone-Distal end	2											**2**
	Long Bone-Distal portion of shaft											1	**1**
Mammalia (Very Large)	Vertebral-Sacral wing										1		**1**
Sus scrofa	Mandible-Alveolar frag. of cheekteeth								2				**2**
	Tooth-Incisor									1			**1**
Total		**3**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**17**

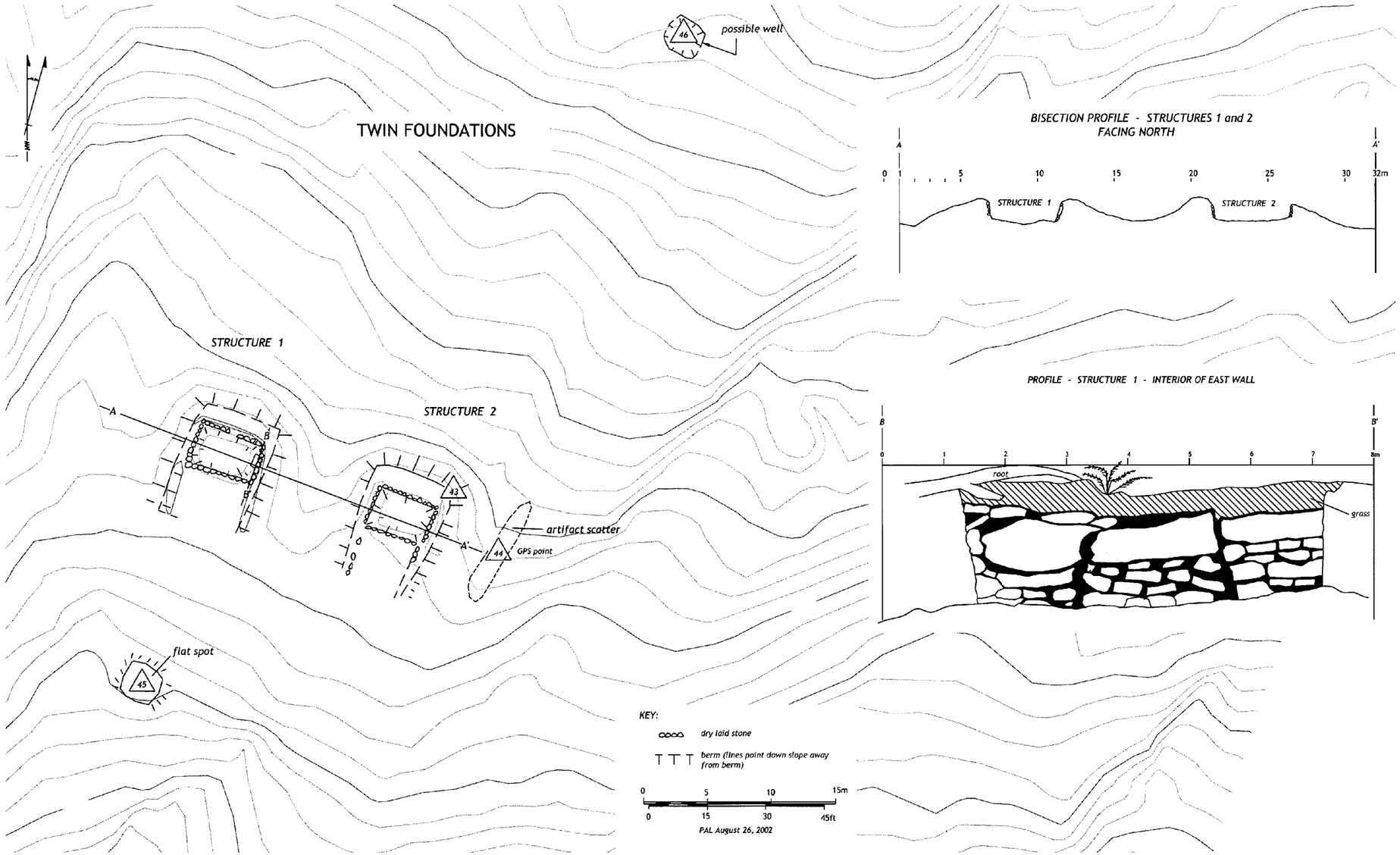


Figure 6-60. Map of the Twin Foundations including cross-section looking north.

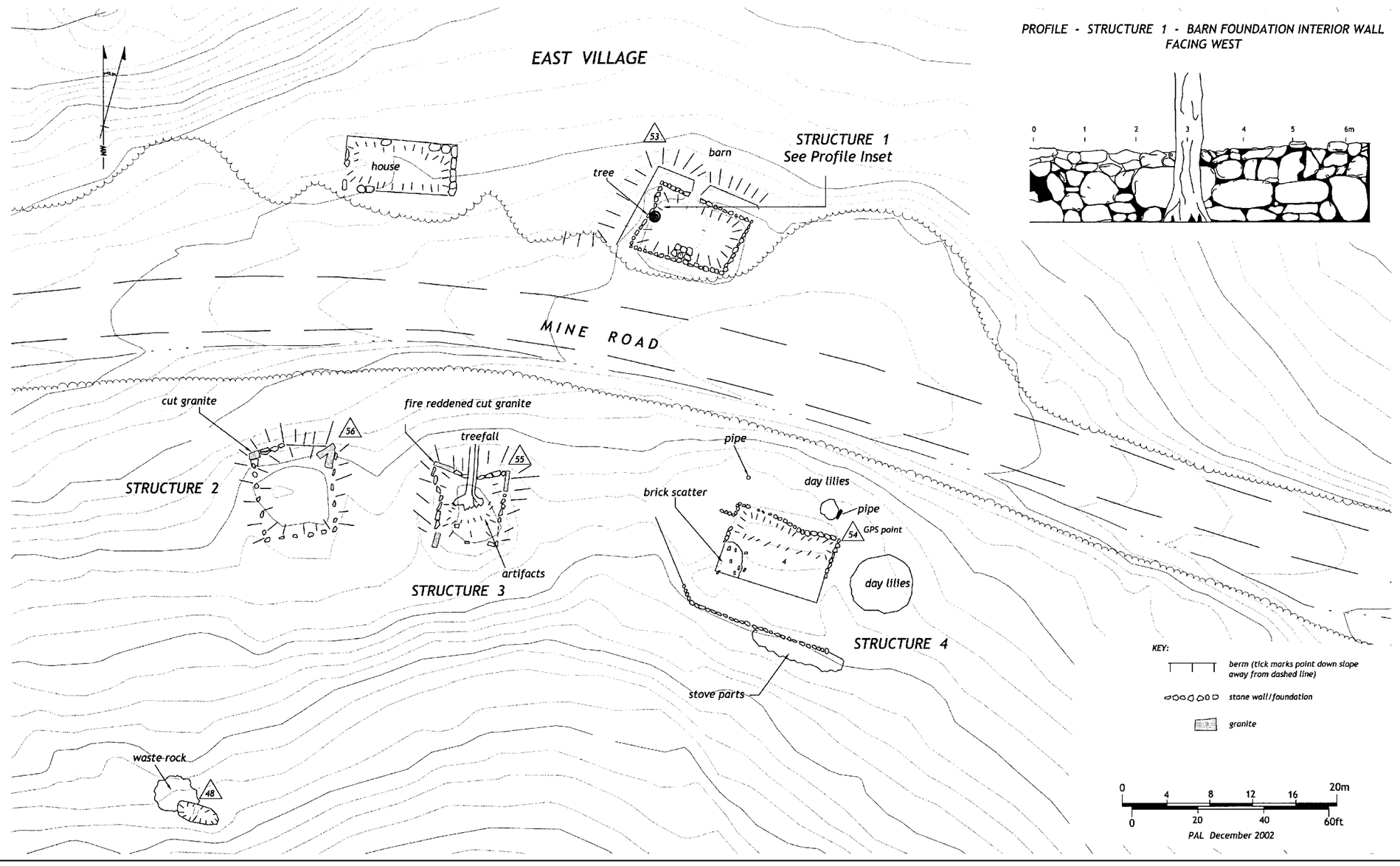


Figure 6-61. Map of the East Village subsite including a profile of the west wall of the barn foundation north of Mine Road.

in the north berm and wall. It is not possible to positively identify this break as an entrance because of the deterioration of the surrounding walls. A stone pad is located in the south-central portion of the cellar. Located 20-m west of the barn is the 10.5-x-3-m house foundation. The house is in worse condition than the barn with only portions of its stone cellar still evident. Additionally it is considerably more shallow, approximately one-half-m deep. A number of the surrounding stone walls appear to be associated with the farmstead. At the end of one of these walls on the terrace overlooking Copperas Brook 57-m north of the barn is a piece of farm machinery, likely part of a tractor or associated cultivating equipment (GIS database #79). Another stone wall northwest of the farmstead has a gate in it (GIS database #90). Just south of the gate is an ambiguous depression measuring 6-x-3-m (GIS database #510). The area surrounding the gated wall appears to have been cleared until sometime within the past 50 years at which point it was allowed to return to wood lot. Extending from the gate, heading north and east along the contours of the hill, is a path that eventually runs into TP 2. A boulder quarry is present north of where the path disappears beneath TP 2, at a distance of 134-m north of the barn (GIS database #87). The granite boulder, a glacial erratic, is split in half with a number 3.2-cm diameter and smaller drill holes. A number of split pieces of the boulder lie nearby.

Similar to Twin Foundations, East Village was not subjected to subsurface testing because of its peripheral nature relative to the APE and the clear evidence for cultural remains at the subsite. However, unlike Twin Foundations, East Village was surface-collected for diagnostic artifacts (n=23) (see Appendix A and Table 6-12). Structure four had the nearly complete remains of a cast iron stove in a concentrated surface scatter near it southeast corner. The stove was decorated with a moderately elaborate floral motif (Figure 6-62). Also collected from structure four were an ironstone saucer and remnants of two glass storage jars. Structure two yielded a mostly complete firebrick, marked "J & M Craig Kilmarnock No. 1" (made in Scotland) possibly transported there from elsewhere on the site (Figure 6-63). Structure three contained the bulk of the cultural materials both deposited on the surface and within the roots and displaced soils of a tree-throw. A number of pieces of representative construction debris samples were collected including brick, window glass, and machine-cut nails. The large ceramic assemblage includes porcelain and whiteware plates, many with various examples of blue shell-edged decoration. Additionally, a stoneware crock and various yellow ware sherds were collected. A tin egg cup was recovered from this site as well. Many of the artifacts recovered from structure three, like the foundation itself, show evidence of exposure to heat.

Table 6-12. Summary of Artifacts from East Village.

Stratum	Material										Total
	Brick	Glass	Glass, Molded	Iron	Ironstone	Porcelain	Stoneware	Tin	White-ware	Yellow-ware	
Surface	2	3	3	3	1	1	3	1	5	1	23
Total	**2**	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**5**	**1**	**23**

Unidentified Documented Resources (Completely Within APE)

A number of documented historic period resources that could not be identified in the field were geo-referenced from historic maps onto the one-half-m contour site base-map. These nineteenth and early twentieth century resource areas are currently located under TP 1 and TP 2, created during the 1940s and 1950s. It is possible that physical remains of these resources have survived

under the tailings piles. They include: 1) the ca. 1900–1902 Tyson Smelter Plant; 2) the ca. 1907–1909 Heckscher Smelter Plant; 3) the Preston Farm. All of these documented, but unidentified resources are within the project APE.

Both the **ca. 1900–1902 Tyson and ca. 1907–1909 Heckscher smelter plants** are located under the north and west edges of TP1 (Figure 6-64). It is possible that buried remains of Tyson's smelter are still present at either side of the toe of the west edge of TP 1 north of the World War II mill and south of the Warming Hut. It is also possible that buried remains of Heckscher's blast furnace with its stack (demolished) attached via a 108-m flue (partially demolished), a dam with associated reservoir and pump house, coke storage buildings, and the boarding house are present just beneath the northern toe of TP 1. The presence and proximity of the Heckscher resources are indicated by the burnt ore and slag near the center of the north toe just beyond the pile itself. Additionally, the berm and valley strange topography at the seep at the center of the toe of TP 1 now appear almost certainly to be the remains of Heckscher's dam, providing a visible geographic reference point for the other resources. Other documented resources beneath the central portion of TP 1 include the assay office, an unidentified structure, and the ore trestle that connected the mine with the smelter.

The geo-referenced 1890s map shows the farmstead of the 225-acre **Preston Farm** located just under the east toe of TP 2 and possibly under the western reaches of TP 1, 40-m north of the ravine caused by the collapse of the Copperas Brook culvert (Figure 6-65). The farmstead appears to consist of six structures on both sides of the historic road still visible as a sunken roadway between two stone walls south of TP 1. In an attempt to identify the site, two test pits were excavated south of Copperas Brook, but still within the bounds of TP 1/TP 2 (see Figure 2-4). The pits yielded 21 cultural materials (molded bottle glass, flat glass, brick, and three redware ceramic sherds) from 0 to 40 cmbs in tailings deposits (see Appendix A). The eight test units excavated farther south, beyond the bounds of TP 1 on the east side of the historic road appeared to contain a plow zone stratum to a depth of 45 cmbs, but no artifacts were recovered (see Figure 2-4).

Figure 6-62. Cast iron stove door recovered from East Village subsite.

Figure 6-63. Refractory brick from East Village subsite.

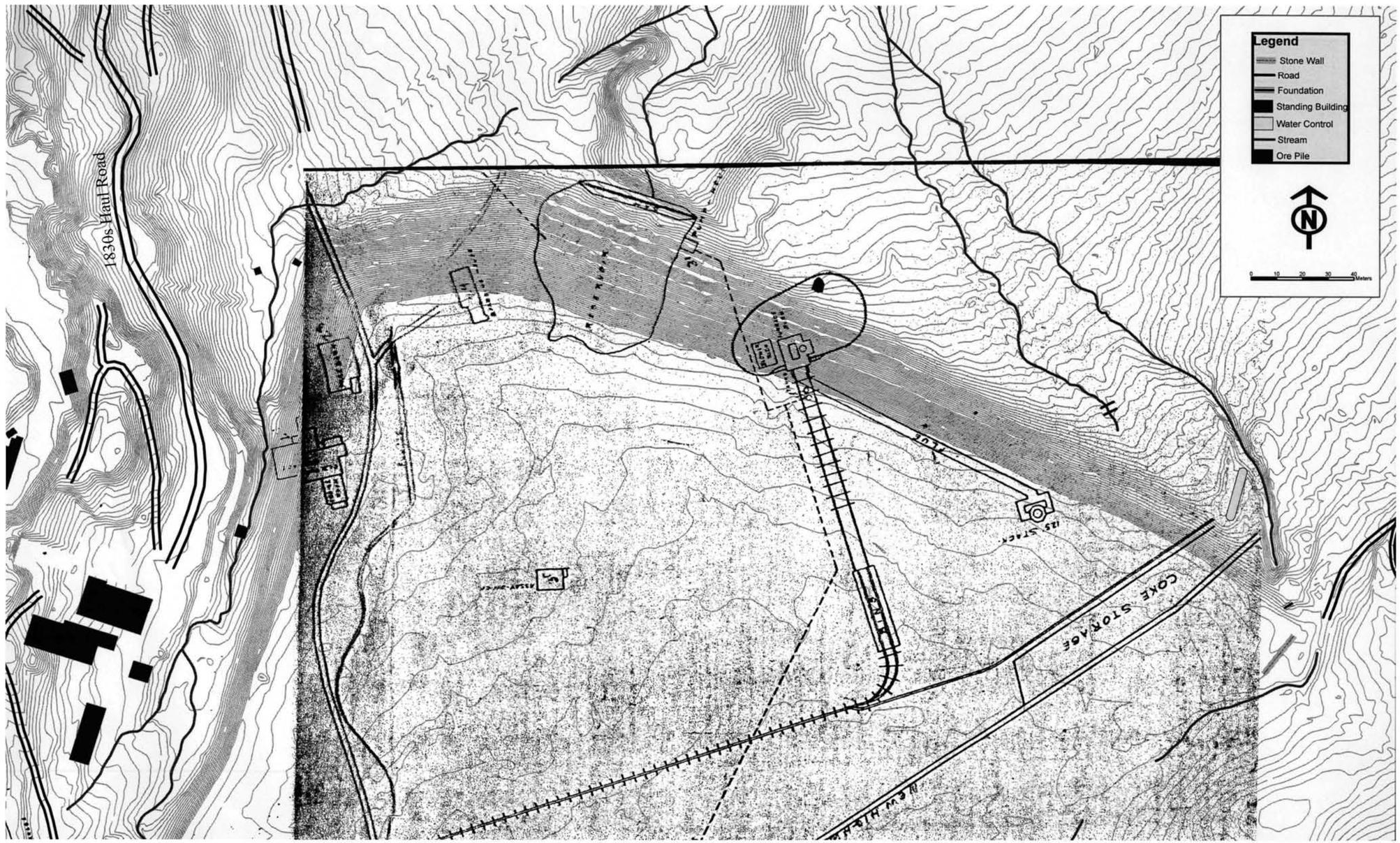


Figure 6-64. Selected portion of the ca. 1910 map geo-referenced onto the project map, depicting potential resources beneath Tailings Pile 1. [Root mean square error is 8.3 meters]

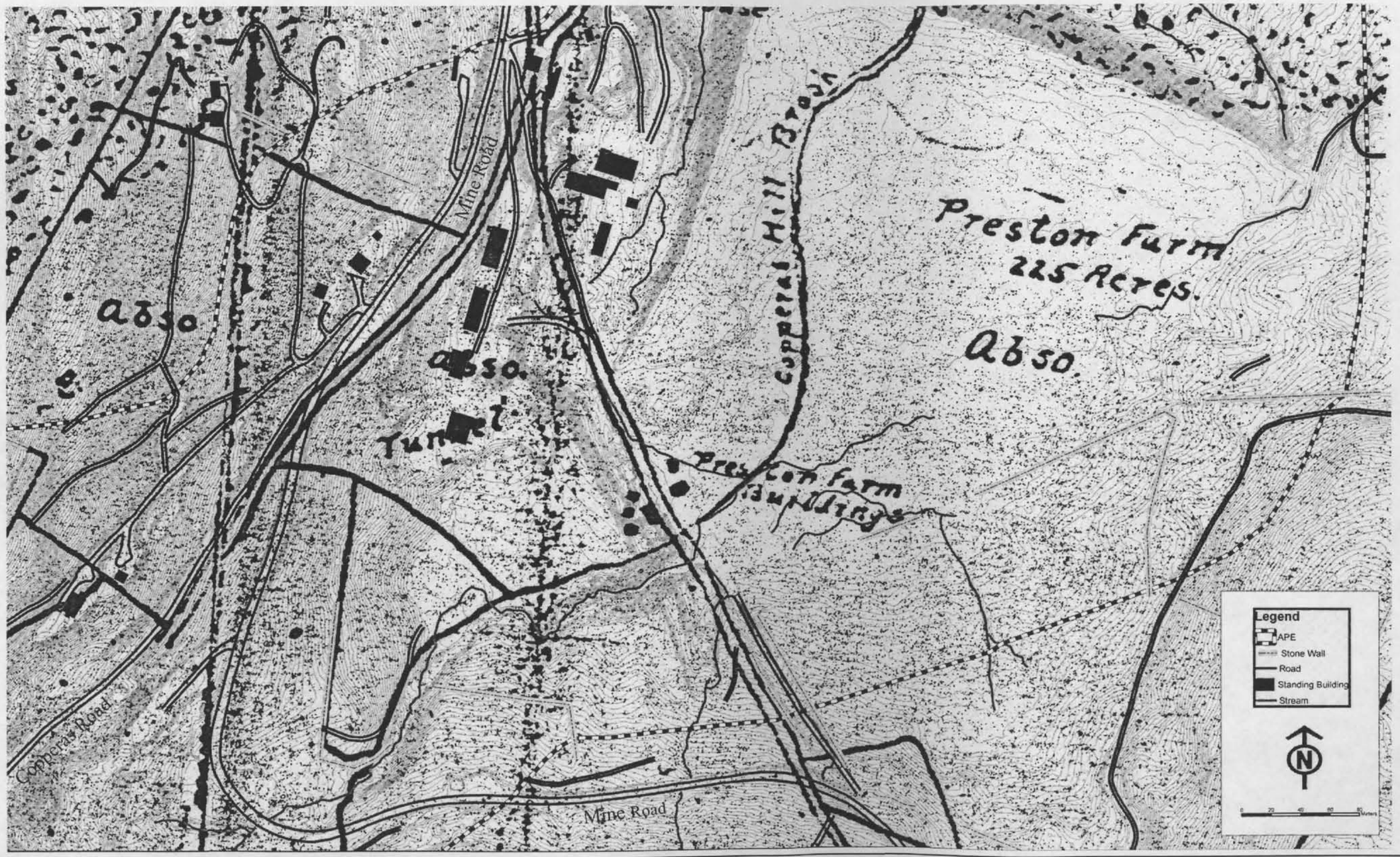


Figure 6-65. Selected portion of the 1890s map geo-referenced onto the project map, showing the probable location of the Preston Farm. [Root mean square error of 24.2-meters]

GCHAPTER SEVEN

INTERPRETATIONS

Prehistoric Period Resources

No prehistoric period cultural resources were encountered during the archaeological mapping and testing at the Elizabeth Mine Site. While upland cultural adaptations have been recorded in northern New England, especially during the Late Archaic and Late Woodland periods, the focus of Native American activity in the region appears to have been concentrated in the major river valleys. With the Connecticut River only a few miles to the east, there may have been only sporadic prehistoric period settlement and land use in the vicinity of the West Branch of the Ompompanoosuc River and Copperas Brook. The rugged, upland topography would not have been particularly attractive for the types of long-term habitation activities (e.g., structures, food processing/storage/disposal pits, hearths, lithic workshops) that would have left readily discernable cultural deposits in the archaeological record at the site. There are only limited settings within the site study area that are relatively flat and contain sources of raw materials and perennial water sources where potentially important prehistoric period resources could be present. These settings include the terrace overlooking the West Branch of the Ompompanoosuc River in the northeast portion of the study area, north of TP1; and quartz outcrops in the west-central portion of the study area, west of the North Open Cut.

Historic Period Resources

Cultural Landscape

The identified historic period architectural and archaeological resources at the Elizabeth Mine Site are all components of a larger, complex, integrated cultural landscape. The Elizabeth Mine can be considered a single megasite composed of numerous temporally, functionally, historically and physically related industrial, agricultural, domestic and administrative subsites. The natural and man-made environments provide the most dramatic visual images of the mine, and are as important as the buildings, structures, features, and artifacts arranged within them. Mining landscapes can be characterized and distinguished by historic patterns of land use such as strip-mining, hydraulic mining, or open-pit mining; the spatial organization or layout of the landscape; characteristic natural and cultural landforms such as mine waste rock dumps and mill tailing flows; roads and pathways; vegetation patterns related to land use such as secondary growth of plants on mine waste rock dumps; distinctive buildings and structures; clusters of buildings and structures such as those at mines and village settlements; and small-scale features such as mine claim markers, stone walls, or fences (Noble and Spude 1992). The cultural landscape at Elizabeth Mine provides insights into the technological advances of copperas production, copper mining and metallurgy, and informs about how the arrangement of features defines socioeconomic relations of the inhabitants. The Elizabeth Mine landscape took its form as a result of cultural, technological, and environmental factors.

The topography at the Elizabeth Mine and the shape and orientation of the orebody within its host rock played an important role in the development of the historical landscape. The North Open Cut orebody outcrops at the east shoulder of Copperas Hill, at an elevation of 1,300 to 1,400 ft. The bowl-shaped hillside below the cut drops to an elevation of 1,140 ft at Mine Road. This natural hillside amphitheater, which includes springs and is the headwaters of Copperas Brook, provided a fortuitous landscape for the

nineteenth-century gravity and water-fed, cascading copperas manufacturing process that incorporated timber structures and engineered surfaces in its ore roasting, heap leaching, and liquor conveying steps (Figure 7-1). As the north-south oriented orebody was exploited increasingly to the north and deeper underground as time progressed, infrastructure and activity followed the trend of the ore. First mined from an open pit, the plunging shape of the orebody required new access points from progressively longer adits to the east down the slope of Copperas Hill during the mid-nineteenth century. In the 1880s the northward trend of the ore dictated that James Tyson's shafts be located north of the North Open Cut. Again in 1898 and 1948, the northward and downward progress of mining required the driving of lower, longer adits to the north and east of the ore trend. Again in the early 1940s the topography of the Copperas Brook valley allowed placement of the cascading processes of the ore crushing and flotation plants, and the nearby, downslope deposition of tailings pumped in a water slurry. Smelting site locations were particularly dependent on water for power, and later, for blast furnace hearth cooling. The earliest smelters, which operated in the 1830s and in the Civil War period, were located to the north of the mine on the West Branch of the Ompompanoosuc River, and 1880s smelting was located to the west on Sargent Brook. These operations were distant from the site and required significant effort to haul cobbed ore from the mine. Once steam, and later, electric power were brought to the mine, James Tyson, Jr. and August Heckscher were freed of waterpower constraints and could build their smelters close to their mine openings. These shifting mine access points, smelter sites, and their immediate topography dictated the location of mining-era processing facilities, waste deposits, and habitation sites.

The results of the copperas and copper mining and processing campaigns noted above left behind visible and belowground landscape features at the site, the largest and most dramatic being the North Open Cut, South Open Cut, and Tailings Piles 1, 2 and 3. Irrespective of the historical significance of the activities that took place there or the specific artifacts and features that these subsites contain, these landscapes are, in and of themselves, important historic resources. They represent large outdoor industrial artifacts of the historic attitudes of entrepreneurs and industrialists toward mineral resources and the environmental consequences of their extraction.

The Elizabeth Mine landscape contains historically significant industrial archaeological sites. Furnace Flats South was the site of American non-ferrous metallurgy firsts including the first successful, large-scale, mine-side copper smelting operation, the first use of hot blast and anthracite coal in copper smelting, and the first successful smelting of sulfide copper ores in a masonry-lined furnace. The Copperas Works including the North Open Cut, TP 3, the Upper Copperas Factory and the Lower Copperas Factory is the only known archaeologically investigated copperas works in the United States. The Tysons' late-nineteenth-century smelting furnaces were one of the earliest applications of chromite refractory materials and were an incremental step in the ultimate development of the copper converter. Clearly, a number of historically important industrial events took place at the Elizabeth Mine. Outside the main mine complex in the Copperas Brook valley, the Elizabeth Mine Site includes a number of remote, discrete and well-preserved industrial complexes such as Furnace Flats North and South, the Old South Mine and Sargent Brook Smelter.

The Elizabeth Mine landscape includes a variety of historic domestic archaeological resources that reflect different aspects of mining- (and some non- or pre-mining) associated human activity. The variety of domestic sites at several locations are evidence of the mine workers' and managers' lives and their relationships with the surrounding agrarian community. Several sites and buildings are also present and reflect the administrative aspects of mine operations. The domestic resources and associated agrarian elements including field systems could be in part visible manifestations of the mine companies' conscious choices regarding the ordering of the site, including provisions for feeding and sheltering their employees.

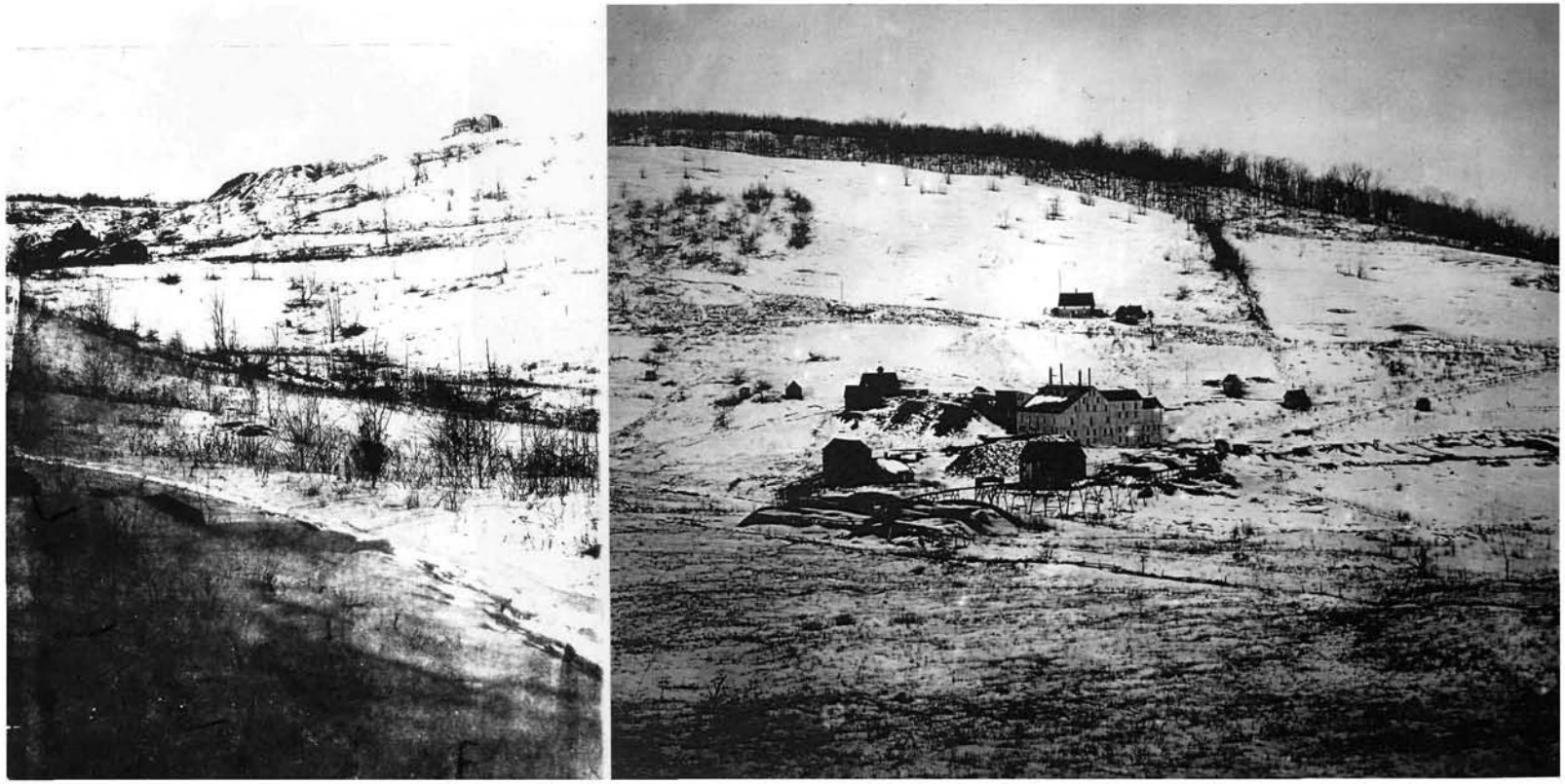


Figure 7-1. Combination of two historic photographs showing most of western half of Copperas Brook valley (source: Strafford Historical Society, Strafford, VT).

The Elizabeth Mine landscape includes standing architectural resources. The World War II-era plant includes the only intact complex of historic hard rock metal mining buildings in the Eastern U.S., and the only remaining historic flotation mill of its class east of the Rocky Mountains. Several nineteenth-century domestic architectural resources reflect the earlier architectural trends and domestic occupation characteristic of the mine.

All of these resource groups in the Copperas Brook valley, and in the remote mining and processing sites, were linked by transportation routes and/or materials handling and energy transmission systems. Traces of many roads are still visible, and these routes were vital for carrying ore and supplies. Water was important to early operations on TP3 to leach the copperas from the ore, and channels and a reservoir remain from this period. Waterpower was used at Furnace Flats to drive furnace blowers and at Sargent Brook and Copperas Hill to cool furnaces. Pump houses were built and pipelines were laid to bring water to the mine site, and electrical lines were strung to power equipment and light the plant. Scattered discrete resources including power poles, fire hydrants, and exploratory drill casings are all evidence of the linking systems and widespread human presence within the Elizabeth Mine landscape.

Industrial Archaeological Resources

The historic and archaeological mapping and testing program identified 11 industrial archaeological subsites, six of which are completely or partially within the project APE (Table 7-1). These subsites have been interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address salient research questions, as discussed in detail below.

Furnace Flats North (Outside APE)

Copper smelting was conducted at Furnace Flats North from about 1854 until 1867 and then again briefly in 1884. Additional associated water-powered industrial activities were conducted during and outside of those years. The only historic cartographic representation of the area is the 1874 Vermont Copperas Company map (see Figure 5-8). This map indicates that there were four houses north of what is now Route 132, and south of that road there was a dam, sawmill, cooper shop, furnace, paint factory, barn (or bath), and a house. This configuration corresponds closely to the resources recorded during the detailed site mapping. The north end of the dam is still extant. South of the dam is the retaining wall that appears to be the east wall of the sawmill. The purpose of the angled end and dogleg in this wall is not apparent. It is possible that the other walls of the mill were supported by posts in the water, or that the stone foundations have been washed out. Regardless, based on its elevation relative to the dam and the furnace wheel pit it appears that the foundation represents the interior of the sawmill's waterwheel pit. The footpath connecting the sawmill foundation with the next foundation downstream may correspond with the location of the raceway, as it appears that all of the water-driven machinery at Furnace Flats North was driven by a single raceway leading from the dam to the blast furnace building.

The next structure downstream corresponds with the cooper shop as shown on the 1874 map. Inside the foundation is an iron turbine shaft, possibly from one of the three turbines mentioned in the 1880 Census of Manufactures (Vermont State Library). It is likely that the foundation that contains the turbine shaft is the wheel pit. It is unknown if the nested corner walls up slope are the actual foundation of the cooper

Table 7-1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
World War I Smelter	1916	- Concrete platform (floor); - Piles of brick and rebar; - Iron scraps and slag	Eight test pits - yielded construction materials including a handmade brick	Poor	Poor	Low
Tyson Mill	1899 to 1930	- Section of stone foundation - Concrete pads and piers; - Angle iron bases; - Timber arrangements	Twelve test pits in blacksmith shop area - yielded fire-reddened earth, coke, slag, charcoal, and window glass	Fair to Good?	Fair	Moderate to High
Tailings Pile 1	1940s to 1950s	415-m-x-490-m flat, triangular plateau of mine waste; visible launder trestle supports	N/A	Excellent	Good	Low
Tyson Smelter (buried under west toe)	ca. 1900-1902	None	N/A	Unknown	Fair	High
Heckscher Smelter (partially buried Copperas Brook dam and slag heap - north toe)	ca. 1907-1909	- Burnt ore and slag; - Dam remains (altered topography)	N/A	Unknown	Fair	High

Table 7-1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Tailings Pile 2	1940s to 1950s	150-m-x-140-m triangular flat-top pile of mine waste	N/A	Excellent	Good	Low
Buried ephemeral Tyson Mill Period outbuildings/sheds and waste rock piles. (See Preston Farm, Table 7-2)	ca. 1900-1902	None	N/A	Unknown	Poor	Low
Tailings Pile 3 (contains visible remains of 19th c. and early 20th c. resources)	1809-1958	See below	See below	See below	See below	See below
North Open Cut	1809-1958	Open excavation	N/A	Excellent	Good	Low
Tyson Mining Zone	ca. 1880s	- Manway; - Shafts 1 and 2; - Clinker pile; - Waste rock	No subsurface testing conducted	Fair	Fair	Moderate
Water Reservoir and Dam	19th century	- Dam - Reservoir	No subsurface testing conducted	Good	Low	Low
Leaching and Roasting Beds	1809-1882	- Scaffolding : wood planks and timber features; - Brick-lined channel; - Ore corrals - Piles of roasted ore, - Piles of burnt fused ore - Piles of waste rock	Four test pits - yielded construction materials and industrial waste	Fair	Fair	High
Blacksmith Shop	ca. 1874	- Stone foundation; - Iron plates and implements	See above	Fair to Good?	Poor	High

Table 7-1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Cob Shop	ca. 1874	- Stone foundation	See above	Fair to Good?	Moderate	High
Upper Adit	ca. 1830	- Possible stone foundation - Collapsed mouth	See above	Fair	Poor	Low
Lower Adit (Deep)	ca. 1854	-collapsed mouth -wasterock pile	No subsurface testing required	Fair	Poor	High
Evaporators	ca. 1874	- Possibly one of 3 visible as stone wall protruding from yellow waste-rock	No subsurface testing conducted	Poor	Poor	High
Upper Copperas Factory	19th century	- Interior and exterior stone foundations, stanchions, and wood wall posts	Five test pits - yielded construction materials and industrial waste; three ceramic sherds	Good	Poor	High

Table 7-1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Lower Copperas Factory	19th century	- Interior and exterior stone foundations; iron chutes and plats; platforms; stanchions, brick piles; earth berms	No subsurface testing conducted - fire brick and iron bracket (wood supports) surface collected; iron chutes and arch noted.	Excellent	Poor	High
Outside of the APE:						
Furnace Flats North	1854-1884	- Dam embankment - Saw mill foundation - Cooper shop foundation and turbine shaft - Wheel pit - Furnace area - Two paint factories - Bath house foundation - Bridge abutment - Domestic component: two house and one barn foundations	No subsurface testing conducted	Excellent	Poor	High
Furnace Flats South	ca. 1830	- Bridge abutment - Haul road (1830s) - Furnace debris including salamanders, slag piles, and refractory material - Charcoal storage platform	No subsurface testing conducted	Excellent to unknown	Poor	High

Table 7-1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Sargent Brook Smelter	1882-1890	- Haul road - Foundation - Stalls - Reservoir - Dam - Charging ramp - Furnace floor - Furnace hood and binder rods - Slag dump	No subsurface testing conducted	Good	Fair	High
Old South Mine	early 19th century	- Two large excavated trenches - Waste rock piles - Exploratory trenches - Adit mouth - Domestic foundation	N/A	Good	Poor	Moderate
South Open Cut	1950	- 500-m-x-40-m excavated trench; - Various logging and haul roads; - Tunnel leading to North Open Cut; - Drill steels in bedrock. - Waste rock pile	N/A	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address research questions relating to the mine technology and the lifeways of mine workers.

shop, although it seems unlikely based on their orientation. The row of wrought iron hoops extending to the east indicate the continued orientation of the raceway, here carried by a wood stave penstock. It is likely that the penstock was supported on a trestle and as it rotted and collapsed the hoops maintained their original location. The trestle would have been necessary to give the water sufficient height above the wheel or turbine in the pit to provide the head to generate power. The wrought iron plate in the east could have functioned as an axle support for a water wheel or a shaft support for a turbine. The tailrace appears to have exited at the bottom of the west wall of the pit.

The walls east of the pit are the foundation of the copper smelting blast furnace building. The furnaces were likely located immediately south of the wheel pit in the area where the pins and slag are located. This area is flat and close to the source of power for the air blast bellows, but also far enough removed from the water to keep the molten metal and slag safely away from moisture. It is unclear if the rest of the furnace building foundation has been destroyed or was originally constructed of wood. South of the furnace area are two similar low, long, narrow stone foundations separated by patches of red earth and a pile of ore and waste rock. Based on the correlation of field mapping and 1874 map these structures could be the paint factories that produced red paint from the waste products of ore processing. The slightly smaller north foundation appears to be the remains of the earlier factory, and the south foundation appears to be the factory constructed in 1863 and shown on the 1874 map as its location most closely matches the 1874 map (Nash n.d.). Apparently, the two paint factories did not operate simultaneously for very long as the 1865 inventory only mentions one paint factory at the site (Reynolds 1865). The patches of discolored earth could represent waste from the paint-making process or the raw material itself. South of the paint factories is the north abutment for the bridge that connected the subsite to the remainder of the mine landscape and permitted the transportation of ore from the mine to the furnace site.

East of the bridge is the partially stone-lined foundation cut into the river terrace bank. The writing on the 1874 map is unclear, but appears to indicate this structure as a "bath," although the structure could be a barn. The latter use is possible given its proximity to a large domestic foundation and historic road.

The large house foundation southeast of the barn/bath does not appear to have been owned by the mine based on the 1877 Beers map. The house may have been occupied by either a J. Bryant or may be the house that J. Burnham "settled" in about 1815 (Beers 1877). The massive stone and fill pier in the center of the foundation appears to be a chimney crib, indicating a large central chimney, and a construction date prior to roughly 1850, prior to or early during the industrial occupation of Furnace Flats North. After that time stoves quickly replaced hearths in both new and old construction (Hubka 1984:125). The early construction date is supported by the size of the foundation, which is substantially larger than that of most of the later worker houses at the site. The pier located in the eastern wing may also be a chimney base suggesting that this space was used as a kitchen. The other two wings may represent attached porches or sheds, or may be portions of the main house without excavated cellars. A depression located 40-m north of the foundation may be a privy or other feature associated with the foundation.

Both the 1874 Vermont Copperas and 1877 Beers maps show four company-owned houses northeast of the intersection of what are now Furnace Flat Road and Route 132 (formerly River Road). Only two of these foundations were located because of a lack of access permission. However, evidence of the remaining two may be present within 30 m of the visible foundations. The larger of the two foundations may have supported a boardinghouse as it is larger than the majority of the single-family dwellings seen on the site, however, it may be the residence of the furnace master or supervisor in charge of Furnace Flats North. It is unlikely that this foundation was for a barn as it is nearly square and there is no ground-level access to the cellar. The smaller, northern, foundation more closely reflects the expected size of a

company owned single-family dwelling. This house may have been one of the residences that cost a laborer $2.00 per month to rent (Abbott 1986). The two halves of the structure may have been built at different times based on differences in construction methods. The southern half has an excavated cellar and has walls constructed of fieldstone with cut granite sills at two of its corners, while the unexcavated northern half utilizes a mixture of laid brick, fieldstone, and cut granite in its foundation. The presence of laid brick is unusual for building foundations at the Elizabeth Mine Site. All other existing foundations at the site are of stone or mounded earth. Regardless, it appears that both halves of the smaller foundation as well as the square foundation were built after the industrial operations began north of the West Branch of the Ompompanoosuc River in 1854.

Furnace Flats North provided a conducive topographical setting for the mid-nineteenth-century smelting operations that took place there. The natural terracing of the river provided an area close to waterpower yet high and dry enough for smelting furnaces and a paint factory, all within close proximity to the preexisting 1830s waterpower dam. Additionally, the existing haul road from the mine already provided service to the furnaces. The presence of River Road, which was an unpaved but maintained thoroughfare in the late nineteenth century, provided a ready transportation route from the furnace to the railroad on the Connecticut River.

Furnace Flats North constitutes the remains of an important satellite industrial and residential community associated with the Elizabeth Mine proper to the south. Considering the improvement of Route 132 and partial location in floodplain, the site maintains sufficient integrity to have visible resources and understandable function and progression. Archaeological investigations at this site have a high potential to yield belowground resources that could contribute to a greater understanding of the copper smelting and paint-making technology used at this location, the age and spatial arrangement of the large house foundation with the chimney crib, the actual function(s) of the bath/barn, and the lives of the laborers who inhabited the houses, especially in comparison to the workers who lived closer to the core of the site

Furnace Flats South (Outside APE)

The southern portion of Furnace Flats South is the better-preserved portion of the subsite, and the flow of materials in this area is clearly indicated by visible transportation routes and soil deposits. The 1830s haul road from the mine, the secondary haul road that forks northwest from it to service the roast beds, and the spur road to the east that served the charcoal sheds, are still intact. Red discolored soil marks the roast bed terraces, and deep black soil with fragments of charcoal on a prepared terrace clearly indicates the charcoal shed foundation area where wood colliered elsewhere was brought by cart and stored to fuel the blast furnaces. The location of a charcoal shed on a terrace above a smelting furnace and along a transportation route is a common configuration for most iron smelting sites in Vermont and New England. The only surviving evidence of the shed itself is the black stained earth, charcoal, prepared terrace and the short segment of stone wall at its west end. However, it can be inferred that the shed was approximately 3 m high based on the height of the loading platform. Consequently, if the shed was 18.5-x-10-m, the rough measurements of the shed platform, it could contain approximately 555 cubic meters of charcoal, enough to supply the furnaces for a number of days (Johnson, personal communication 2002). The small trench on the south side of the shed site separating it from the slope of the loading platform may have served to direct runoff away from the shed, helping to keep the charcoal dry. The function of the semi-circular trench and pit just east of the charcoal platform is less clear. It is possible that they are part of a system to transfer the charcoal from the shed located high enough up the slope to remove it from danger of flooding, to the floodplain closer to the waterpower where the furnaces were located.

The remainder of the site closer to the river appears to have been disturbed by scavenging for slag for use as road metal. Earthmoving machinery was brought in and slag trucked out across the bridge from Furnace Flats North during the World War I era (C. Abbott, personal communication 2002). It is difficult to determine the integrity of the deposits in this area based on surface evidence alone. The concentrations of refractory materials and discarded hearth salamanders may represent the approximate locations of the eight furnaces that operated at the site. Some of the piles of slag and burned soapstone (used as a refractory) are located close to the salamanders and may be debris from the frequent relining of the smelter hearths. However, it is also possible that the deposits of slag and refractories are because of the slag scavenging and any apparent spatial relationships between them are purely coincidental. In any event, the presence of sawn blocks of soapstone, and pieces of glazed and fused sandstone, quartzite, and slate attest to the refractory material experiments carried out by Isaac Tyson, Jr. during his 1830s tenure at the Furnace Flats South smelter.

The Furnace Flats South subsite is significant in the history of American copper metallurgy as the site of the first use of hot blast and anthracite coal in copper smelting, the first successful large-scale mine side smelting of sulfide copper ores, and the first successful smelting of American sulfide copper ores in a masonry refractory lined furnace. These advances can be credited to the direction of Isaac Tyson, Jr. The integrity of the site varies from undisturbed to possibly highly disturbed depending on the location. Other than references in Isaac Tyson, Jr.'s 1833 journal (Vermont Historical Society Library) there are no known primary sources, and no maps or photographs of this site. Since no subsurface testing was conducted at this subsite, it is difficult to ascertain at this time the exact location and degree of belowground disturbances. Should intact subsurfaces be identified belowground, archaeological investigations could generate new information about early American copper metallurgy, site layout, furnace location, and the paint, sulfur and sulfuric acid experiments conducted at this location.

World War I Smelter Site (Completely Within APE)

The only graphic representation of the World War I Smelter Site is a ca. 1918 map that depicts a "blower house" and a "furnace" building (Figure 7-2). None of the visible features at the site or the archaeologically recovered remains correspond directly to the image shown on the map. The presence of the section of concrete floor and other heavy construction artifacts suggests that portions of the structures may lay buried beneath the soil. The apparently in situ pipe in the trench below the smelter debris suggests that portions of the area may retain integrity. However, the jumbled nature of the concrete and steel debris on the surface and much of the subsurface remains indicate that later grading and demolition have resulted in moderate to severe earthmoving disturbances.

The World War I Smelter Site is evidence of August Heckscher's third and final abortive attempt to smelt copper with a pyritic blast furnace at the Elizabeth Mine. This operation was of short duration and used proven technology. The associated debris can be dated to the correct period by the heavy use of twisted square steel rods to reinforce the concrete. The smelter site, however, is not considered to be a potentially significant archaeological resource since it has limited information content in relation to salient technology research questions and possesses a poor integrity.

Tyson Mill Site (Completely Within APE)

The Tyson Mill is depicted in a number of historic views and maps (see Figure 5-9 and Figure 7-1). The original concentrator mill was built in 1899 and went through a number of expansions and technological

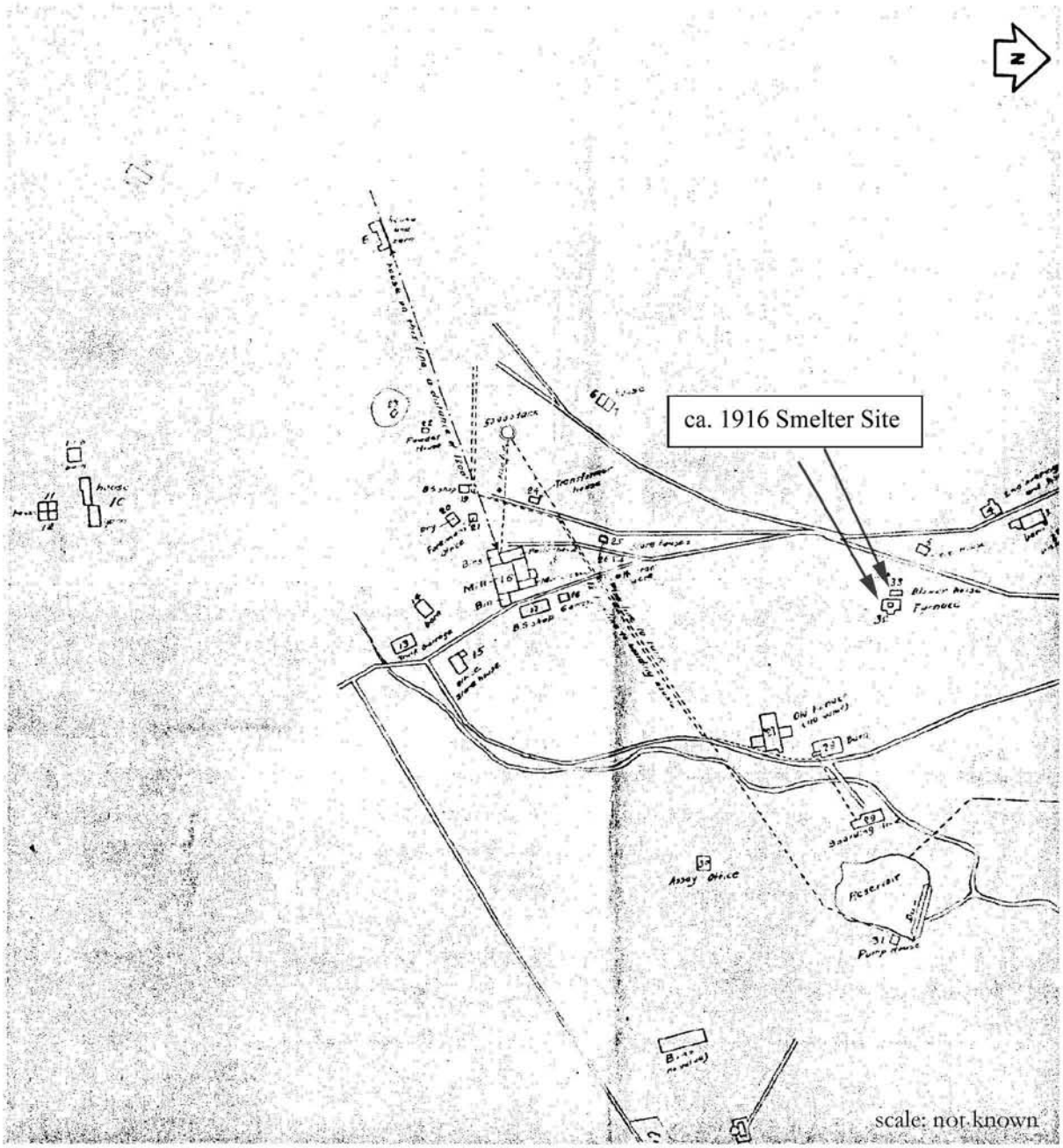


Figure 7-2. Ca. 1918 map showing ca. 1900 Tyson Mill and smelters, and ca. 1907-1909 and 1916 Heckscher operations in the Tailings Pile 1 area. Note farm to the south of the mill (source: Collamer Abbott Collection, Bailey Howe Library, Special Collections University of Vermont, Burlington, VT).

improvements under different operators until it was finally abandoned in 1930. During that time experiments with the electromagnetic separation of the ore and the first installation of froth flotation technology at Elizabeth Mine took place within the mill. The expansion of the mill was a testament to the adaptability of the structure to changing technology.

The multi-tiered arrangement of the features inside the footprint of the mill are a hallmark of this type of structure, where the processes employed took advantage of the flow of water and gravity. In the original configuration used by the Tysons until about 1902 ore was brought out of the 1898 adit on a light rail line and dumped in storage bins on the west side of the mill. From there the ore was crushed and separated through a number of hand and crude mechanical processes as it traveled down slope inside the mill before being deposited in a second set of bins on the east side of the building. The selected and crushed ore was then loaded onto carts and taken to a roast bed complex to the north. After roasting, the ore was transported to the smelting furnace (see Figure 5-11). Subsequently, under August Heckscher, the mill building was expanded and more sophisticated fine crushers and flotation cells were added to the structure altering the interior arrangements (see Figure 5-16). The type and function of the equipment that was mounted on the visible concrete pads, angle iron bases, and timber arrangements now visible are unknown. The concrete acted as a solid foundation for large stationary machinery, and the timbers acted as shock absorbers to absorb the vibration of reciprocating machinery. The electrical vault may be associated with the introduction of electromagnetic separation to the mill, as this was the first time that large amounts of electricity were required inside the building, or it may date to the World War II era. The three-tiered concrete pier with threaded steel pins located at the east side of the building site can be associated with the Heckscher occupation of the structure during the first two decades of the twentieth century based on the inclusion of slag aggregate in the concrete. It is difficult to identify the exact nature of the machine that rested on this base, but comparison of the bolt pattern with machine catalogs of the period might provide a more precise answer. The only piece of the actual mill foundation that is still visible is a short section of stone wall south of the interior features. This section of dry-laid wall quite possibly dates to the original construction of the building and may help to place the remaining features within the structure.

The 12 test pits placed in the suspected area of the documented blacksmith shop, associated with the Tyson Mill, did not identify any conclusive foundation remains (see Figure 7-1). However, the presence of large quantities of fire-reddened earth in addition to coke, clinker, and charcoal within what appear to be undisturbed soil deposits suggest that intact belowground cultural deposits associated with the blacksmith shop may be present. In fact, the intact layer of burned planking and concrete pads encountered in this area may represent structural remains associated with the blacksmith shop or the mill itself. Although a portion of the Tyson Mill appears to be buried by grading associated with World War II era site preparation, enough of interior mill features are visible to show the spatial relationships between several discrete machinery locations. The presence of intact above- and probably belowground resources indicates that the Tyson Mill subsite could yield additional data classes that would contribute to an understanding of the inner workings of the mill and the blacksmith shop.

Sargent Brook Smelter Site (Outside APE)

Copper smelting was conducted by James Tyson at Sargent Brook from 1882 until 1890, using ore mined north of the North Open Cut on TP 3. The ore was transported northwest from the mines along a haul road, past two small quartz quarries (possible sources of smelting flux), and down the west side of Copperas Hill to a roast bed complex located at either side of the road and above the smelter building. A

small foundation above this area is of unknown purpose but may have been associated with tending the roast beds. After roasting, the ore was transported further along the haul road to the smelter.

This area, which is where Figure 6-16 begins, contains one definite foundation, a set of stone roasting/storage stalls, a reservoir, and a small stone-lined foundation. The reservoir, which could contain approximately 48,000 liters (12,680 gallons) of water, was likely used to feed the water-jacketed blast furnace employed at the site. The small foundation, possibly a foreman's house, may represent the only domestic structure at the smelter subsite. However, given its small size it is also possible that the structure represents a storage building associated with the furnace. The matte roasting/storage bins are clearly associated with the industrial process, but their location is somewhat problematic. If roasted ore was carried along the haul road from the roast beds to the staging area then it would make sense in terms of material flow for the bins to be used to store roasted ore prior to it being smelted. If the feature is indeed a roasting stall, copper matte would have been transported uphill and back across the site from the smelter 100-m away. An inspection of the interior of the bins for the presence of roasted ore, which would be present only if the bins were used for storage, or evidence of high heat, which would be associated with roasting matte, would clarify the use of the bins. Unfortunately, the structure is covered by numerous heavy cut trees that make it impossible to access its interior. The small foundation contains numerous fine-grained, hand-struck firebricks of a non-standardized size in its earth berm walls.

The ore, quartz flux and coke fuel were carried out onto the charging ramp and loaded into the upper side of the furnace. The ramp includes a number of timbers and planks, but it appears to have been built up over time with slag that would have required a number of runs of the furnace to generate. The furnace itself is no longer standing but a number of features indicate its rough location. The furnace stack hood, similar to one depicted in a ca. 1890 technical illustration (Figure 7-3), and binder rods, used to hold the stack together, lie just below the charging ramp. The hood and rods are located in a corner formed by two intersecting stone walls, likely the outside corner of the furnace building or a support for a trestle that connected the charging ramp to the top of the stack. The carefully prepared brick floor in this area was almost certainly located within the furnace building. The floor appears to have been leveled and constructed with a number of layers of brick in order to bear substantial weight. Surrounding this area are examples of raw material and waste products of the smelting process. A scatter of crushed quartz flux lies on the brick floor, and blocks of beehive-type coke and refractory bricks are scattered in the immediate vicinity. The expansive slagheap is still visible. Although all but one corner has been quarried for road metal, its area gives some indication of the scope of smelting activity at the site.

The remainder of the resources at the subsite are of indeterminate age. The parallel stone walls just at the crest of the hill west of the furnace are likely associated with the furnace but their exact function is unclear. The dam across Sargent Brook is likely associated with the industrial occupation of the site. A reliable water source would have been necessary to keep the furnace cooling reservoir filled. The dam itself is of particularly sturdy construction, utilizing mortise and tenon joints indicating that it is not of modern vintage. Given the preservative nature of continuous submersion in water it is conceivable that the dam was built 120 years ago. Similarly, the bridge across Sargent Brook from the furnace site to the main road appears to be of some antiquity, as the culvert pipe is built of a riveted sheet of iron rather than more modern corrugated steel.

The Sargent Brook Smelter Site constitutes the remains of an important satellite industrial plant associated with the Elizabeth Mine proper to the east. It is notable as the site of the first known American experimental use of chromite refractory materials in a copper smelter. These experiments were not

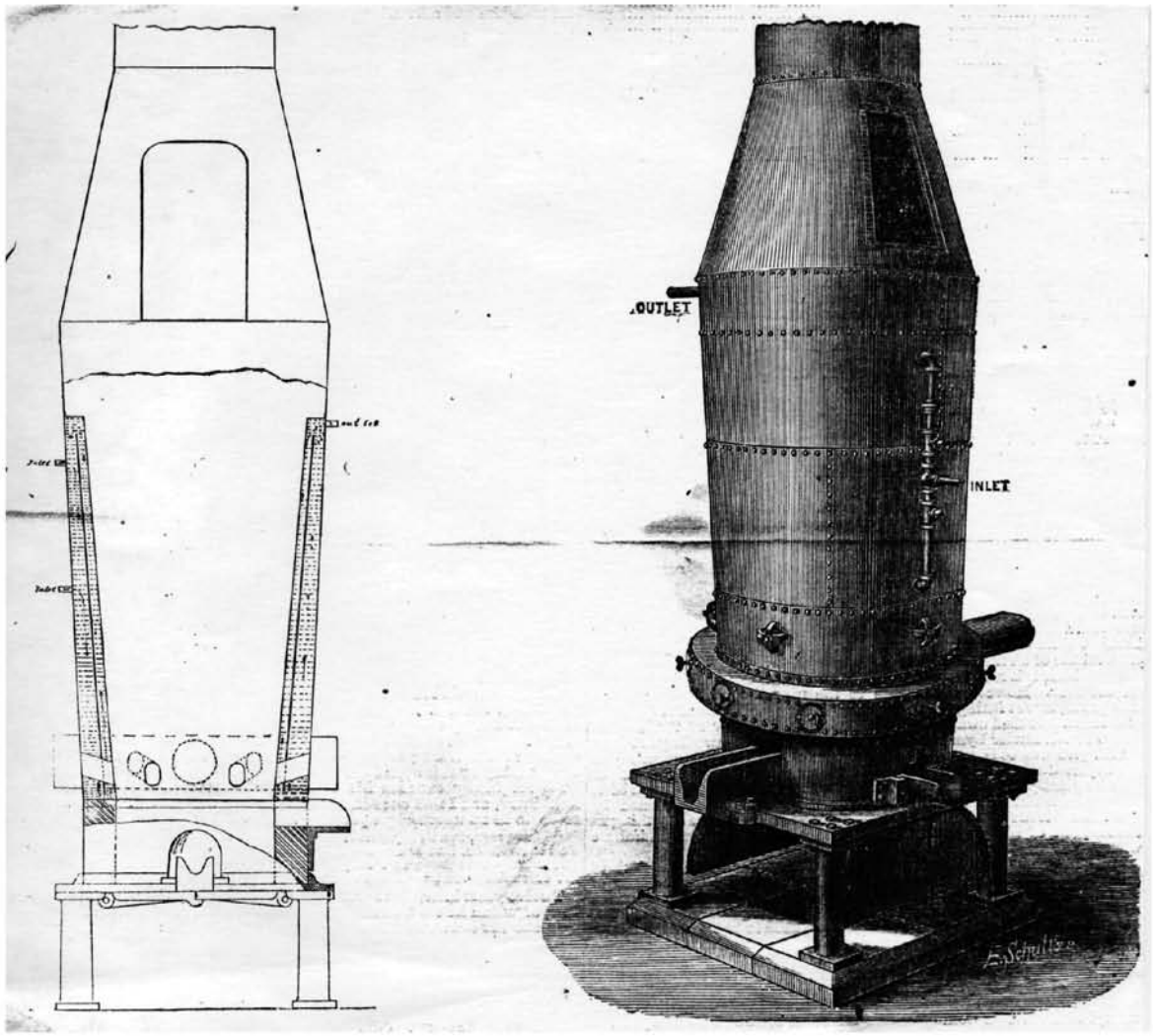


Figure 7-3. Blast Furnace drawing from late-nineteenth-century technical publication (source: Johnny Johnsson).

successful at this location and the practice was later proven at Tyson's ca. 1900 smelter on the east side of Copperas Hill. The majority of the site appears to be intact with the various support structures visible in their original locations. The slag quarrying activities that threaten to further impact the smelter building site have not yet reached the core of the structure. The site still possesses good integrity and archaeological investigations in and around the smelter and support structures has the potential to yield new information about copper smelting and the industrial layout and processes at Sargent Brook.

Tailings Pile 1 and Tailings Pile 2 (Completely Within APE)

Tailings Pile 1 (TP 1) and Tailings Pile 2 (TP 2) are more complex historic resources than many other Elizabeth Mine subsites as they are significant on different levels. Although the tailings material resting above the original buried ground surface in both tailings piles is of high integrity, its disposition in terms of general disposal processes and changing appearances can likely be ascertained through an analysis of historic photographs and interviews with former mine workers as well as close examination of written records available at the University of Vermont. However, these two tailings piles have historical significance and value in their own right as massive historical and technological elements of the mine's cultural landscape. TP 1 and TP 2 also have structural and archaeological resources that are buried beneath them and that are located around their periphery.

Tailings Pile 1

The location of the ca. 1900 Tyson smelting furnaces, one of the earliest American applications of chromite refractories, lies under the western edge of TP 1 north of the World War II mill buildings. Historical photographs (see Figure 5-11) show part of the materials handling portion of these structures extending up the east flank of Copperas Hill, possibly beyond the west toe of TP 1. However, the furnace buildings themselves appear to be under the west toe of TP 1 based on Figure 6-64, which would explain why no trace of them was found on the hillside west of TP 1. It is possible the pile has inundated enough of the valley to conceal the furnace foundations, which would have been massive masonry structures, or they were destroyed during mid-twentieth-century grading. The actual integrity of these resources cannot be ascertained based on the current survey. However, while it is unlikely that the buildings were buried as standing structures, foundations and cultural strata containing associated artifact assemblages could survive beneath the waste materials. Any such archaeological deposits could inform on the physical layout and technological workings of the Tyson smelting furnaces.

The site of August Heckscher's assay office and much of the trestle connecting the Tyson Mill with the blast furnace lie buried under the core of TP 1. However, the site of the Tyson and Heckscher-era boardinghouse (Figures 7-4 and 7-5) appears to be located beneath the west toe of TP 1. This structure, which likely replaced many of the village sites as the mine operation moved north, was a five bay by three bay, two-and-a-half story gable roofed structure with a central entrance in the west façade. The structure appears to have had a minimum of eight rooms flanking a central hall on the second floor with a similar arrangement on the first. The one-and-a-half story ell is likely the kitchen and may have contained a communal room. It is not possible to assess the integrity of these resources based on the current survey. However, while the boarding house was standing in 1939 (Arthur D. Little; 2000), it is unlikely that the buildings were buried as standing structures (see Figure 5-13). Foundations and cultural strata containing associated artifact assemblages could survive beneath the waste materials. Any such archaeological deposits could inform about the physical layout and range of activities that took place at these domestic, administrative, and industrial buildings.

Figure 7-4. Ca. 1900-1902 photograph of Tyson furnace (right) looking southeast with the boardinghouse located at the left (source: Strafford Historical Society, Strafford, VT).

Figure 7-5. Ca. 1928 photograph of the boardinghouse looking east (source: Strafford Historical Society, Strafford, VT).

Other elements of the Heckscher plant from this era were located remarkably close to the edges of TP 1 (see Figure 6-64), and some evidence of these resources is actually visible at the TP 1 periphery. Heckscher's ca. 1906–1908 furnace site was located under the north toe of the pile and the stack was located just past the crest of the pile. This location is confirmed by the discovery of slag and an inverted slag pot skull north of the north toe of TP 1. Comparison with the georeferenced historic map overlay places the smelter under the north toe of TP 1 as the slag deposit is located at the outer edge of the slag car dump loop track. Slag removed from the furnace would have been carted out on this track in mule-hitched carts and dumped. The position and size of the flat-topped berm spanning the Copperas Brook valley at the north toe of TP 1 corresponds nearly exactly to Heckscher's reservoir dam depicted on the historic maps. This would place the reservoir and associated pump house just under the north toe of TP 1. The low, broad, watered trench recorded at the east tip of TP 1 may be associated with the Heckscher coke storage facility storage structures indicated on historic maps (see Figure 6-64) and that may extend to the very margin of the pile. The actual integrity of these resources cannot be ascertained based on the current survey. Structural foundations and cultural strata containing associated artifact assemblages could survive beneath the waste materials. The corner of the stone wall located in this area is still an unidentified resource. Archaeological investigations in this area have the potential to inform about the nature and function of this stone wall as well as the physical layout and technological workings of the Heckscher furnace.

The west edge of TP 1 also includes visible World War II-era resources including tailings launder trestles, a standing pump house, a ruined pump house, and a standing warming hut, all north of the mill buildings. The flotation cells that were removed from the mill are located south of the mill buildings. Although the integrity of these resources varies from an architectural standpoint, they have the potential to contribute to the understanding of the materials handling and tailings deposition at the site and are therefore assigned a high research value. The Blacksmith Shop site, although discussed within the Tyson Mill subsite section, is located near the flotation cells point where the southwest tip of TP 1 and the northwest tip of TP 2 meet, and has been assigned high archaeological sensitivity, as discussed above.

Tailings Pile 2-Preston Farm

The Preston Farm area, believed to be located partially beneath the eastern margin of TP 2 and shallow southwestern section of TP 1, is named for the property owner shown on the 1890s period map (see Figure 6-65). However, the farm may predate the 1890s by at least seven decades, and several lines of evidence point to this being the company farm mentioned throughout the nineteenth century. The location is close to Copperas Brook and the early copperas facilities, on some of the most level land on the site, and appears to be a logical location for a farm owned by the mining company. Furthermore, the company farm was recorded as containing five structures, including a boardinghouse, farm house, barn, shed, and stable in 1831 (Strafford Town Records). The historic map shows six structures on the site, and is the only identified agricultural complex at Elizabeth Mine with nearly enough structures. Further deed research and archaeological investigations would be needed to confirm the ownership of the property. By 1918 the farm buildings appear to have been destroyed. However, limited archaeological testing south of the building site (Transect H) identified an intact plow zone, suggesting that the surrounding area remains relatively unchanged. Structural foundations and cultural strata containing associated artifact assemblages could survive beneath the waste materials in this area. Any such archaeological resources could inform about the early-nineteenth-century agrarian activities of the mine and its inhabitants.

Tyson Mill

Historic photographs indicate that there were at least three ephemeral outbuildings or sheds and fans and piles of waste rock located due south of the Tyson Mill outbuildings. Because of the nature and function of these resources, the survival potential for important archaeological remains is considered low, as is their research value.

Copperas Works/Tailings Pile 3 (Completely Within APE)

TP 3 is one of the most complex historic resources identified within the Elizabeth Mine Site study area. In addition to the numerous architectural and archaeological resources contained within its perimeters, TP 3 is valuable as a massive historical and technological element of the cultural landscape, representing multiple copperas mining and production campaigns from the early nineteenth through early twentieth century.

The cultural resources included in TP 3 in conjunction with the Lower Copperas Factory constitute the core of the copperas production landscape at Elizabeth Mine. Historic accounts claim that nearly an acre of the hillside was scraped down to bedrock and used as a leaching ground (Duncan 1871). However, based on both the detailed mapping and archaeological investigations it appears that TP 3 incorporates a nearly continuous spread of water control and ore processing features, which is considered to be, in and of itself, an engineered industrial landscape.
The numerous plank and timber features visible across the hillside and in the majority of the erosional gullies appear to be the scaffolds and plank deck features that were reportedly erected for the leaching of the roasted ore. Scaffolds of this nature would have been necessary to hold the ore in place. Some of the historical accounts also mention that areas of the hillside intended for leaching the roasted ore were scraped down to bedrock and/or lined with clay. The majority of the visible bases of the wood structures rest on bedrock, and one of the timbers located in the northern portion of the subsite appears to be resting on top of a layer of clay. While large expanses of the hillside are still covered with roasted and leached ore, which is a positive indicator of the activities that took place there, some areas have been disturbed by later mining activity. However, limited archaeological testing in this area revealed possibly disturbed upper layers, followed by two layers of intact roasted ore down to a solid wood plank floor, likely the deck of a leaching platform. This feature appears to be in situ, as do most of the other wood structures, which are clearly arranged in vertical and horizontal alignments across the hillside.

Given the fact that copperas was used to preserve wood and the high level of wood preservation on the site, it is not unreasonable to assume that these structures date to 1880, if not before. Since the roast beds are functionally located before, and therefore logically higher uphill than the leaching beds, it is possible that the roast beds were largely destroyed when the North Open Cut was widened during World War II. However, an area of roasted and unleached ore is located just below the lip of the North Open Cut. This appears to be one of only two possible exposures of this early step of copperas production, the other located further to the northwest in the 1880s Tyson mining area north of the North Open Cut, just southwest of the No. 1 Shaft site. There is no mention in the historic descriptions of brick channels used to direct the fluids generated by leaching the ores, however, what appears to be a brick lined channel was identified on the hillside.

In addition to the scaffolds on the upper part of the hill, there are the remains of two ore corrals on the lower portion of the hill, east of Copperas Road. These structures consist of upright timbers arranged in a semi-circular pattern. A historic photograph shows these structures as they appeared in the 1920s (Figure 7-6). They appear to have been built to retain the shape of the roasted ore piles. The condition of the structures and the presence of so much roasted ore in leaching structures so low on the hill suggests that these features are possibly late period leach heaps.

In addition to the water and ore control features on the hillside there are the structural remains of a number of buildings within TP 3. The 1874 Vermont Copperas Co. map shows three structures west of Copperas Road. From north to south these are listed as a blacksmith shop, a cob shop, and the Upper Adit (see Figure 5-6). It appears that the northern and southernmost partial foundations identified on the upper portion of TP 3 are the blacksmith shop and a structure at the mouth of the adit, respectively. This is supported by the presence of quantities of various iron plates and implements in and around the northern foundation and the alignment of the southern foundation and the inferred location of the collapsed mouth of the Upper Adit. By process of elimination the central two retaining walls are most likely the visible remains of the cob shop. The scatter of artifacts including timbers, rail, bolts, and iron plates are likely associated with the transportation of the ore from the mine to the cob shop. East of the road, the short section of wall projecting from beneath the large pile of yellow waste rock may be a section of the foundation of one of the three evaporators depicted in the 1874 map, as it is located within a few meters of where the map shows the center evaporator in relation to the Upper Copperas Factory and the upper adit. The massive, long timber with plank decking immediately uphill from the Lower Copperas Works may be the remains of one of the large plank copperas liquor holding cisterns as described in the historical accounts.

The Upper Copperas Factory is the most substantial foundation on TP 3. Four different sets of measurements for the copperas factories appear in historical accounts. Three of them are discussed in Chapter 5 and list the factories as 267-x-94 ft in 1827 and 1842, and as 110-x-75 ft in 1870. The fourth measurement dates from 1865 and describes the factories as 100-x-75 ft (Reynolds 1865). The factories may have been expanded during the Civil War era and the foundations currently visible are the remains of the later structures as they correspond to the 1874 map. It is quite likely that the later factories were rebuilt in the same locations as their predecessors because the copperas process at Elizabeth Mine depended so heavily on the natural setting. While the Lower Copperas Factory (see below) corresponds well with the dimensions noted in the historical accounts (at least in terms of its length), the upper works does not match the published measurements in any dimension. The distance from the southeast corner of the foundation to the bend in the wall, which may be the logical northern extreme of the building, is 28 m (92 ft), and the two corners of the southern wall are 7-m (23 ft) apart. An undated (ca. 1890) historic photo of the Upper Copperas Factory (see Figure 5-7) shows the factory extending considerably farther down Copperas Brook toward Mine Road and also to the south over the brook itself, which indicates that the building may have been bigger than the stone foundation. The upright timbers along the north margin of Copperas Brook, some exhibiting mortises, may be posts for the factory. Thus, it appears that the visible foundation of the factory is actually an internal wall constructed to support a substantial amount of weight and to provide tiered floor levels within the factory. It is possible that the lead-lined crystallizers, evaporators, and coolers were positioned on this upper tier, possibly supported by the heavy cast iron stanchions located near the center of the building. The packing of the barrels of copperas crystals possibly took place on one of the terraces below. From there the barrels were loaded onto carts and transported via a road that ran along the east side of the building. The bricks and planking encountered

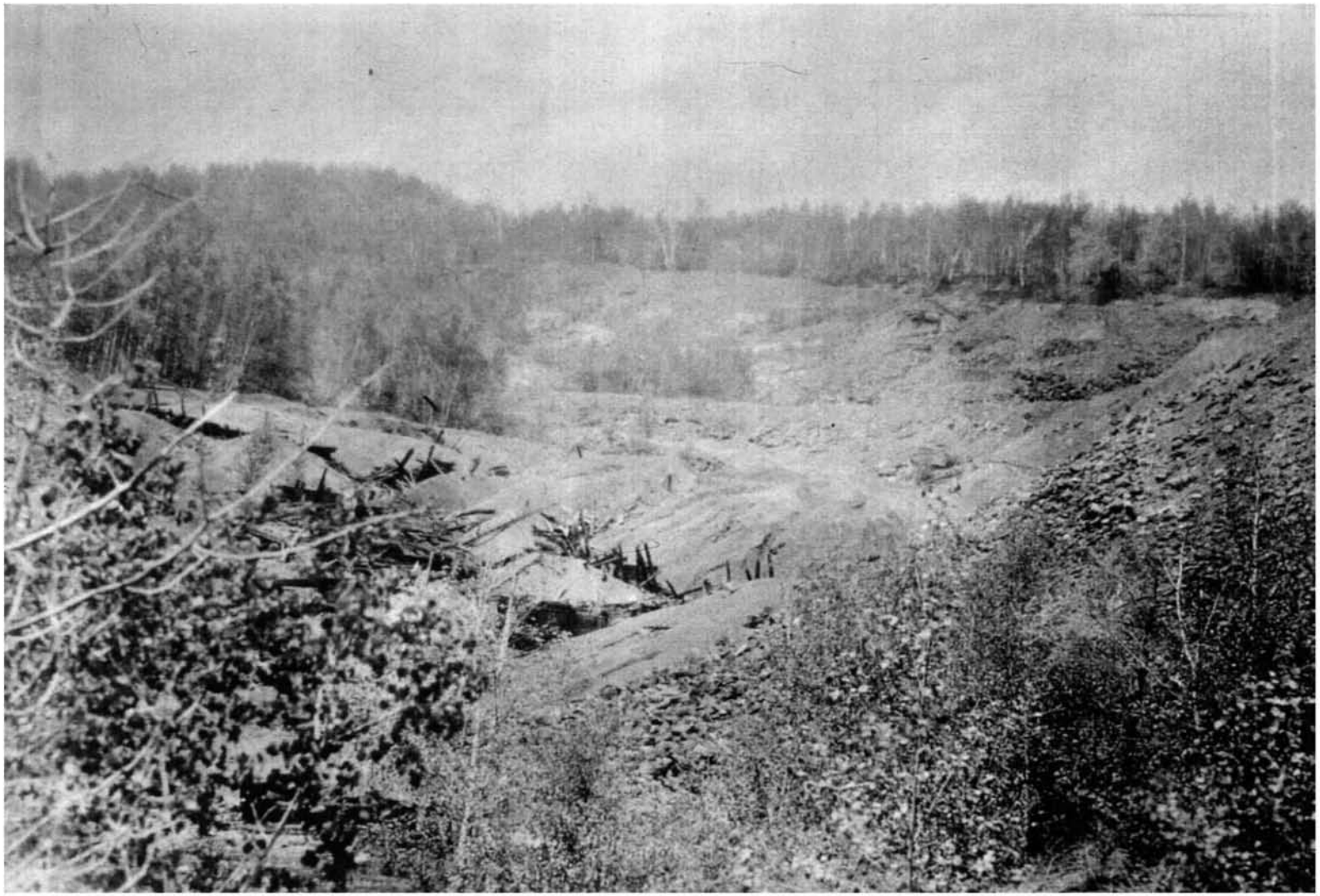


Figure 7-6. Ca. 1928 Historic photograph of roasted ore corrals or leaching piles, Tailings Pile 3 (source: Strafford Historical Society, Strafford, VT).

during limited archaeological testing in this area may relate to the demolition of the structure, with the planks coming from the structure itself and the bricks possibly from the equipment inside. The presence of refined earthenware and American stoneware in the test pit just north of the factory (JTP-28) is currently unexplained. This area would have been outside of the factory, between it and the office. As the ceramics are jumbled with brick it seems unlikely that this is a primary deposit, and these artifacts were possibly deposited as fill associated with the demolition of the original factory.

Despite the numerous detailed historical descriptions of the copperas manufacturing process and the extensive identifiable cultural remains there are still a number of questions and problems related to process on TP 3. The majority of these data gaps concern movement of materials from the mine openings, through the roasting and leaching steps, to the factories, and the interior layout of the factories themselves. The purpose of the pile of burnt ore on the lower portion of the hill and the location of the ore leaching corrals so low on the hill are not currently well understood. It could be that the process expanded and shifted up and down the hillside over time, and did not always utilize the entire area from the mouth of the North Open Cut to the Lower Copperas Factory. Evidence such as the pile of burned and fused ore in the southeastern section of TP 3 and the 1844 Jackson sketch (see Figure 5-5) suggest that some roasting took place on the lower portion of the hill. Similarly, the corrals, which may represent later leaching piles, suggest leaching on the lower portion of the hill.

Other early copperas factories operated in Cuttingsville, VT; Ogdensburg, NY; Cape Sable, MD; Hubbardston and Brimfield, MA; Casco Bay, ME; and in Ohio. However, none of these are known to have survived in the modern landscape, and no other copperas factories have been reported in the United States. The only other eighteenth-century copperas works site known to have survived to modern times and to be investigated archaeologically is located in England. Copperas was a vital early industrial chemical, and at one time the Elizabeth Mine copperas works reportedly supplied 75 percent of copperas made in the U.S. The factory was important enough to be included in President James Monroe's 1817 good will tour, and is the only known surviving site visited on that tour. Monroe directly supported the copperas works through the imposition of import tariffs. Despite later mining impacts, including widening of the North Open Cut, deposition of waste rock, and erosion, TP 3 and the Lower Copperas Factory combine to form an industrial landscape of sufficient integrity to include and document many of the steps of the copperas production process. Based on the current mapping and limited archaeological testing, it appears that many features associated with the process remain buried across the hillside. The archaeological resources at TP 3 are of high research value and have the potential to inform about the copperas process, particularly the construction of roast bed and heap leach structures, methods of copperas liquor conveyance, and the processes that took place inside the copperas factories.

TP 3 includes several other discrete resources that are of value as landscapes and/or archaeological sites. The North Open Cut at the west edge of TP 3 has inherent significance and value in its own right as a massive historical and technological element of the cultural landscape. The North Open Cut was the scene of early mining and the area at the original east edge originally included an excavated bedrock channel for conveying runoff to the copperas liquor basins, as well as roasting heaps. The North Open Cut was expanded during the World War II era and this activity partially buried and may have destroyed some of these earlier features. However, an area of roasted ore is visibly intact along the east edge, and could contain archaeological deposits important to understanding the construction of roast bed structures.

West of the North Open Cut lies the stone and earth-fill dam for an early water reservoir. The date of this feature is unknown. However, it may have been the source of water for the roasted ore leach heaps on the

east slope of Copperas Hill. Water was an important part of the roasting process as it was used to cool the roast heaps to regulate the roasting temperature, as well as to leach them to create the copperas liquor. Until the discovery of this dam and reservoir it was unclear what the source of water for this activity was, and this resource is therefore an important part of the copperas production landscape.

The Tyson 1880s mining zone north of the North Open Cut is important as the supply of copper ore for the Tysons' late nineteenth-century return to South Strafford. It was also the site of the first steam-powered hoist at the Elizabeth Mine. The site includes an open manway and the collapsed remains of two shafts. It is also another site of piles of roasted ore that may predate the Tyson development and could be associated with early copperas ore roasting. This area appears to have been impacted by World War II-era waste rock removal, and is of fair integrity. Because of to previous disturbances and limited information content, archaeological investigations of the Tyson mining zone, are not considered to have the potential to inform about late-nineteenth-century mining and beneficiating practices at the Elizabeth Mine.

Lower Copperas Factory (Completely Within APE)

As stated above the Lower Copperas Factory is closely associated with nearby TP 3. This site is an important complement to the Upper Copperas Factory at TP 3 as it appears to be better preserved and more of its internal arrangement is readily visible. The long dimension of the foundation wall is 36 m (118 ft), which fairly closely resembles the dimensions noted in the 1870 description. However, the west edge of the building is only 6 m (20 ft) long, much shorter than the 75 ft stated in the 1870 account. This suggests that like the Upper Factory, the superstructure of the Lower Factory extended beyond its stone foundation. Consequently the long north wall may be an interior wall rather than an outside foundation. Although there are more discernible features within the foundation than at the Upper Factory, the interior of the Lower Copperas Factory is still difficult to interpret based on surface remains alone. This situation is exacerbated by the fact that many of the visible artifacts appear to have been moved around inside the foundation remains.

Several large cast iron artifacts are located within the foundation. The fire-damaged cast iron arch and support located in the depression near the center of the structure may be associated with the heating flues that ran underneath the evaporating pans. The outside edges of the stones that frame the larger of the two pits within the foundation are 2.7 m (9 ft) apart, nearly the narrow width of the 10-x-26 ft evaporating pans mentioned in the 1870 description. Similarly, the iron chutes and plates partially embedded in the ground east of the pits may be associated with the crystalizers and packing room. The packing room was located directly below the crystalizers, presumably on the terrace just north of the stone wall. The chutes may have functioned as funnels for conveying material and the fact that they appear to have been partially lined with brick suggests that the material was hot, possibly the copperas liquor being transferred from the evaporator to the crystalizer. These chutes may also be ash hoppers for the fireboxes for the boilers or evaporators. The purposes of the cast iron stanchions and the two platforms at the western end of the building are unclear. However, the stanchions are linked by a binder rod and may have held a heavy container, possibly a lead-lined vessel as described in the historical accounts.

The origin of the mounds of brick and two stone walls north of the main stone foundation is unclear. Since it is unknown how far north the factory extended it is possible that one of the stone walls represents the northern wall of the foundation, which would place the piles of brick within the factory. The abundance of firebrick suggests that the bricks were discarded as part of furnace maintenance. However, they may represent a halted salvage operation or road disturbance associated with Mine Road.

Between the Lower Copperas Factory and TP 3 is an area containing a series of rectangular earth platforms and berms. Three of these features have depressions in their centers: one is a simple platform, one is a mound, and one is a long berm extending north to Copperas Brook. The location of these resources between the southern piles of burned and fused ore at TP 3 and the Lower Copperas Factory, and the presence of bright red earth and brick in a tree-fall suggest that the area was used for industrial processes. However, the exact nature of the features is unknown. It is possible that they are remnants of the brushwood-filled evaporators mentioned in most descriptions, or holding reservoirs for the copperas liquor before it was processed.

The historical significance of the Lower Copperas Factory is linked to that of TP 3 and the Upper Factory. The Lower Factory has excellent integrity. Archaeological investigations have the potential to address questions relating to the ambiguity of the area of berms and platforms as well as the uncertainty regarding the internal arrangement of the Lower Copperas Factory, all of which would contribute to a greater understanding the copperas process that took place inside the copperas factories.

South Open Cut (Outside APE)

The South Open Cut was operated briefly in the 1950s as a source of ore for the World War II mill. The ore was surface mined and hauled using steam shovels and dump trucks. The cut is an intact mining landscape with good integrity although it has flooded and some rock fall has occurred. The South Open Cut was not associated with any significant technology or habitation sites, and is therefore of low historical research value.

Old South Mine (Outside APE)

The Old South Mine was possibly the first deposit of ore that was exploited at the site, and was a source of ore for the early copperas works. It has good integrity and includes mining landscape elements including open cuts, waste rock piles, prospect pits, a flooded shaft collar, and a horizontal exploratory adit. The subsite includes a large, potentially early domestic foundation to the north of the waste rock piles. This foundation appears on the earliest map of the site and could date to the first decades of the nineteenth century (Vermont Copperas Co. 1874). The Old South Mine has good integrity and archaeological investigations have the potential to identify belowground resources related to both the domestic and industrial aspects of this mine subsite.

Domestic Archaeological Resources

The historic and archaeological mapping and testing program identified seven domestic archaeological subsites, all of which are completely or partially within the project APE (Table 7-2). These subsites and two isolated domestic foundations outside of the project APE have been interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address salient research questions, as discussed in detail below.

Blaisdell Farm (Completely Within APE)

The Blasdell Farm Site is one of several nineteenth-century domestic and agricultural properties that were associated with the Elizabeth Mine by immediate proximity and as a likely provider of animal or vegetable foodstuffs. The Blasdell Farm is named for the property owner indicated on the 1890 Elizabeth

Table 7-2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Completely or Partially Within the APE:						
Blasdell Farm	19th century	House and barn foundations/cellar holes; well	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
The Farm	19th century	House foundation/cellar hole and stone retaining wall	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
Preston Farm (buried beneath southeast toe of TP2)	ca. 1828-1890	Stone-lined roadway leading into TP2 (buried foundations are suspected)	Ten test pits - yielded low density of nondescript bottle glass and brick	Unknown	Good	High
North Village	19th century	Two (mine agent?, mine family?) house/cellar hole foundations and two terraces associated with barn foundations	Eight test pits - yielded moderate density of19th c. and early 20th c. domestic and construction debris.	Fair to Poor	Poor	High
Office	19th century	One cellar hole/foundation, and related platform	Six test pits - yielded moderate density of mid-19th c. to early 29th c. domestic and construction debris	Fair to Poor	Fair	High
South Village	ca. 1809-1880	Seven house cellar hole/foundations, two barn foundations	Eight test pits - yielded a relatively high density of 19th c. to early 20th c. domestic and construction debris. Of note, only domestic site with a faunal assemblage	Excellent	Poor	High

Table 7-2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Twin Foundations	19th century	Two nearly identical stone foundations with cellar holes; possibly well or privy depression	No testing conducted; dense surface scatter of 19th c. to early 20th c. domestic debris.	Excellent	Poor	High
East Village	ca. 1809-1942	Three (boarding?) house foundations and possibly well/privy depressions on south side of Mine Road; connected house and barn foundation with intact agricultural landscape on north side of Mine Road	No subsurface testing; surface collection of representative 19th c. domestic materials; farm machinery observed in woods	Good	Poor	High
Outside of the APE: see Table 7-1 - Furnace Flats North contains remains of several domestic structures; TP1 is documented to encompass a late 19th/early 20th c. boardinghouse.						
Teamster's Foundation	mid-19th century	drylaid fieldstone and earth berm foundation	No subsurface testing conducted	Good	Good	Low
Unnamed Foundation	unknown	drylaid stonewall corner section	No subsurface testing conducted	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address priority research questions for Vermont relating to the lifeways of workers and local farmers.

[3] based on expected available sources: land evidence and probate records, tax records etc; company records, anecdotal/travelers accounts historic photographs

Mining Company map, which shows a barn, well, and two other structures. The barn, the house, and possibly the well were identified during the current mapping process. The barn appears to have been a bank barn, partially built into the hillside with the sills resting on a number of discrete stones rather than a continuous foundation. The house appears to have a number of ells attached to it. The northern section including the cellar appears to be the main block of the dwelling (Structure 4 in Figure 6-48). The other two attached foundations likely represent a kitchen and a workshop area, and the scatter of bricks in Structure 2 may be the remains of a chimney. The original layout and function of Structure 1 and the adjacent platform are unclear. Structure 2 intrudes into Structure 1 indicating that either Structure 2 was a later addition to the earlier freestanding main house block, or the two structures were interconnected when first built. None of the artifacts from Structure 1 help clarify its function or relationship to the other structures. The function of the large prepared flat platform south of the structures is also unclear. This area may be a work-yard, but the lack of any artifacts recovered during limited archaeological testing suggests that this was not a heavily utilized space. It is possible that the area was used as a pen for livestock or served another function. A small depression southwest of the foundations may be the well for the farm.

The 1890 map also shows two additional structures located along the strike of the ore. There are no visible remains of these two structures, which may have been destroyed when the area around the Tyson Shaft was mined for copper rich waste rock during World War II.

The Blasdell Farm Site possesses excellent integrity and has the potential to contribute information related to domestic agrarian occupation in proximity to the mine community. The artifact assemblage recovered to date supports the documented nineteenth-century occupation. Additionally, the presence of large numbers of machine-cut nails with a smaller assemblage of wire nails suggests that the original structure was built prior to the last quarter of the nineteenth century and that it was still inhabited and being repaired into the later part of the century. The large number of nails and the presence of melted glass without a large number of other artifacts suggest that the site was abandoned and then burned at a later date.

The Farm (Completely Within APE)

The Farm is one of several nineteenth-century domestic and agricultural properties that were associated with the Elizabeth Mine by immediate proximity and as a likely provider of animal or vegetable foodstuffs. The Farm is included on the 1909 Vermont Copper Company map and the ca. 1910 map (see Figure 7-1). It appears in two ca. 1900 historic photographs, projecting above the Tyson Shaft building in Figure 5-9 and in the upper left hand corner of Figure 7-4. These images show a three by two bay, one-and-a-half story, gable roofed structure with a chimney in its north end. The sill of the house rested in a pocket visible in the lip of the stone foundation. It is impossible to tell from the photographs but the house likely fronted to the west, toward the road as the hill falls away steeply to the east. The barn, which was oriented at a right angle to the house, is of the bank barn type. The main floor of the gable roofed, one-and-a-half story barn would have been accessed from the road to the west, while the lower level was open to the east. The photograph shows a small shed located between the two buildings.

The farm possesses excellent integrity and has the potential to contribute information related to domestic agrarian occupation in proximity to the mine community. Like the Blasdell Farm, the recovered artifact assemblage supports a nineteenth century occupation of the farm. The nail assemblage, in particular, indicates that the house was built prior to ca. 1880 and was inhabited well after that date. The photographic record supports this conclusion as the building appears to be occupied in the photograph

taken between 1880 and 1888 (see Figure 5-9) and at least standing ca. 1900 (see Figure 7-4). Similarly, the presence of a large number of nails and melted glass, charred wood, and an ash layer suggests that the structure burned. While there are a substantial number of artifacts from this subsite there are far fewer than would have been expected had the structure burned while inhabited. Consequently, it appears that the house was abandoned prior to its destruction sometime in the mid to late twentieth century.

It is unknown whether these structures were owned by the mine or how they were used for subsistence-related needs. Their proximity to the Tyson Shaft suggests that they were owned by the mine and may even be the remains of the farm owned by the mine after 1828. However, given the distance between the Farm and the copperas factories it seems unlikely that this could be the company-owned farm. The rugged terrain around the farm suggests that it was more likely a cattle or sheep farm rather than a crop farm as the company farm may have been. Further documentary research and archaeological investigations would be needed to clarify the ownership and function of the structures.

North Village (Completely Within APE)

The North Village is a mixed-use site, containing one of several nineteenth-century domestic and agricultural sites that were associated with the Elizabeth Mine, and an administrative facility. The best historic cartographic representation of the North Village is the 1874 Vermont Copperas Company map. On the east edge of Copperas Road, from north to south, the map shows a barn, three houses, a road leading down to Mine Road, and two more barns. The two sets of terraces bracketing the house sites appear to be the foundations for the barns. The large, relatively intact cellar hole corresponds with the central house. The house to the south likely sat in the man-made cut south of the cellar hole, and the short stretch of stone wall north of the central cellar hole may be a section of foundation for the house to the north. The southern house foundation contains a small stone-lined pit. No cultural materials were recovered in the one test pit (TF-4) placed in this feature, suggesting that it may have been a cold or food storage area that was kept intentionally clean.

The North Village possesses poor to fair integrity based on the visible remains, but has the potential to yield belowground data that could inform about the industrial and domestic land use dichotomy of the mine site. The cultural materials recovered in this area include several creamware ceramic sherds, found just south of the main foundation. This type of ceramic ware was produced from the late eighteenth to early nineteenth century, and suggests that the houses were inhabited during the earliest period of the mine site. The near total lack of nails suggests that the structures were cleaned out and pulled down, with the wood and hardware perhaps used elsewhere on the site. Given the size of the one remaining foundation it is conceivable that multiple individuals or families inhabited each house.

The North Village subsite also includes the remains of an office structure, which possesses poor to fair integrity based on the visible features, but as one of the few surviving administrative features at the mine site, has high research potential to inform on that aspect of the mine company management. This part of the North Village included the office and a two-story brick agent's house with an attached stable (Reynolds 1865). Based on the 1874 map the visible foundation on the site is that of the agent's house. This foundation is similar to the "L" shaped structure represented on the map except the leg of the "L" is pointing in the wrong direction. One possible interpretation is that the "L" on the map is the attached stable, while the "L" formed by the berms currently visible is an entrance into the cellar of the house. The remains of the stable may have been destroyed when the adjacent lot was graded for a trailer. The interpretation of the house site is somewhat problematic since it may have been impacted by the expansion of Mine Road and the installation of a sewer line to service the trailer. The artifact assemblage

recovered during limited archaeological testing within the structure supports the documented nineteenth-century occupation, and the relative scarcity of brick may indicate that the house materials were salvaged at a later date.

The office appears to have been situated on the small platform south of the house foundation. This location suggests that the upper or western of the two terraces between the office and the Upper Copperas Factory is the road indicated on the 1874 map. If this is the case the road ran directly in front of the stone wall of the copperas factory foundation and quite possibly into the building itself.

South Village (Completely Within APE)

South Village is one of several nineteenth-century domestic complexes that were associated with the Elizabeth Mine, and it is shown on the 1874 Vermont Copperas Company map. Curiously, the number of buildings on that map and the number of structures actually recorded is the same, yet their orientation is reversed 180 degrees (compare Figures 5-8 and 6-56). The 1874 map suggests that Copperas Road formerly ran through the center of the South Village, likely just to the west of the foundation with the chimney crib. The stone walls that flank Copperas Road south of the South Village proper appear to be the remains of the two barns indicated east of the road on the 1874 map. The remainder of the structures appear to be houses, at least three of which have excavated foundations.

A substantial number and range of artifacts were recovered from the South Village, some of which provide information about the structures and their inhabitants. The ceramic assemblage includes creamware and pearlware, both of which suggest that the houses were occupied during the earliest use of the mine site. The fact that the artifact assemblage contains only cut nails and the foundation of the center house has a chimney crib further supports occupation in the first half of the nineteenth century. The lack of chimney cribs in the other buildings does not necessarily indicate that they had stoves rather than chimneys, just that they did not have central chimneys. It is possible that the dwelling with the chimney crib was a duplex with a central chimney while the other structures were single-family residences. It is unclear if there was any differentiation between the inhabitants based on the size of the houses. The lack of wire nails in the artifact assemblage recovered to date suggests that the houses were abandoned prior to the last quarter of the nineteenth century.

After the copperas works closed in the early 1880s and mining operations moved north and east following the ore trend, the South Village conceivably became an inconvenient place to house laborers. It may have been superseded by the boarding house now buried under TP 3. However, it is difficult to say whether or not the South Village was simply abandoned or intentionally demolished. The presence of large quantities of brick suggests that some of the structures may have been built of that material, or at least had brick chimneys. The single piece of roofing slate from JTP-14 may indicate that at least the western structures may have had slate roofs. Artifacts were found distributed throughout the foundations, however, the densest deposits were found in the two test pits excavated along the edge of the suspected roadbed (JTP-11 and JTP-12). This arrangement may suggest that the majority of cultural materials were deposited between and amongst the foundations rather than within the foundations themselves. It also may indicate a waste disposal strategy centered on the road such as carting the majority of waste away from the domestic sites. South Village is the only domestic subsite investigated to date that yielded material information about the diet of the miners. The faunal assemblage included pig and other mammal bones, such as those from a large mammal, possibly a cow. The feline bones were likely those of a pet or feral intrusive.

East of Copperas Road is the tripartite foundation, which does not appear on the 1874 map. Its construction differs from the other foundations, utilizing smaller fieldstones rather than large pieces of sulfide mine waste rock, suggesting that it may have been built during an earlier or later building episode from the foundations across the road to the west. Based on its size and configuration it may have been a barn with the flat area to the north possibly serving as an animal pen. The South Village has excellent integrity and further archaeological investigations have a high potential to inform about the lifeways, particularly the diets, of the early miners at the site.

Twin Foundations (Partially Within APE)

The Twin Foundations subsite is one of several nineteenth-century domestic complexes that were associated with the Elizabeth Mine. These two foundations are depicted as houses on the 1874 map (see Figure 5-6). It is unclear why the two structures are located some distance from known historic thoroughfares while the other mine-related domestic resource clusters are located directly adjacent to the main routes in the area. The artifact scatter does suggest that the houses were inhabited through the end of the copperas manufacturing period (ca. 1882) and perhaps into the early twentieth century. It is possible that twentieth-century occupation of the houses, if it occurred, was not mine related. It is also possible that non-miners inhabited houses that were not immediately destroyed after their abandonment by the mine companies. The buttressed stonework on the east interior of the west foundation may be associated with a chimney at this location. The flat spot and the watered depression may be the remnants of a well or privy. The Twin Foundations possess excellent integrity and archaeological investigations have the potential to yield belowground resources that could inform about one of the few non-mine related habitation areas within the mine landscape.

East Village (Partially Within APE)

The East Village subsite is one of several nineteenth-century domestic properties that were associated with the Elizabeth Mine. Inhabitants of the East Village may have been workers at the Lower Copperas Factory based on the relative location and the visible road connecting the two areas. All three of the buildings on the 1874 Vermont Copperas Company map (see Figure 5-6) are visible today. The remains of the structures suggest that they were somewhat different in size and configuration. The east foundation is reminiscent of the tripartite foundation east of Copperas Road in the South Village, and is split longitudinally into excavated and non-excavated sections divided by a stone wall, with a possible bulkhead entrance for access to the excavated portion. Two pipes are sunk vertically 2.5-m from its north corners, which may have supported a porch. The presence of daylily patches and the rear retaining wall are unique at East Village. Possible interpretations for this large foundation are that it is the remains of a dwelling for an upper echelon employee, or that it could have been a multiunit dormitory, or a barn.

The other two foundations are square and fairly similar in size, with granite blocks at the corners that appear to be doorsills for side entrances. These structures may have been dormitories or boarding houses with an interior side stairway leading to a central hall flanked by multiple rooms. The first floor may have contained a larger common room. Photographic or descriptive evidence is required to determine the actual layout of those buildings. The small watered depressions upslope from the house foundations appear to be the collapsed remains of privies and wells. The uppermost of these pits has steel angle brackets at the corners connected by binder rods that resemble the hardware from a well cover. The artifact assemblage for this subsite suggests that the structures were built during the nineteenth century and inhabited through the end of the century. The presence of machine-cut nails indicates that the structures were built sometime prior to the final quarter of the nineteenth century, probably prior to mid-

century. Similarly, the stove fragments date to the second half of the nineteenth century and the debased blue shell-edged whiteware ceramic sherds indicate that the houses were inhabited until after ca. 1860. Given the strong evidence of fire and the heavy concentration of artifacts in the center foundation it appears that at least the central structure was destroyed in a catastrophic event, likely creating a sealed artifact assemblage.

North of Mine Road, opposite the three house foundations, are the remains of a connected farmstead (Figure 7-7) that appears to have stood into the mid-twentieth century. The visible remains consist of a medium size barn to the east and a small house to the west. The barn contains a stone pad of unknown function, and appears to have a small entrance into the foundation to the north, facing the farm's fields. Apparently, the main entrance to the barn faced Mine Road or toward the modern turnoff immediately to the east, but no access ramp is currently visible. Road grading has encroached on the barn foundation. The small house foundation appears to be that of a two bay, one room deep, central chimney, Cape. The historic photograph shows a connecting shed between the barn and the house. No evidence of this structure was located during the current field investigations. It is possible that these structures were ephemeral and had either stone piers, now destroyed or covered, or wooden sills resting directly on the ground. At least one freestanding shed is documented at the location of the present-day turnoff. The presence of a full stone barn cellar suggests that it was built after the middle of the nineteenth century (Hubka 1984:58). Further documentary research and archaeological investigations would be needed to determine the occupation of the site, as well as the cause of its destruction, and any information about its inhabitants.

The East Village subsite possesses good integrity and has high research value. In addition to the barn and house foundations, the East Village contains additional landscape elements that identify it as one of the more clearly agricultural landscapes at Elizabeth Mine. These features include a network of surrounding stone walls, which may predate the farm, abandoned cultivating machinery, granite boulder quarry, wall gate, paths, and possible field shed foundation.

Domestic Isolates (Outside APE)

The Elizabeth Mine Site includes two isolated domestic resources that cannot be associated with any of the identified subsites described above, based on documentary research and fieldwork conducted to date. These domestic isolates include the documented Teamster's House and an unnamed foundation, both of which lie outside of the project APE.

Teamster's House

The visible foundation remains of the documented Teamster's House are identified at the west edge of the 1830s Copperas Hill-Furnace Flats haul road. The location, dimensions, and possible evidence of a center entrance facing the road all point to a domestic nineteenth-century use. The structure does not appear on any of the available historic maps, though a property division depicted on the Elizabeth Mining Company ca. 1890 map may suggest the structure. The lettering on the map is difficult to read but the lot is either owned by a W. Drott or a Wolcott. The visible foundation has good physical integrity. Additional documentary research would clarify ownership and occupation of this structure, and assist in determining whether archaeological investigations could contribute important information related to mine worker living conditions at the site.

Figure 7-7. Ca. 1900 photo of Tyson Mill looking south. Note connected farmstead in background (source: Strafford Historical Society, Strafford, VT).

Unnamed Foundation

The visible remains of an isolated, unnamed foundation are situated north of the APE, and between Mine Road and the 1830s Copperas Hill-Furnace Flats haul road. This structure does not appear on any of the available historic maps. Its location near several intersecting stone walls and roadway traces, and the liberal surface scatter of glass and ceramic wares all point to a domestic nineteenth-century use. Groundwater bubbling up from the earth and the presence of threaded steel piping and fittings indicate that the structure was probably used to provide water. The visible foundation remains has good physical integrity. Additional documentary research would clarify ownership and occupation of this structure, and assist in determining whether archaeological investigations could contribute important information related to mine worker living conditions, particularly in respect to sanitary facilities at the site.

Buildings and Structures

The historic and archaeological mapping and testing program identified a total of 43 architectural resources including 31 buildings, nine structures, one individual object, and a multiple object artifact scatter. Twenty-eight of these resources are located within the APE. These buildings and structures have been interpreted and assessed in terms of their internal complexity, architectural integrity, historic research value, and associated archaeological resource potential (Table 7-3).

Nineteenth-Century Buildings

The Elizabeth Mine Site study area includes four standing nineteenth-century buildings associated with the mine. All are significant as surviving historic domestic and support buildings for the mine. The finest home, **Buena Vista**, is an estate that was constructed about 1859 and was occupied by James Tyson and his son James Jr. during their tenure at the mine. The property includes a barn and agricultural outbuildings and is in an excellent state of preservation, under the ownership of Tyson descendants. The **Copper Castle** was constructed during the mid-nineteenth century and appears to have served as a dwelling. Despite the addition of two tiers of roof dormers it retains much of its original details and is in an excellent state of preservation. The **Infirmary/Carpenter Shop** appears to include components from several nineteenth-century construction periods, and served as an infirmary and carpenter shop during the 1940s and 1950s. It is currently used as a private a residence. It is now restored and in an excellent state of preservation. The **Club House** served as a mine residence and boardinghouse in the 1940s and 1950s, and as the company dining room for management (Gwenda Smith, personal communication 2002). It has poor integrity as it has been recently moved on site, extensively altered, and a large wing that projected to the south burned down. All of these properties have high historical research value related to the architectural development of the Elizabeth Mine, and their surrounding landscapes have the potential to contain belowground resources (e.g., small outbuildings/sheds, privies, wells, trash pits, small garden plots, walkways) that could inform about the documented domestic occupations.

World War II-Era Buildings and Structures

The World War II-era buildings and structures are concentrated within the APE along two graded terraces on the lower slope of Copperas Hill, with administrative, laboratory, and mechanical support buildings in a line on the upper terrace, and ore storage, crushing, milling, and shipment preparation buildings on the lower terrace to the east. Below them to the east is a gully along the west toe of TP 1 containing several buildings and structures associated with tailings disposal. Isolated buildings and structures outside the

Table 7-3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Copper Castle	B	Y	ca. 1840-1855	Excellent (inhabited dwelling)	High	High
Infirmary/Carpenter Shop	B	Y	ca. 1850	Excellent (inhabited dwelling)	High	High
Club House	B	Y	late 19th/early 20th c.	Fair (altered, inhabited dwelling)	High	High
Buena Vista House Buena Vista Barn Complex Buena Vista Ash House	B B B	N N N	1859 ca. 1859 ca. 1859	Excellent (inhabited dwelling) Excellent Excellent	High High High	High High High
Lower Water Tank Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
Laboratory/Assay Office	B	Y	1941-1958	Excellent (inhabited dwelling)	High	Moderate
Office/Warehouse	B	Y	1941-1958	Excellent	High	Moderate
Machine Shop	B	Y	1941-1958	Excellent	High	Moderate
Shed south of Machine Shop	B	Y	1941-1958	Fair	Moderate	Low
Compressor Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
1898 Adit	S	Y	1898 - rebuilt ca. 1942	Good	High	Low
Change House	B	Y	1941-1958	Excellent	High	Moderate
Shed behind Change House	B	Y	1941-1958	Fair	Moderate	Low
Shed northeast of Change House	B	Y	1941-1958	Poor	Moderate	Low
Artifact Scatter northeast of Change House	O	Y	1941-1958	N/A (various steel objects and machinery	High	High

Table 7-3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Mine Car Bridge	S	Y	1941-1958	Good	High	Low
Ore Bin	S	Y	1941-1958	Poor	High	Low
Storage Shed northwest of Crusher Building	B	Y	1941-1958	Fair	Moderate	Low
Crusher Building	B	Y	1941-1958	Poor (superstructure and machinery removed)	High	Low
Grinding/Flotation Mill	B	Y	1941-1958	Fair (roof partially collapsed, machinery removed)	High	Low
Thickener/Drier Building	B	Y	1941-1958	Fair (north section demolished, all equipment removed)	High	Low
5-Bay Garage	B	Y	1941-1958	Excellent	Moderate	Low
Heating Plant/Pipe Shop	B	Y	1941-1958	Excellent	High	Low
Flotation Cells	O	Y	1941-1958	Poor (not in situ - removed from Grinding/Flotation Mill, motors and agitators missing)	High	Low
Launder Trestle	S	Y	1941-1958	Poor (partially buried uprights)	High	Moderate
Upper Tailings Pumphouse	B	Y	1941-1958	Fair	High	Moderate
Lower Tailings Pumphouse	B	Y	1941-1958	Poor (ruin)	Moderate	Low
Warming Hut	B	Y	1941-1958	Fair (may not be in situ)	Moderate	Moderate
World War II Housing	(Site)	N	1941-1958	N/A (buildings demolished, but site terracing still visible)	N/A	High
Community Center	B	N	1941-1958	Fair (altered inhabited dwelling)	High	High
Upper Water Tank Building	B	Y	1941-1958	Poor (foundation only)	Moderate	Low

Table 7-3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
1948 Shaft Hoist House	B	N	1941-1958	Poor (foundation and machinery bases only)	Moderate	Low
1948 Shaft Idler Tower	S	N	1941-1958	Poor (tower demolished)	Moderate	Low
1948 Shaft Headframe	S	N	1941-1958	Poor (shaft capped, headframe demolished)	Moderate	Low
River Pumphouse (WW II)	B	N	1941-1958	Poor (collapsed)	High	Low
River Pumphouse (Heckscher)	B	N	ca. 1906-1916	Poor (concrete foundation and machinery footings only)	Moderate	Low
Air Shaft and Electrical Substation	S	N	1941-1958	Fair (shaft capped, transformers removed)	Moderate	Low
Air Vent	S	N	1941-1958	N/A (steel pipe)	Moderate	Low
Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	Mid-1800s	Excellent (inhabited dwelling)	Moderate	High
Copper Shed at Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	1941-1958	Fair (altered)	High	Low

B=building
S=structure
O=object

[1] Architectural Integrity = primarily based on the degree of alteration, however, condition is indicated where relevant.
[2] Historical Research Value = based on the potential to reveal information on the arrangement, architecture, construction, and technology of the historic mining system and lifeways of the mine workers, managers, and neighbors.
[3] Associated Archaeological Resource Potential = based on the likelihood for intact ground surfaces within the surrounding landscapes that could contain potentially significant belowground resources.

APE include resources at the 1948 Shaft site, the Community Center, Ompompanoosuc River Pumphouse, Furnace Flats Air vent and Air Shaft/Electrical Substation and discontiguous resources at Pompanoosuc Depot in Norwich. [Refer to Table 7-3 for information related to their integrity, research value, and associated archaeological resource potential.] Architectural integrity is primarily based on degree of alteration, and condition is indicated in Table 7-3 where relevant. The historical research value for the industrial buildings is based on the potential to inform about the arrangement, architecture, construction, and technology of the historic mining system. The historical research value for the domestic resources is based on the potential to inform about the architectural development of the Elizabeth Mine and the lifeways of the people in the mining community. The associated archaeological resource potential of these resources is based on the likelihood for intact ground surfaces within the surrounding landscape. Any such intact cultural strata could contribute archaeological data salient to research questions related to mine technology and mine worker living conditions.

One domestic structure, the Community Center, is located at the west edge of the former World War II Housing site (also referred to as Federal Housing Site) west of Mine Road, outside of the APE. This former recreational center and catholic chapel has been moderately altered and has fair architectural integrity. It is the last remaining building in the only World War II housing area at the Elizabeth Mine, and therefore, is assigned a high research value. The surrounding landscape is also considered to have the potential to contain belowground deposits that would provide comparative data about the lifeways of mid-twentieth-century miners.

Two isolated structures are located on the south bank of the Ompompanoosuc River, east of Furnace Flats South and outside the APE. The World War II Pumphouse is in poor condition, with its collapsed walls lying on top of remaining electrically powered pump equipment. Immediately adjacent are the slag aggregate concrete footings for the early-twentieth-century Heckscher-era pumphouse. Both of these structures are significant as examples of the materials handling networks at the Elizabeth Mine and provided process water for flotation milling and water-cooled smelters. However, their architectural integrity and historical research value is poor, and the surrounding landscape is not considered likely to contain potentially important belowground resources.

Two small, isolated World War II-era structural resources are located outside the APE at Furnace Flats. The Air Shaft and electrical substation are on the north side of the Ompompanoosuc River, west of Furnace Flats North, and the Air Vent is located to the south on the south side of the river, near the south end of the 1830s dam ruins. These surface resources indicate the northern extent of underground mining of the Elizabeth Mine orebody at the time the mine closed in 1958. They have fair architectural integrity, but have limited information content and the surrounding landscape is not considered likely to contain potentially important belowground resources.

CHAPTER EIGHT

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Prehistoric Period Resources

The fieldwork completed as part of the current historic and archaeological investigations did not identify any prehistoric period cultural resources within the Elizabeth Mine study area. Thirty-three percent of the subsurface testing conducted within the 170-acre project APE was used to investigate locations selected by Abenaki tribal representatives and areas determined to have prehistoric site potential based on the Vermont Division for Historic Preservation's (VDHP) environmental predictive model. The absence of prehistoric period deposits in tested portions of the project APE suggests that the land use patterns in the vicinity of the West Branch of the Ompompanoosuc River and Copperas Brook reflect sporadic, short-term occupations. This type of low visibility settlement pattern may have continued into the Contact and early historic periods.

Historic Period Resources

The current survey included documentary research and field investigations to identify and record visible cultural features associated with the industrial and domestic occupations at the Elizabeth Mine Site. The documentary research consisted primarily of a synthesis of information collected to date for the mine site, along with additional contextual data about the historical development of the surrounding communities. The field investigations recorded 545 distinct cultural features associated with industrial and domestic site utilization. The majority of these features are related to the mining period, but some post-date the industrial occupation. (A GIS database for the recorded features including temporal affiliation was produced for the NAE and EPA as part of a separate contract – a report and CD are included in Volume II, Appendix H) The mining period resources are collectively organized into 18 subsites. All or portions of 13 of these subsites are situated within the project APE.

The 13 APE mine period subsites along with a number of intersite and isolated resources have been interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address priority research topics related to themes of industry and abandoned communities important to Vermont history (see VDHP 2002:22). The industrially related research themes for the identified Elizabeth Mine resources within the project APE focus on the various mine technologies, spatial organization of industrial complexes, and the living conditions of the mine workers. These research themes have been identified as important to Vermont history, and as such should be important to a broad public, including the communities of Strafford and Thetford. They are as follows:

1. Organization of and Modifications to the Copperas Landscape Over Time

The boundaries of TP3 encompass almost the entire working area used historically for copperas production, including the sites of extraction and the various steps of lixiviation, concentration and crystallization. Documentary records explain the general procedures of copperas manufacture, and provide a sense of the relative spatial layout of historic operations. The production process included features such as ore roasting piles, leaching pads, holding cisterns for collecting the

copperas liquor, and evaporators and heated metal pans for concentrating and crystallizing the copperas. The company arranged these steps of the process down the hillside to enable the use of gravity for conveyance. Differences in the descriptions of the works written between the 1820s and 1870s indicate changing technological practices. Ore roasting, for instance, was added later to enhance the effectiveness of leaching, and equipment used for evaporation and crystallization also evolved. Cartographic and photographic documentation of the copperas works is poor, with only one schematic map from 1874 and two indistinct photographs taken after the works closed.

Aboveground survey and mapping of TP3 identified features and structural remains associated with the copperas production process distributed across the hillside. These features include a pile of roasted, unleached ore below the lip of the North Open Cut, evidence of the first step in the process after actual extraction from the ground. Below this area, and corresponding to the next step in the production sequence, are mounds of eroded, red, leached and roasted ore revealing numerous wood structures. These include heavy timber cribbing and plank decking corresponding to historical descriptions of the leaching decks. Archaeological testing in this part of the slope revealed intact plank decking, and erosion has uncovered an area of mortared brick lying on bedrock. Still further down the hillside are timber corrals surrounding piles of leached and roasted ore, and scatters of brick in the location of the evaporators as indicated on the 1874 map. Below these features a massive timber and plank decking are in a location corresponding to a copperas liquor holding vessel in the historic descriptions. Directly downslope stands the foundation of the upper copperas factory and a complex arrangement of heavy timbers and planking in the bed of Copperas Brook.

The locations and relationships of most of these features do correspond generally to the order of the various steps in the cascading copperas manufacturing process as described in historical accounts. However, additional important information about the copperas works not found in documentary sources could be obtained through further archaeological investigations. Many of the wood features appear to be just the tips of more extensive structures that remain buried. The exposure of this wood indicates not only the presence of historic archaeological features in situ, but also the subsurface preservation of organics. Excavation of these features could yield information about the configuration and construction of the ore leaching structures and possibly copperas liquor conveyance features. Examination of the stratigraphy of the soils in several areas to identify the characteristic industrial by-products and waste materials associated with the copperas process could provide more detailed understanding about the location and arrangement of the phases of production, particularly as they evolved over time. Excavation of soil to bedrock has the potential to identify conveyance features including additional brick channels and the excavated troughs noted in historical accounts.

The areas where further archaeological investigations could be conducted are widespread. However, a concentration of exposed features is located in an east-west swath that stretches from a point near the north end of the north open cut east to and including the upper copperas factory (Figure 8-1). As the long-term preservation of this area is currently subject to environmental cleanup design, planning for potential archaeology in this area could follow two scenarios. Excavations could be conducted within this swath if its retention is not possible, and outside it at similar features if it can be preserved. In either case, archaeology investigations could include a combination of limited data recovery through shovel clearing to expose wood structures, and monitoring of soils and bedrock exposed during machine trenching conducted as part of site environmental characterization activities.

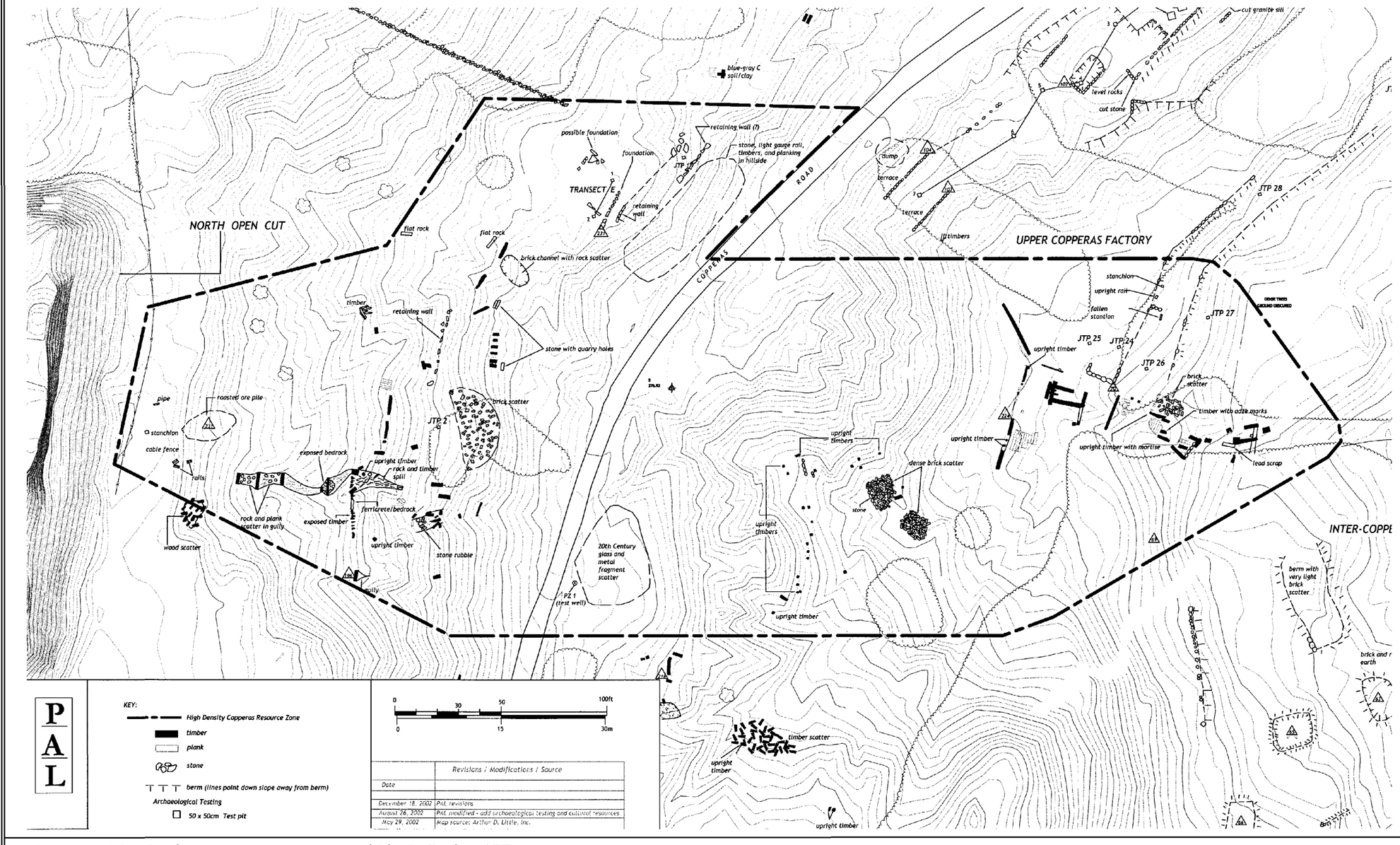


Figure 8-1. High density copperas resource zone within the Project APE.

2. Nineteenth- and Twentieth- Century Copper Ore Mining, Milling, and Smelting Sites and Support Facilities

Mining

Copper mining activities within the TP3 area began during the early nineteenth century, and continued intermittently until the late 1950s. The historical record indicates that an area west of Copperas Road at the north end of TP3 was the site of a 313 ft adit driven west into the ore body about 1830, and that the first physical separation of copper-bearing material from the copperas process feed material took place at this location. The 1874 Vermont Copperas Company map indicates a "cob shop," and a blacksmith shop positioned outside the adit. No photographs of this building or descriptions of activities that took place there have been located. This area is immediately north of and adjacent to the rectangular swath of TP3 noted above that contains a concentration of copperas manufacturing-related features.

Aboveground survey and mapping of TP3 identified some of the features associated with the mining and support activity in this location. Surface features associated with early ore mining include two wall or foundation features at the east lip of the plateau above Copperas Road, potentially the sites of the blacksmith and cobbing shops noted in 1874. Copper and copperas workings were in close proximity here but little is known of the interrelationship between these areas. Specific information about the supplemental activities taking place at this location, such as ore cobbing and blacksmithing, are lacking. There is little indication of how these tasks were conducted at the Elizabeth Mine, such as the types of tools employed for surface and underground work. At the least, the presence or absence of expected remains in this area would confirm if or how twentieth-century mining activities impacted the integrity of earlier features.

Milling

Copper ore milling activities at the Tyson mill site between TP1 and TP2 began about 1900 and continued intermittently until about 1930. This mill began as a small structure housing manual and mechanical ore separation equipment under Tyson management. It was later expanded by August Heckscher to house the first flotation equipment at the Elizabeth Mine. Finally, it was expanded as part of Frederick Foote's efforts to prove the viability of the mine. Aboveground survey and mapping identified a portion of the lower section of the mill that includes portions of wall, terraced floors and machinery bases. Historical accounts, photographic and map evidence provide widely varying levels of information about the several milling campaigns, but do not provide detailed information about internal mill layout. It is not clear how much of the mill remains buried by grading activities associated with World War II-era site preparation, however, major masonry features including walls and machinery bases typically survive at similar abandoned facilities including the Ely Mine smelter. Specific information about the supplemental activities taking place at this location, particularly at the adjacent blacksmith shop, is lacking. The presence or absence of expected remains in this area would confirm if or how twentieth-century mining activities impacted the integrity of earlier features.

Smelting

Historical accounts indicate that James Tyson, Jr. operated a smelter northeast of the 1898 Adit. This plant included an elevated charging trestle, blast furnace building and reverberatory furnace building. Between 1900 and 1902 Tyson and metallurgist William Glenn successfully smelted copper in furnaces lined with chromite. Between 1907 and 1909 August Heckscher constructed and operated a smelter east of the Tyson plant. This plant included a network of elevated

materials handling trestles, a smoke flue and chimney, and slag car loop track. This operation was plagued by accidents and short-lived, but was a technologically up-to-date facility for its time. Historical accounts, photographic and map evidence provide basic information about activities and plant arrangement, but do not provide detailed information about smelter building construction and internal layout.

No physical evidence of the Tyson Smelter was identified during the aboveground survey and mapping. Evidence of the Heckscher smelter, however, was found. These features include a dam and an expanse of slagheap including a slag car pot skull and scatters of brick and coke. Correlation of historic maps with existing contour maps shows that the Tyson smelter lies under the west toe of TP1, and the Heckscher smelter under the north toe of TP1. It is not clear what structural remains of these plants were buried as TP1 was deposited in the Copperas Brook valley. However, major masonry features including walls and machinery bases typically survive at similar abandoned facilities including the Ely Mine smelter.

The toe perimeter of TP1 may be impacted by installation of drains as part of the environmental cleanup infrastructure. Archaeological investigation could be conducted along the toe of TP1 in the vicinity of the Tyson Mill, blacksmith shop, and smelter sites through monitoring of machine trenching conducted as part of site environmental characterization activities. Although this activity would not uncover all of these sites, it has potential to reveal information about plant layout and construction materials and methods. This monitoring would determine the presence or absence of remains at the locations determined through documentary research. This activity would also test the validity of the mapping methodology, which involved correlation of the historic maps with modern mapping generated through the cleanup process.

3. Mine Workers and Their Living Conditions at the Elizabeth Mine

Current knowledge about the workforce at Elizabeth Mine relies primarily on federal census records. General accounts of the U.S. mining industry, however, point to myriad ways that mining companies actively shaped the labor force—through the construction of work "communities" (that encouraged a more stable workforce) to the division of work tasks based on ethnicity or job assignments. While work was the pervasive backdrop of life at the mine, efforts were clearly made to separate private and public spheres. However, very little is known about miners' living conditions away from the work setting. This lack of information is not uncommon at industrial sites across the country and has attracted the attention of social historians and archaeologists in recent years (Beaudry and Mrozowski 1987; Mrozowski and Handley 1997; Van Bueren ed. 2002). Archaeological studies of work settlements are often the only means to examine and enrich understandings of working and living conditions, class relations, and resistance in the nineteenth and early twentieth centuries (Paynter 1988; Paynter and McGuire 1991).

Social historians (e.g., George Murdock 1949) define "community" as a group of people living in the same place, interacting on a daily basis, and operating under a system of shared understandings. The Elizabeth Mine community can be viewed as a *peripheral work settlement*, a term specifically intended to encompass company towns, work camps, and villages formed by groups of entrepreneurs as well as enclaves of camp followers and strikers that sprang up within or near them (Van Bueren 2002a:2). The defining attributes of these communities include their narrow economic focus, relative geographic isolation, impermanence, and dependence on the global economy. Work communities tied to extractive ventures, such as the Elizabeth Mine copper ore extraction and processing campaigns, were necessarily unstable because of their dependence on global markets. The impermanence of such communities, in turn, limited the

amount of investment made both in economic and social terms. Settlements occupied for longer periods of time, in particular those with higher proportions of families, generally developed a wider range of amenities, social activities, and institutions than those used for shorter periods and occupied largely or solely by men.

At Elizabeth Mine, local and mine historians speak very little about how the nineteenth- and early-twentieth-century miners organized the domestic household, separated their public and private space, or coped with problems of health, diet, foodways, and provisions in general. Similarly, information relating to the non-miners – including wives, children, boarding house operators, and farmers – who supported the mine community is largely absent from the historical record. These social dimensions were as integral a part of the technological production system as roasting beds and holding cisterns. The industrial process did not maintain itself; it required the continuous attention of an entire community, about which very little is known. Documentary research conducted to date has not identified any substantial information about the people employed, their living conditions, wages, or discourse with company managers and/or owners. Archival materials that provide clues as to the community structure at Elizabeth Mine are limited to census records, an early-nineteenth-century description of the operation noting the employment of 30 to 40 workmen, Isaac Tyson Jr.'s journal, an 1830s account book from the company store, a company report (ca. 1865) listing one large boarding house and 34 tenements (Reynolds 1865) on the property; and a number of historic maps indicating the location of some of the domestic resources. Traveler's reports and historic photographs may contain some additional hints about daily life among the miners. Although some of the domestic agricultural resources are depicted in photographs, there are no known views of the miner housing.

Aboveground survey and mapping identified several intact and geographically distinct mine worker and non-mine worker habitation areas across the landscape. These habitation areas include single and double residences, boarding houses, and connected farmsteads located alongside the mining and smelting operations and in more distant settings. The archaeological remains of such peripheral work communities provide particularly rich opportunities for research into the evolution of relations between workers and entrepreneurs.

Community Infrastructure

There is currently little specific information in the documentary record about the development of community infrastructure at Elizabeth Mine. Archival and archaeological data collected to date confirm that prior to the WWII era, most of the workers and managers at the Elizabeth Mine lived in housing provided by the mine companies in proximity to the industrial operations. During the early to late nineteenth century, residences were concentrated in the upper portion of the Copperas Brook watershed and alongside the smelting works at Furnace Flat. During later copper mining phases, boarding houses were constructed further down slope in the vicinity of milling and smelting operations, while managers' residences were afforded a more distant view of the works from Mine Road.

Several of the domestic resource areas identified within the Elizabeth Mine Site project APE have the potential to address important questions relating to the community's infrastructure, which are not described in available written or archival records. These include the South Village, East Village and Twin Foundations resources. Archaeological investigations could provide information about the nature and type of structures that could provide information about the actual builders of the various villages. For example, were the houses erected by contractors or were they built by the miners with company funds? If the miners built the housing, how much autonomy did they have in design and execution? Structures designed and built by the company

would be expected to be of more standardized design, arrangement, and use of materials, while worker-built housing might be more eclectic and vernacular in form. Similarly, if the workers who built the housing were the ones who lived in them, then the design of the villages may reflect the nationalities of the miners who inhabited them. There are different stonework traditions in Cornwall, Ireland, Italy and elsewhere (Allport 1994) that may be correlated with the selection and placement of stones at the various village subsites. Structural remains identified at the South Village, for example, would be particularly useful to examine since the stonework at that village is substantially different from that observed at other domestic subsites at Elizabeth Mine.

The dispersed nature of domestic resources at the Elizabeth Mine Site suggests a more organic community structure, based on less ordered, minimally planned housing areas. This type of community structure reflects a less paternalistic approach to the workers and their lives, both during and after the workday. This structure also appears to be in direct contrast to other contemporaneous sites in the regions, for example, at Ely Mine, where the housing sites are very ordered in geometric and spatial relationships to the work areas and the surrounding community. In the latter case, there is little to no blurring of the lines between the "free" citizens of the town, and the workers, who typically had very little freedom in their off hours. At Elizabeth Mine, it is currently unclear if the more organic model of worker housing was based on the internal structure of the early mine companies, miner/manager choice, job assignments, ethnicity, social standing, or other factors altogether. For example, if ethnicity played an important role in the social composition and development of the housing complexes, then archaeological investigations at South Village, North Village, East Village, and Twin Foundations would be expected to yield comparative artifact assemblages related to the different worker groups.

Ideology: Capitalist and Worker Discourse

Several domestic resource areas at Elizabeth Mine could provide information about diachronic trends in miner's lives. The expansion and recession of the mine under its numerous owners is well documented but the effects of these boom-bust cycles and the attitudes of various owners toward the miners is largely unrecorded. By the late nineteenth century 50 percent of the industrial worker population in eastern cities remained with employers for less than six months (Katz et al 1982; Thernstrom 1964). The occupation date ranges for the various Elizabeth Mine households (e.g., boardinghouses, bunkhouses) could be ascertained through both additional documentary and archaeological investigations. Documentary research would focus on federal census records to provide statistical information relating to increases and decreases in worker mobility over time. Archaeological investigations would be used to verify the expansion and contraction of the work force based on the number of houses occupied during specific time periods. It may also be possible to correlate archaeological data to episodes of transience among the Elizabeth Mine workers and determine if these patterns correspond to regional trends. Certain household and personal items founds in temporally discrete trash deposits, for example, could provide evidence of such an occurrence. Presumably if a miner fled the mine (perhaps while in debt to the company store) whatever items he could not carry would be divided among his co-workers and the remainder discarded. Increased or decreased mobility could be evidence of the treatment of miners by management.

Similarly, the domestic resources at Elizabeth Mine could provide clues about the development of "scientific management" in Vermont. During the late nineteenth and early twentieth century, American capitalists often used racial, ethnic, gender, and job classification schemes to exploit divisions in the work force as a means to enhance productivity. Some of the principals of scientific management include segregation of workers, emphasizing hierarchy and differential awards, and forced temperance (Van Bueren 2002b:31). Scientific management can be

contrasted with "premodern" work habits, which included irregular work hours, alcohol consumption during the work day, and taking time off work for ethnic, religious, or family occasions (Gutman 1976). The development of and extent to which scientific management formed the basis of owners and worker discourse at Elizabeth Mine could be explored through archaeological investigations. Structures and artifact assemblages recovered at the various domestic resource areas could be examined for evidence of an increased regimentation of miner life over time. For example, the presence of time keeping devices and low number of alcohol bottles dating to a later period may indicate an increased application of scientific management by the mine company (Van Bueren et al. 1999:189).

Social Demographics

Beyond workplace ethnic and work category divisions there were typically divisions of status and family that likely influenced the type and nature of housing available at the mining community. In many cases, the lower echelon workers were single men and only the more established crew leaders and management were able to support families (Van Bueren 2002b). During most of the history of the Elizabeth Mine it is unclear where these mid-level employees were living. The agent's house, included in the North Village, is the exception. It is likely that mining shift captains and copperas factory superintendents lived in some of the remaining housing, possibly with families. It would be useful to identify their houses and compare them to the common miner housing. Archaeological investigations at the North Village, in particular, would be expected to provide information important to understanding the social demographics of the community. These investigations would be focused at the identified agent's house and what is believed to be the miner housing in proximity to it. Archaeological investigations at the South Village could also provide information related to this theme because it has to date yielded the only recovered faunal remains from the site. One of the distinctions between common miners and supervisors may have been their diet. If it is true that some of the supervisors and management brought their families to the mine then evidence of home and family life at the mine could be compared to urban and rural households of the same period to identify similar lifestyle trends.

Health, Sanitation, and Diet

The Elizabeth Mine was historically situated in a remote, frontier, and physically harsh environment, yet very little is known about mine worker adaptation to this environment and the role that it played in the social and cultural variability among the housing areas. The domestic areas have the potential to provide archaeological data that reflect the process of adaptation by workers to the mine environment. Important information could be obtained about the ideology of health and sanitation and about how the mine company coped with problems of provisioning its workers and managers. Archaeological investigations of privies, wells, and refuse disposal areas would provide the most useful information to address health, sanitation, and diet at the mine site, and how these basic human needs might have changed or evolved over time. The State of Vermont had regulated sanitation procedures in workplaces by 1902 (State of Vermont 1902:144 –148). The World War II records for the site indicate that health and hygiene standards and amenities were provided at Elizabeth Mine, including an infirmary and washhouse. Prior to that period, the extent to which the various mine owners/management followed the state regulations is unclear. Additionally, prior to state regulations, it is unlikely that any type of formal structures were in place to manage personal hygiene at the site.

Archaeological investigations would be directed at locating and identifying any wastewater control and material refuse features in relation to the domestic subsites. The placement of such features in relation to each other and to the house sites would bear directly on the extent of

sanitation practiced at the site. An absence of privies in the domestic subsites, for example, could also indicate that they were not well located or considered important for the workers. Archaeological investigations could also identify refuse deposits that provide clues as to whether waste was scattered around the sites, disposed of in designated areas, or incinerated to deter infestations by pests and to control odors, etc. These various methods of trash disposal would indicate an increasing level of organization, effort, and concern about the sanitation and appearance of the site. The presence of a company doctor or the employment of local physicians could possibly be traced through the documentary record and would be an important comparative data source regarding the overall worker hygiene at the mine.

The diet of the miners could be partially examined through faunal remains excavated from the site. The South Village, where quantities of bone were recovered, is the most likely subsite to contain faunal remains. The quality of the miners' diet could be inferred from the cuts of meat represented by the faunal assemblage. Additionally, the cuts of meat would suggest the level of butchering prior to arrival at the site. The level of butchering might suggest the distance the meat was transported and the level of autonomy the miners had in procuring their meat. Similarly, the presence of wild animal bones might suggest meat procurement by the miners. The ratio of wild to domestic animal remains could provide information about the diet of the miners. Variability in the miners' diet could be inferred from the number of different species both wild and domestic. Additional fill soils from in and around the foundations and any identified privies could provide organic (e.g., seeds, nuts) evidence of the types of fruits and vegetables consumed by the mine workers. Archaeological investigations could also identify small garden plots at some of the villages. Such features would not only inform on subsistence patterns, but could also provide clues as to household structure and the role that non-miner family members may have played in the overall provisioning of the workforce.

Several of the domestic subsites within the project APE could provide information on the effect the mine had on surrounding farms. Information from sites including The Farm, the Blaisdell Farm, the Preston Farm, and the farm associated with the East Village could all have bearing on this question. The Blaisdell Farm may predate the mine and could provide insight into the effect of the mine on local agricultural concerns, especially for the pre-twentieth-century mine periods. The farm associated with the East Village, which lasted into the twentieth century, could provide similar information for the later mine periods. Both of these farms may have supplied food to the mine and housed workers, and may contain information how the development of the mine affected the surrounding community. The farms represent constants across the boom-bust cycle of the mine. If the Preston Farm is the one operated by the mine then it could provide comparative archaeological data related to a number of important questions. Did the company apply the same management techniques and level of supervision to its agricultural concerns as to its industrial concerns? How important was the farm to the feeding and boarding of the miners? Could the farm supply all of the miners dietary needs, and at what periods? Were there substantial differences between the company farm and farms of a similar size in the surrounding area? Investigations of these non-industrial sites could help to integrate the mine into the context of South Strafford and the surrounding communities.

Recommendations

Prehistoric Period Resources

No prehistoric period Native American resources were identified within the project APE. The subsurface testing results conducted within the APE combined with unfavorable environmental factors and the extent of historic period industrial soil disturbances indicates an overall low

potential for important prehistoric period resources to be present. No additional archaeological investigations for prehistoric period sites within the project APE are recommended.

It is possible that additional areas of potential effect including borrow pits and access roads may be identified in archaeologically sensitive areas outside of the current APE (Figure 8-2), in which case archaeological survey may be warranted. The survey work would be designed to identify and evaluate any potentially important belowground prehistoric period resources. The need for and scope of additional archaeological investigations within project impact areas should be included in the project's Memorandum of Agreement (MOA).

Historic Period Resources

Industrial Landscape

Prior to any earthmoving activities related to the site environmental characterization work, documentation of the mine landscape will be undertaken in the spring 2003 as part of the mitigation efforts for the project. These activities are likely to cause irrevocable changes to the landscape and important cultural features related to industrial and domestic subsites. The landscape documentation will encompass the project APE and other major landscape features including the South Open Cut. The landscape documentation will consist of aerial photographs of the TP1/2/3/North Open Cut/South Open Cut landscape, done in the most archivally stable color transparency film available with some additional black-and-white; and terrestrial large format (4-x-5-inch negative) color transparency and black-and-white photographs of the TP1/2/3/North Open Cut/South Open Cut landscape.

Archaeological Resources/Sensitive Areas

The current survey identified industrial and domestic archaeological resource areas within the project APE that have the potential to address important priority research topics in the state of Vermont (refer to Tables 7-1 and 7-2). The proposed trenching associated with the site environmental characterization work should take place with consideration for further investigating industrial archaeological resources as shown on Figures 8-1 and 8-3 and in Appendix B. A collaborative effort between cultural resource specialists and the geotechnical team would be expected to provide some of the information identified as data gaps in the research priority topics discussed above. Pending the evaluation of archaeological data collected during the site characterization work, additional systematic archaeological investigations of targeted resources may be warranted as part of mitigation efforts for the project. However, the Corps and EPA have no plans to pursue additional archaeological investigations at this time either to further address the research questions or as possible mitigation. Domestic archaeological resource areas having high research potential should be avoided during site environmental characterization work and cleanup activities.

It is possible that additional areas of potential effect including borrow pits and access roads may be identified in archaeologically sensitive areas outside of the current APE, in which case archaeological survey may be warranted. The survey work would be designed to identify and evaluate any potentially important belowground historic period resources. The need for and scope of additional archaeological investigations within project impact areas should be included in the project's MOA.

Standing Structures

There are no current plans to alter the WWII buildings in the project APE. However, given their relatively unstable condition and importance to the overall mine site, Historic American Engineering Record (HAER) documentation will be undertaken in the spring 2003 as part of the mitigation efforts for the project. These buildings and structures include: the upper tier of administrative, maintenance, and operational buildings; the adit and mine car rail line and bridge; the lower tier of ore bin, crusher, grinding/flotation mill, thickener/drier building, tailings pump house and launder remains; the 1948 Shaft Site, TP1 and 2, the Ompompanoosuc River Pump House and Air Shaft, and any other miscellaneous associated resources. Standard HAER documentation will consist of recording the buildings with a set of measured drawings showing site plans, materials handling routes and process flow charts. Although the PAL Historic Context Report (PAL 2000) contains a general history of the Elizabeth Mine that could serve as a basis for the HAER narrative report component, that document will be updated to reflect new information discovered during the course of subsequent research and fieldwork, and edited to shift the focus primarily to the Elizabeth Mine. Since the HAER documentation concentrates strongly on process, the narrative and drawings will be created in consultation with an industrial historian knowledgeable about the Elizabeth Mine and the ore beneficiation processes used there. A set of photographs separate from the abovementioned landscape documentation will be done in large format (4-x-5-inch negative) for the building exteriors (interiors if available) using mostly black-and-white with some color, and also including limited representative views of the TP1/2/3 and North/South Open Cuts landscapes as they were sources of ore during the World War II period.

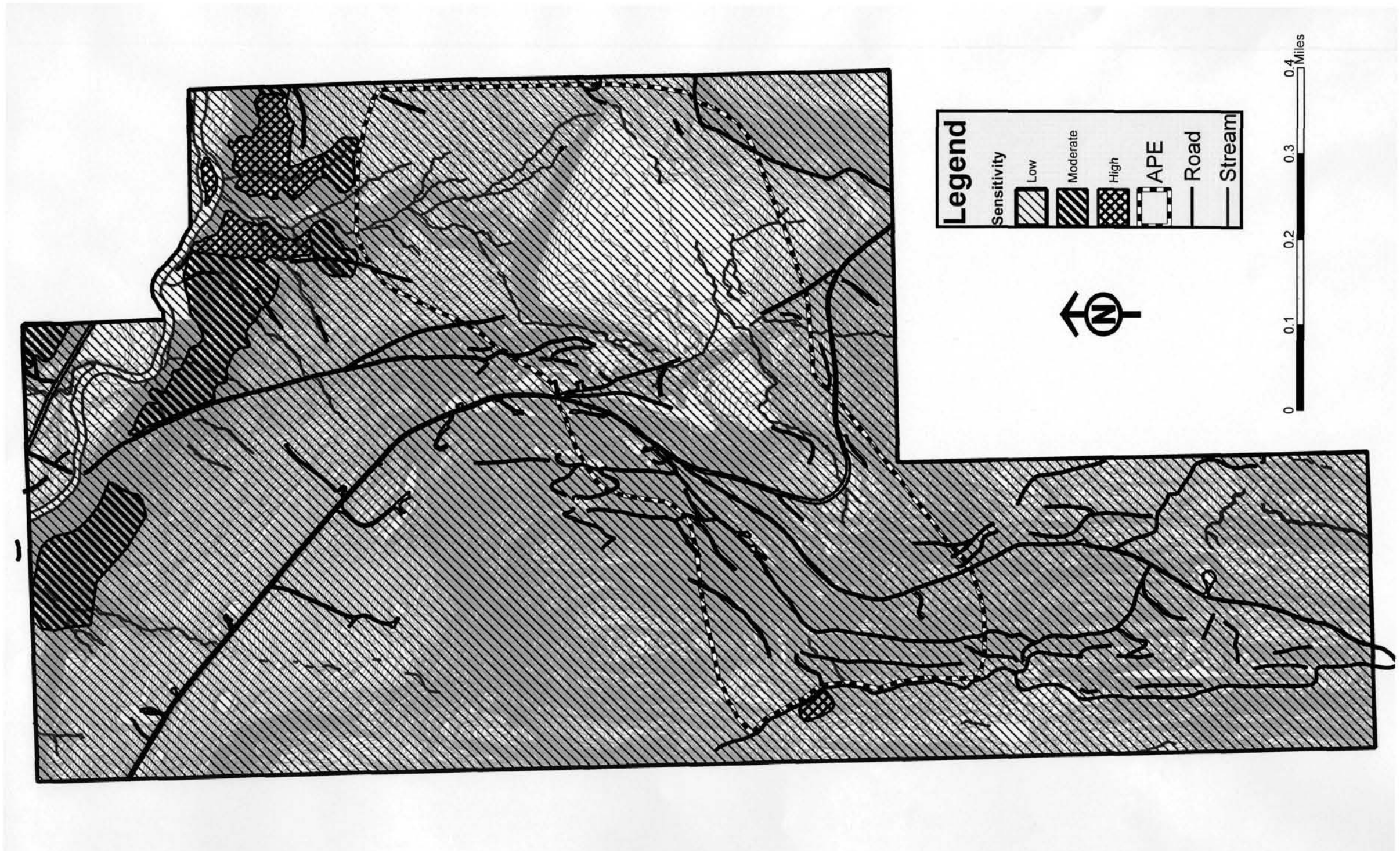


Figure 8-2. Prehistoric period archaeological resources sensitivity assessment, Elizabeth Mine Site study area.

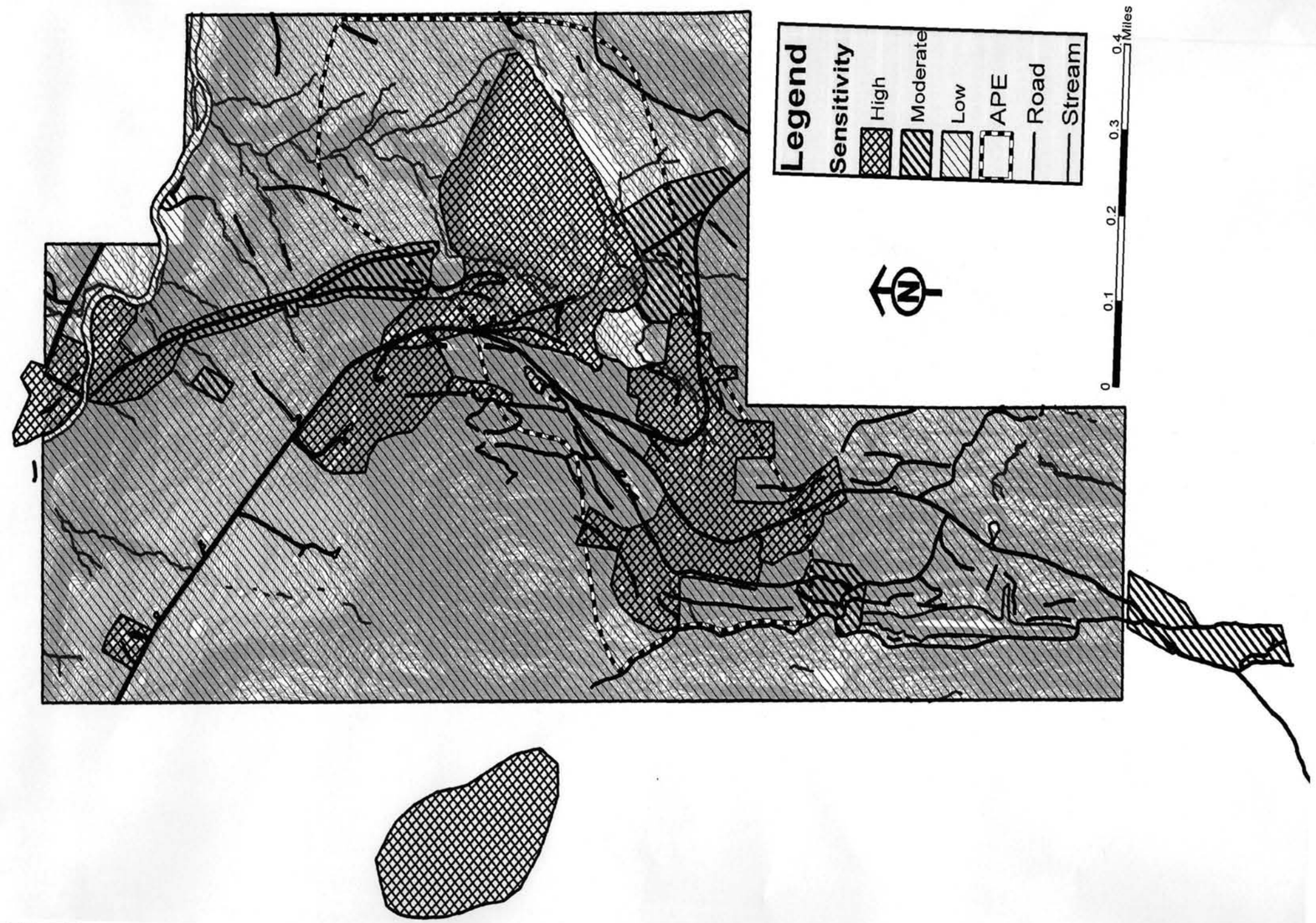


Figure 8-3. Historic period archaeological resources sensitivity assessment, Elizabeth Mine Site study area.

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List of Informants:

Collamer M. Abbott (mining historian)
(summer)
644 Fairview Terrace
White River Junction, VT 05001-2164
(winter)
3 Rue Chaptal
34000 Montpelier
France

Jim Condict (former Elizabeth Mine employee)
HCR 65, Box 72
South Strafford, VT 05070

Johnny Johnsson (mining historian)
2622 Deer Park Road
Finksburg, MD 21048

Gwenda Smith, Curator/Historian, Strafford Historical Society
P.O. Box 67
Strafford, VT 05072

FINAL REPORT

HISTORIC/ARCHAEOLOGICAL MAPPING AND TESTING
ELIZABETH MINE SITE
VOLUME II

Strafford and Thetford, Vermont

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Principal Investigator/Contributing Author:
Suzanne G. Cherau

Project Supervisor/Primary Author:
Ben Ford

Industrial Historian/Secondary Author:
Matthew Kierstead

Prepared for:
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742-2751

Prepared by:
PAL
210 Lonsdale Avenue
Pawtucket, Rhode Island 02860

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13. ABSTRACT *(Maximum 200 words)*

PAL, under contract with the U.S. Army Corps of Engineers, New England District, conducted historic/archaeological mapping and testing at the Elizabeth Mine Site in Strafford and Thetford, Orange County Vermont. The investigations included background research and field investigations. The background research focused on collecting information needed to develop historic contexts for the project Area of Potential Effect (APE) and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort; 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. No prehistoric period resources were identified in the project APE, although sensitive areas were identified in other parts of the overall site, outside of the project APE. The field investigations did result in the identification of numerous industrial and domestic resources related to the historic mine operations during the nineteenth and early-to-mid twentieth century. The resources consist of visible structural remains and features along with a representative artifact assemblage recovered from the ground surface and in 50-x-50 centimeter test pits at select resource areas. Technical report recommendations included the documentation of the mine landscape (to be undertaken in the spring of 2003 as part of the mitigation efforts for the project) for the project APE and other major landscape features.

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EXECUTIVE SUMMARY

Introduction

Elizabeth Mine is a designated National Priorities List (Superfund) site, and as such, the Environmental Protection Agency (EPA) is coordinating the hazardous material cleanup of the site to protect human health and the environment. This report presents the results of an historic/archaeological mapping and testing survey of the Elizabeth Mine Site (Vermont Archaeological Inventory VT-OR-28) in Strafford and Thetford, Orange County, Vermont (see Figure 1-1 of the technical report). The currently defined site encompasses approximately 800 acres of land within the Ompompanoosuc River drainage, a major tributary of the Connecticut River. The majority of the mine site is located in South Strafford in the southern part of the town of Strafford, with an eastern portion in Thetford and small portions at its southern extremity in Sharon and Norwich, which are located in Windsor County. The site is focused on the core area of historic mining activity, although the total land area historically associated with the mine reached 8,000 acres where the mining company(s) had mining rights only. PAL conducted the archaeological investigations for the Department of the Army, New England District, Corps of Engineers (NAE).

Prior to the current investigations, the site had been studied as part of the EPA's compliance with Section 106 of the National Historic Preservation Act and its implementing regulations, 36 CFR Part 800. The initial cultural resources study, titled *Statement of Limits, National Register Eligibility, and Potential Resources in the Proposed APE, Elizabeth Mine, South Strafford, Vermont,* was prepared by Hartgen Archaeological Associates, Inc. (Hartgen 2000). The supplemental report, titled *Historical Context and Preliminary Resource Evaluation, Elizabeth Mine Site, South Strafford, Orange County, Vermont* (PAL 2001), and an addendum report, titled *Addendum to Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont* (PAL 2001), were both prepared by PAL under contract with Arthur D. Little, Inc. on behalf of the EPA. The goal of the current investigations was to locate, identify, photograph, map, and in some cases draw visible structural, artifactual, and landscape features associated with the Elizabeth Mine Site. Limited subsurface testing was also conducted to locate and identify prehistoric and historic period resources within the preliminary Area of Direct Potential Effect (APE). The current APE covers an estimated 170 acres characterized by Tailing and Mine Waste Piles 1, 2, and 3 (TPs), and surrounding lands. The total current study area for the site encompasses approximately 460 acres.

The fieldwork, report, and database will assist the EPA in complying with Section 106 of the National Historic Preservation Act of 1966, as amended, for the proposed undertaking at the Elizabeth Mine Site. The report is a scholarly document that not only fulfills the mandated legal requirements, but also serves as a scientific reference for future professional studies and as a framework for possible future interpretive programs. All archaeological survey work was undertaken in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (48 FR 44716, 1983), the Advisory Council on Historic Preservation's handbook "Treatment of Archaeological Properties" (1980), and the Vermont State Historic Preservation Office's (VTSHPO) *Guidelines for Conducting Archeology in Vermont* (2002).

The Elizabeth Mine was established in the early nineteenth century and operated until the mid-twentieth century. It lies approximately one-half mile south of the West Branch of the Ompompanoosuc River, in the rugged uplands of east-central Vermont (Figure 1-2). This section of Orange County hosted mining activity in the approximately 20-mile long Copper Belt, and by the late nineteenth century was the location of several other mining operations, including the Ely Mine in Vershire (VT-OR-14) and Pike Hill Mines (Eureka and Union) (VT-OR-27) in the town of Corinth. Today, Elizabeth Mine contains major mining landscape features, numerous standing structures, and the aboveground and buried remains of structures and features

related to several periods of mining operations at the site. There are also a number of non-mining historic period farmstead sites within the approximately 800-acre mine site.

Survey Methodology

The current investigations of the Elizabeth Mine Site included additional background research and field investigations. The background research focused on collecting information needed to develop prehistoric and pre-/non-mining historic period contexts for the APE and its environs. Additional research into the mining period was limited to interviews with local mine experts and a review of local manuscript collections. The fieldwork was comprised of three primary tasks: 1) site mapping using the global positioning system (GPS) coordinates linked to the site's geographic information system (GIS) completed as part of another contract effort (included as Appendix H of the technical report); 2) detailed drawings of visible aboveground structural remains related to historic period pre-/non-mining and mining activities at the site; and 3) limited subsurface testing to locate and identify prehistoric and historic period resources within the preliminary APE that may be directly impacted by the proposed site remediation project. The subsurface testing included several locations selected by the Abenaki Tribe as areas that could potentially contain Native American resources. These investigations resulted in the identification of historic period resources for which there is physical evidence and the preparation of archaeological sensitivity maps for prehistoric and historic archaeological resources within the entire site.

The goal of the archaeological survey was to locate, identify, photograph, map, and in some cases draw visible structural and landscape features and artifacts associated with the Elizabeth Mine Site. These activities were conducted in the APE where cleanup activities will take place and outside the APE within documented activity areas. To accomplish this objective, three research strategies were used:

- additional archival research and local informant interviews;
- field investigations, consisting of a comprehensive site walkover/GPS survey, limited subsurface testing in the APE, and detailed drawings of select cultural features; and
- laboratory processing and analyses of recovered cultural materials.

Background research was conducted to assist in the development of prehistoric and pre-/non-mining historic period contexts. Historical contexts are needed to interpret and evaluate the significance of any Native American and Euro-American (non-mining) resources that may be identified during the field investigations. The background research for prehistoric sites primarily consisted of a review of archaeological site files and cultural resource management reports and studies maintained at the Vermont Division for Historic Preservation (VDHP) for up-to-date information about known prehistoric sites within and/or near the site. Interviews with the Native American Abenaki representatives also provided information relating to culturally sensitive locations within the site.

Additional historic research focused on examining primary and secondary documentary sources (town histories, maps, etc.), including those previously collected by PAL and others, to identify potential Euro-American (non-mining) archaeological sites within or adjacent to the project area. Interviews with local persons knowledgeable about the non-mining history of the area, including Gwenda Smith, historian/curator of the Strafford Historical Society, were conducted to assist in the development of the pre-mining historic context. An interview with mining historian Collamer Abbott regarding the industrial use of the site was also conducted, along with a review of his archival collection at the University of Vermont for preliminary information relating to its contents and potential contribution to the site's mining period history.

The first field survey task was to produce a comprehensive site plan that depicts the spatial configuration of visible features and landscape elements. This site plan is linked to the GIS cultural resources database for the site (see Appendix H of the technical report). For the purposes of this survey, the Elizabeth Mine Site includes known and documented habitation and mining activity areas at TPs 1, 2, and 3, Old South Mine, South Open Cut, Sargent Brook Smelter Site, Furnace Flat South Smelter Site, and Furnace Flat North Smelter Site.

Initially, a walkover survey with close ground inspection was conducted to locate and identify visible features and landscape elements across the site. The survey encompassed 460 acres that extended from the cemetery in the south to Furnace Flat North and from the Sargent Brook Smelter Site in the west to east of TP 1 (see Appendix B of the technical report). The types of resources that were recorded as part of the site mapping include structural features, area features, linear features, and isolates (see Table 2-1 of the technical report). The walkover survey was designed to maximize coverage of open and wooded areas, using pedestrian transects at 30-meter (m) intervals. The transects were oriented along predetermined compass headings across roughly 460 acres of the historic mining landscape.

Visible features and landscape elements identified during the walkover survey were recorded using a GPS unit. A Trimble GeoExplorer 3, containing PAL's custom historic resource GPS database, with an external antenna, set to collect from a minimum of four satellites achieving a maximum PDOP (percent dilution of precision) of seven was used to collect geographic and attribute data for all identified features. With these settings a minimum accuracy of 5 m was achieved. Linear features such as roads, trenches, and stone walls were recorded as lines, while finite objects like building corners, exploratory drill casings, and discrete artifact scatters were recorded as points, and larger more amorphous features such as large artifact scatters and mine openings were recorded as polygons. Representative photographs were taken of all recorded visible features and landscape elements.

Areas not subjected to GPS survey, because of a lack of landowner permission at the time of the field investigations, include: 1) the majority of the area along the strike of the ore north of the North Open Cut and the West Branch on the Ompompanoosuc River; 2) Lower Bailey Road east of TP 1 (the haul road near Gove Hill); and 3) two house foundations near the intersection of Furnace Flat Road and Route 132. The documented historic period resources in these areas provide information as to their archaeological sensitivity in relation to the overall Elizabeth Mine Site (see Chapter 7 of the technical report).

The information collected during the walkover of accessible site areas was transferred from the GPS unit to the project map utilizing both ESRI ArcView 3.2 and 8.1 GIS. This data was instrumental in determining where subsurface testing would occur within the project APE. Additionally, the GIS data permitted a more sophisticated analysis of the landscape and visualization of the historic spatial arrangement of the project area.

Information collected during background research and the walkover survey was used to develop a predictive model to assess the potential for the presence of Native American and Euro-American resources, the types of sites that might be found, and their cultural and temporal affiliation. The development of predictive models for locating cultural resources has become an increasingly important aspect of CRM and planning.

The predictive sensitivity model used criteria to rank the potential for the project area to contain Native American or Euro-American sites. The general criteria used to assess the Elizabeth Mine project area were proximity of known and documented cultural resources, local land use patterns, environmental characteristics, and the area's physical condition. The prehistoric period Native American archaeological sensitivity of the Elizabeth Mine Site was based on the VDHP's environmental predictive model for pre-contact settlement sites and information collected during the walkover survey on current project area conditions. The predictive

model alone was not sufficient because it provides only a rough approximation of an area's sensitivity while the walkover survey took into account the relative importance of resources and natural barriers to their procurement. Because of the size of the APE and the diversity of environments contained within it, it was necessary to divide the Native American archaeological sensitivity assessments into eight regions based on an environmentally derived parsing of the landscape.

The likelihood of Euro-American archaeological resources was a foregone conclusion based on the intensive mining use of the site during the historic period and the previous historic and archaeological studies conducted by PAL and others. However, based on historic maps and the comprehensive walkover survey it was possible to identify areas of intensive Euro-American utilization, areas of sporadic Euro-American use, and areas where there were little or no Euro-American resources. Furthermore, by georeferencing, or "rubber-sheeting," historic maps of the mine on top of the modern project map it was possible to ascertain which historic resources had been buried or destroyed by subsequent mining campaigns. Based on the GPS survey and archival research a number of Euro-American industrial and domestic occupation areas were identified within/adjacent to and outside of the project APE at the Elizabeth Mine Site. The large majority of these areas were grouped collectively within designated subsites, or vicinities of intensive occupation.

Limited subsurface testing was conducted in moderate and high archaeologically sensitive portions of the project APE to locate and identify any potentially important archaeological resources. A total of 73 test pits were excavated for historic period resources within the project APE. These test pits, 50-x-50 centimeters (cm) in size, were excavated at 8-m intervals along 14 judgmental linear transects and as 28 judgmentally placed test pits. Specific subareas subjected to subsurface testing include: the World War I Era Smelter Site, the Tyson Mill Site (specifically the blacksmith shop), the Preston Farm, the Blaisdell Farm, the Farm, North Village, South Village, and TP3 (cob shop, Upper Copperas Factory). Subsurface testing was conducted at a representative sample of visible historic period resources within the project APE. This testing was designed to collect archaeological data on the temporal affiliation, possible function(s), and subsurface soil matrices for individual resource areas (or subsites) where this information was not readily discernable based on visual characteristics alone.

In addition to the above testing, 44 test pits were placed in areas of the project APE determined to be archaeologically sensitive for prehistoric period resources based on the results of the predictive model, walkover survey, and consultation with representatives of the Abenaki Tribe. An additional four test pits were placed in the area northeast of TP1 in proximity to a culverted branch of Copperas Brook. All of these test pits, 50-x-50 cm in size, were excavated at 8-m intervals along nine judgmental transects and as six judgmentally placed test pits.

Furnace Flat North, Furnace Flat South, Tyson Mill Site, Sargent Brook Smelter Site, Blaisdell Farm, the Farm, North Village, TP3, South Village, the Twin Foundations, East Village, and the Lower Copperas Factory contain visible structures and landscape features that were subjected to detailed plan and cross-section line drawings. Plan maps, which show the spatial relationship of the various features of a resource, were created at either a scale of 1 inch equals 2 m or 1 inch equals 5 m, depending on the size of the resource. Similarly, cross sections were employed to depict the topographic relationships between the various features as well as aspects of wall construction.

Cross sections were completed at a scale of 1 inch equals 2 m. In general the transit was used to establish a baseline and measurements were taken relative to the transit along a tape measure to create the cross sections. However, a number of the shorter wall profiles were drafted using a tape measure across the top of the wall with measurements taken down from the top of the wall. In general the plan maps were created using a hand compass and tape measure to establish the angles and distances between points within a resource. However, in

the case of TP3 where the exceedingly steep slope of the area prohibited the effective use of a tape measure, the transit was used to measure both angle and distance. The field maps were digitized using AutoCAD 2000i and were then exported into the GIS database. Besides adding more detail to the GIS map the field drawings permitted the data collected during the GPS survey to be corrected for greater accuracy.

All cultural materials recovered from the project APE during subsurface testing and representative industrial-related artifacts collected from the entire site during the field mapping were organized by subsite and provenience, and recorded and logged in on a daily basis. Cultural materials were sorted by type and either dry brushed or cleaned with tap water depending on the material or artifact type and condition. Following the laboratory processing and cataloging activities, all recovered cultural materials were stored in acid-free Hollinger boxes with box content lists and labels printed on acid-free paper. These boxes are being *temporarily* stored at the PAL facilities in Pawtucket, Rhode Island according to curation guidelines established by the U.S. Army Corps of Engineers.

Results

No prehistoric period cultural resources were encountered during the archaeological mapping and testing at the Elizabeth Mine Site. While upland cultural adaptations have been recorded in northern New England, especially during the Late Archaic and Late Woodland periods, the focus of Native American activity in the region appears to have been concentrated in the major river valleys. With the Connecticut River only a few miles to the east, there may have been only sporadic prehistoric period settlement and land use in the vicinity of the West Branch of the Ompompanoosuc River and Copperas Brook. The rugged, upland topography would not have been particularly attractive for the types of long-term habitation activities (e.g., structures, food processing/storage/disposal pits, hearths, lithic workshops) that would have left readily discernable cultural deposits in the archaeological record at the site. There are only limited settings within the site study area that are relatively flat and contain sources of raw materials and perennial water sources where potentially important prehistoric period resources could be present. These settings include the terrace overlooking the West Branch of the Ompompanoosuc River in the northeast portion of the study area, north of TP1; and quartz outcrops in the west-central portion of the study area, west of the North Open Cut.

A total of 545 distinct historic period features was recorded during the GPS component of the fieldwork. Identified artifact, feature, and structure concentrations were collectively organized into 18 spatially distinct historic period industrial and domestic subsites related to the nineteenth and twentieth-century operations of the Elizabeth Mine. The historic and archaeological mapping and testing program identified 11 industrial archaeological subsites, seven domestic archaeological subsites; and 43 architectural resources including 31 buildings, nine structures, one individual object, and a multiple object artifact scatter. Thirteen of the industrial and domestic archaeological subsites are located in the project APE. Twenty-eight of the architectural resources are located within the APE. All of the identified archaeological and architectural resources were interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address salient research questions, The following three tables summarize the identified cultural resources by type, time period, major visible physical remains, integrity, and historical research value (documentary data, archaeological sensitivity).

The identified historic period architectural and archaeological resources at the Elizabeth Mine Site are all components of a larger, complex, integrated cultural landscape. The Elizabeth Mine can be considered a single megasite composed of numerous temporally, functionally, historically and physically related industrial, agricultural, domestic and administrative subsites. The natural and man-made environments provide the most

Executive Summary-Table 1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
World War I Smelter	1916	- Concrete platform (floor); - Piles of brick and rebar; - Iron scraps and slag	Eight test pits - yielded construction materials including a handmade brick	Poor	Poor	Low
Tyson Mill	1899 to 1930	- Section of stone foundation - Concrete pads and piers; - Angle iron bases; - Timber arrangements	Twelve test pits in blacksmith shop area - yielded fire-reddened earth, coke, slag, charcoal, and window glass	Fair to Good?	Fair	High
Tailings Pile 1	1940s to 1950s	415-m-x-490-m flat, triangular plateau of mine waste; visible launder trestle supports	N/A	Excellent	Good	Low
Tyson Smelter (buried under west toe)	ca. 1900-1902	None	N/A	Unknown	Fair	High
Heckscher Smelter (partially buried Copperas Brook dam and slag heap - north toe)	ca. 1907-1909	- Burnt ore and slag; - Dam remains (altered topography)	N/A	Unknown	Fair	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Tailings Pile 2	1940s to 1950s	150-m-x-140-m triangular flat-top pile of mine waste	N/A	Excellent	Good	Low
Buried ephemeral Tyson Mill Period outbuildings/sheds and waste rock piles. (See Preston Farm, Table 7-2)	ca. 1900-1902	None	N/A	Unknown	Poor	Low
Tailings Pile 3 (contains visible remains of 19th c. and early 20th c. resources)	1809-1958	See below	See below	See below	See below	See below
North Open Cut	1809-1958	Open excavation	N/A	Excellent	Good	Low
Tyson Mining Zone	ca. 1880s	- Manway; - Shafts 1 and 2; - Clinker pile; - Waste rock	No subsurface testing conducted	Fair	Fair	Moderate
Water Reservoir and Dam	19th century	- Dam - Reservoir	No subsurface testing conducted	Good	Low	Low
Leaching and Roasting Beds	1809-1882	- Scaffolding : wood planks and timber features; - Brick-lined channel; - Ore corrals - Piles of roasted ore, - Piles of burnt fused ore - Piles of waste rock	Four test pits - yielded construction materials and industrial waste	Fair	Fair	High
Blacksmith Shop	ca. 1874	- Stone foundation; - Iron plates and implements	See above	Fair to Good?	Poor	High

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Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Cob Shop	ca. 1874	- Stone foundation	See above	Fair to Good?	Moderate	High
Upper Adit	ca. 1830	- Possible stone foundation - Collapsed mouth	See above	Fair	Poor	Low
Lower Adit (Deep)	ca. 1854	-collapsed mouth -wasterock pile	No subsurface testing required	Fair	Poor	High
Evaporators	ca. 1874	- Possibly one of 3 visible as stone wall protruding from yellow waste-rock	No subsurface testing conducted	Poor	Poor	High
Upper Copperas Factory	19th century	- Interior and exterior stone foundations, stanchions, and wood wall posts	Five test pits - yielded construction materials and industrial waste; three ceramic sherds	Good	Poor	High

Executive Summary-Table 1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Lower Copperas Factory	19th century	- Interior and exterior stone foundations; iron chutes and plats; platforms; stanchions, brick piles; earth berms	No subsurface testing conducted - fire brick and iron bracket (wood supports) surface collected; iron chutes and arch noted.	Excellent	Poor	High
Outside of the APE:						
Furnace Flats North	1854-1884	- Dam embankment - Saw mill foundation - Cooper shop foundation and turbine shaft - Wheel pit - Furnace area - Two paint factories - Bath house foundation - Bridge abutment - Domestic component: two house and one barn foundations	No subsurface testing conducted	Excellent	Poor	High
Furnace Flats South	ca. 1830	- Bridge abutment - Haul road (1830s) - Furnace debris including salamanders, slag piles, and refractory material - Charcoal storage platform	No subsurface testing conducted	Excellent to unknown	Poor	High

Executive Summary-Table 1. Summary of Historic Industrial Resource Areas, Subsites, Buildings, and Structures Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Sargent Brook Smelter	1882-1890	- Haul road - Foundation - Stalls - Reservoir - Dam - Charging ramp - Furnace floor - Furnace hood and binder rods - Slag dump	No subsurface testing conducted	Good	Fair	High
Old South Mine	early 19th century	- Two large excavated trenches - Waste rock piles - Exploratory trenches - Adit mouth - Domestic foundation	N/A	Good	Poor	Moderate
South Open Cut	1950	- 500-m-x-40-m excavated trench; - Various logging and haul roads; - Tunnel leading to North Open Cut; - Drill steels in bedrock. - Waste rock pile	N/A	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address research questions relating to the mine technology and the lifeways of mine workers.

Executive Summary Table 2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Completely or Partially Within the APE:						
Blasdell Farm	19th century	House and barn foundations/cellar holes; well	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
The Farm	19th century	House foundation/cellar hole and stone retaining wall	Six test pits - yielded moderate density of mid-19th c. to early 20th c. domestic and construction debris	Excellent	Good	High
Preston Farm (buried beneath southeast toe of TP2)	ca. 1828-1890	Stone-lined roadway leading into TP2 (buried foundations are suspected)	Ten test pits - yielded low density of nondescript bottle glass and brick	Unknown	Good	High
North Village	19th century	Two (mine agent?, mine family?) house/cellar hole foundations and two terraces associated with barn foundations	Eight test pits - yielded moderate density of19th c. and early 20th c. domestic and construction debris.	Fair to Poor	Poor	High
Office	19th century	One cellar hole/foundation, and related platform	Six test pits - yielded moderate density of mid-19th c. to early 29th c. domestic and construction debris	Fair to Poor	Fair	High
South Village	ca. 1809-1880	Seven house cellar hole/foundations, two barn foundations	Eight test pits - yielded a relatively high density of 19th c. to early 20th c. domestic and construction debris. Of note, only domestic site with a faunal assemblage	Excellent	Poor	High

Executive Summary Table 2. Summary of Historic Domestic Resource Areas and Subsites Identified Within the Elizabeth Mine Site Study Area.

Location/Area	Time Period	Major Visible Physical Remains	Archaeological Testing/Resources	Integrity[1]	Historical Research Value[2]	
					Documentary Data[3]	Archaeological Sensitivity
Twin Foundations	19th century	Two nearly identical stone foundations with cellar holes; possibly well or privy depression	No testing conducted; dense surface scatter of 19th c. to early 20th c. domestic debris.	Excellent	Poor	High
East Village	ca. 1809-1942	Three (boarding?) house foundations and possibly well/privy depressions on south side of Mine Road; connected house and barn foundation with intact agricultural landscape on north side of Mine Road	No subsurface testing; surface collection of representative 19th c. domestic materials; farm machinery observed in woods	Good	Poor	High
Outside of the APE: see Table 7-1 - Furnace Flats North contains remains of several domestic structures; TP1 is documented to encompass a late 19th/early 20th c. boardinghouse.						
Teamster's Foundation	mid-19th century	drylaid fieldstone and earth berm foundation	No subsurface testing conducted	Good	Good	Low
Unnamed Foundation	unknown	drylaid stonewall corner section	No subsurface testing conducted	Good	Good	Low

[1]based on visual inspection conducted to date and/or limited subsurface testing

[2]based on potential to address priority research questions for Vermont relating to the lifeways of workers and local farmers.

[3] based on expected available sources: land evidence and probate records, tax records etc; company records, anecdotal/travelers accounts historic photographs

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Copper Castle	B	Y	ca. 1840-1855	Excellent (inhabited dwelling)	High	High
Infirmary/Carpenter Shop	B	Y	ca. 1850	Excellent (inhabited dwelling)	High	High
Club House	B	Y	late 19th/early 20th c.	Fair (altered, inhabited dwelling)	High	High
Buena Vista House Buena Vista Barn Complex Buena Vista Ash House	B B B	N N N	1859 ca. 1859 ca. 1859	Excellent (inhabited dwelling) Excellent Excellent	High High High	High High High
Lower Water Tank Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
Laboratory/Assay Office	B	Y	1941-1958	Excellent (inhabited dwelling)	High	Moderate
Office/Warehouse	B	Y	1941-1958	Excellent	High	Moderate
Machine Shop	B	Y	1941-1958	Excellent	High	Moderate
Shed south of Machine Shop	B	Y	1941-1958	Fair	Moderate	Low
Compressor Building	B	Y	1941-1958	Poor (recently collapsed from snow loading)	High	Low
1898 Adit	S	Y	1898 - rebuilt ca. 1942	Good	High	Low
Change House	B	Y	1941-1958	Excellent	High	Moderate
Shed behind Change House	B	Y	1941-1958	Fair	Moderate	Low
Shed northeast of Change House	B	Y	1941-1958	Poor	Moderate	Low
Artifact Scatter northeast of Change House	O	Y	1941-1958	N/A (various steel objects and machinery	High	High

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
Mine Car Bridge	S	Y	1941-1958	Good	High	Low
Ore Bin	S	Y	1941-1958	Poor	High	Low
Storage Shed northwest of Crusher Building	B	Y	1941-1958	Fair	Moderate	Low
Crusher Building	B	Y	1941-1958	Poor (superstructure and machinery removed)	High	Low
Grinding/Flotation Mill	B	Y	1941-1958	Fair (roof partially collapsed, machinery removed)	High	Low
Thickener/Drier Building	B	Y	1941-1958	Fair (north section demolished, all equipment removed)	High	Low
5-Bay Garage	B	Y	1941-1958	Excellent	Moderate	Low
Heating Plant/Pipe Shop	B	Y	1941-1958	Excellent	High	Low
Flotation Cells	O	Y	1941-1958	Poor (not in situ - removed from Grinding/Flotation Mill, motors and agitators missing)	High	Low
Launder Trestle	S	Y	1941-1958	Poor (partially buried uprights)	High	Moderate
Upper Tailings Pumphouse	B	Y	1941-1958	Fair	High	Moderate
Lower Tailings Pumphouse	B	Y	1941-1958	Poor (ruin)	Moderate	Low
Warming Hut	B	Y	1941-1958	Fair (may not be in situ)	Moderate	Moderate
World War II Housing	(Site)	N	1941-1958	N/A (buildings demolished, but site terracing still visible)	N/A	High
Community Center	B	N	1941-1958	Fair (altered inhabited dwelling)	High	High
Upper Water Tank Building	B	Y	1941-1958	Poor (foundation only)	Moderate	Low

Executive Summary Table 3. Summary of Historic Industrial and Domestic Buildings and Structures Identified Within the Elizabeth Mine Site Study Area.

Resource Name	Type	In APE (Y/N)	Time Period	Architectural Integrity[1]	Historical Research Value[2]	Associated Archaeological Resource Potential[3]
1948 Shaft Hoist House	B	N	1941-1958	Poor (foundation and machinery bases only)	Moderate	Low
1948 Shaft Idler Tower	S	N	1941-1958	Poor (tower demolished)	Moderate	Low
1948 Shaft Headframe	S	N	1941-1958	Poor (shaft capped, headframe demolished)	Moderate	Low
River Pumphouse (WW II)	B	N	1941-1958	Poor (collapsed)	High	Low
River Pumphouse (Heckscher)	B	N	ca. 1906-1916	Poor (concrete foundation and machinery footings only)	Moderate	Low
Air Shaft and Electrical Substation	S	N	1941-1958	Fair (shaft capped, transformers removed)	Moderate	Low
Air Vent	S	N	1941-1958	N/A (steel pipe)	Moderate	Low
Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	Mid-1800s	Excellent (inhabited dwelling)	Moderate	High
Copper Shed at Pompanoosuc Depot	B	N (located in Norwich at Jct. of Rtes. 5 and 132)	1941-1958	Fair (altered)	High	Low

B=building
S=structure
O=object

[1] Architectural Integrity = primarily based on the degree of alteration, however, condition is indicated where relevant.
[2] Historical Research Value = based on the potential to reveal information on the arrangement, architecture, construction, and technology of the historic mining system and lifeways of the mine workers, managers, and neighbors.
[3] Associated Archaeological Resource Potential = based on the likelihood for intact ground surfaces within the surrounding landscapes that could contain potentially significant belowground resources.

dramatic visual images of the mine, and are as important as the buildings, structures, features, and artifacts arranged within them. The cultural landscape at Elizabeth Mine provides insights into the technological advances of copperas production, copper mining and metallurgy, and informs about how the arrangement of features defines socioeconomic relations of the inhabitants.

Recommendations

No prehistoric period Native American resources were identified within the project APE. The results of subsurface testing conducted within the APE combined with unfavorable environmental factors and the extent of historic period industrial soil disturbances indicates an overall low potential for important prehistoric period resources to be present. No additional archaeological investigations for prehistoric period sites within the project APE are recommended.

The 13 APE historic mine period subsites and associated landscape features interpreted and assessed in terms of their internal complexity, physical integrity, and potential to address priority research topics related to themes of industry and abandoned communities important to Vermont history (see VDHP 2002:22). The industrially-related research themes for the identified Elizabeth Mine resources within the project APE focus on the various mine technologies, spatial organization of industrial complexes, and the living conditions of the mine workers. These research themes have been identified as important to Vermont history, and as such should be important to a broad public, including the communities of Strafford and Thetford.

Prior to any earthmoving activities related to the site environmental characterization work, documentation of the mine landscape will be undertaken in the spring 2003 as part of the mitigation efforts for the project. These activities are likely to cause irrevocable changes to the landscape and important cultural features related to industrial and domestic subsites. The landscape documentation will encompass the project APE and other major landscape features including the South Open Cut. The landscape documentation will consist of aerial photographs of the TP1/2/3/North Open Cut/South Open Cut landscape, done in the most archivally stable color transparency film available with some additional black-and-white; and terrestrial large format (4" x 5" negative) color transparency and black-and-white photographs of the TP1/2/3/North Open Cut/South Open Cut landscape.

The current survey identified industrial and domestic archaeological resource areas within the project APE that have the potential to address important priority research topics in the state of Vermont (refer to Executive Summary Tables 1 and 2/Tables 7-1 and 7-2 in the technical report). The proposed trenching associated with the site environmental characterization work should take place with consideration for further investigating industrial archaeological resources as shown on Figure 8-1 and in Appendix B of the technical report. A collaborative effort between cultural resource specialists and the geotechnical team would be expected to provide some of the information identified as data gaps in the research priority topics discussed above. Pending the evaluation of archaeological data collected during the site characterization work, additional systematic archaeological investigations of targeted resources may be warranted as part of mitigation efforts for the project. However, the Corps and EPA have no plans to pursue additional archaeological investigations at this time either to further address the research questions or as possible mitigation. Domestic archaeological resource areas having high research potential should be avoided during site environmental characterization work and cleanup activities.

It is possible that additional areas of potential effect including borrow pits and access roads may be identified in archaeologically sensitive areas outside of the current APE, in which case archaeological survey may be warranted. The survey work would be designed to identify and evaluate any potentially important

belowground historic period resources. The need for and scope of additional archaeological investigations within project impact areas will be included in the project's Memorandum of Agreement (MOA).

There are no current plans to alter the WWII buildings in the project APE. However, given their relatively unstable condition and importance to the overall mine site, Historic American Engineering Record (HAER) documentation will be undertaken in the spring of 2003 as part of the mitigation efforts for the project. These buildings and structures include: the upper tier of administrative, maintenance, and operational buildings; the adit and mine car rail line and bridge; the lower tier of ore bin, crusher, grinding/flotation mill, thickener/drier building, tailings pump house and launder remains; the 1948 Shaft Site, TP1 and 2, the Ompompanoosuc River Pump House and Air Shaft, and any other miscellaneous associated resources. Standard HAER documentation will consist of recording the buildings with a set of measured drawings showing site plans, materials handling routes and process flow charts. Although the PAL Historic Context Report (PAL 2000) contains a general history of the Elizabeth Mine that could serve as a basis for the HAER narrative report component, that document will be updated to reflect new information discovered during the course of subsequent research and fieldwork, and edited to shift the focus primarily to the Elizabeth Mine. Since the HAER documentation concentrates strongly on process, the narrative and drawings will be created in consultation with an industrial historian knowledgeable about the Elizabeth Mine and the ore beneficiation processes used there. A set of photographs separate from the above-mentioned landscape documentation will be done in large format (4" x 5" negative) for the building exteriors (interiors if available) using mostly black-and-white with some color, and also including limited representative views of the TP1/2/3 and North/South Open Cuts landscapes as they were sources of ore during the World War II period.

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APPENDIX A

CATALOG OF CULTURAL MATERIAL RECOVERED DURING THE HISTORIC/ARCHAEOLOGICAL MAPPING AND TESTING PROGRAM, 2002

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
B. Shop at Tyson's Mill	JTP-07	00-10	Fill	Porcelain	Electrical Item	Insulator	1
		10-20	Fill	Concrete	Construction		1
				Glass	Flat glass		1
				Lithic	Unidentified		1
	TI-01	00-10	Fill 1	Brick	Construction		2
				Glass	Flat glass		1
		10-20	Fill 2	Glass	Flat glass		1
				Glass Molded	Container		2
				Red Bodied Coarse	Ceramic Sherd		2
				Wood	Unidentified		1
	TJ-01	00-10	Tailings	Glass	Flat glass		1
				Metal	Unidentified		1
				Porcelain	Unidentified		1
		30-40	Fill 1	Glass Molded	Electrical Item	Insulator	1
		40-50	Fill 1/2	Glass	Flat glass		1
	TJ-02	50-60	Coke Layer	Unidentified	Unidentified		1
	TJ-03	00-10	Tailings	Glass	Flat glass		1
				Glass Molded	Household		1
	TK-01	00-10	Tailings 1	Glass Molded	Household		1
		30-40	Tailings 2	Glass	Flat glass		1
				Glass Molded	Curved Glass		1
		40-50	Tailings	Iron	Mine Related Equipment	Rock Crusher Ball	1
				Slag	Industrial Waste		1
		50-60	Tailings 3	Glass	Flat glass		1
				Iron	Mine Related Equipment	Rock Crusher Ball	1
					Unidentified		1
				Slag	Industrial Waste		1
	TK-03	00-10	Tailings	Glass	Flat glass		4
				Glass Molded	Container		1
				Slag	Industrial Waste		2
		10-20	Tailings	Glass	Flat glass		2

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
B. Shop at Tyson's Mill	TK-03	10-20	Tailings	Slag	Industrial Waste		1
		40-50	Tailings	Textile	Unidentified		2
		50-60	Tailings	Glass	Flat glass	Window glass	1
				Lithic	Unidentified		1
				Textile	Unidentified		1
		60-70	Tailings	Lithic	Unidentified		1
Subtotal B. Shop at Tyson's Mill							*46*
Blasdell Farm	Surface	00-00	Surface	American Stoneware	Food/drink storage	Jar	1
				Iron	Hand tools	Shovel	1
	TA-01	00-10	Fill 1	Iron	Hardware	Machine cut nail	3
						Square Nail	5
					Unidentified		3
		10-20	Fill 2/3	Iron	Hardware	Machine cut nail	6
		20-30	Fill 4	Iron	Hardware	Machine cut nail	1
						Square Nail	1
		30-40	Fill 4	Charred Wood	Unidentified		4
				Iron	Unidentified		2
	TA-02	00-10	A1	Glass Molded	Curved Glass		1
				Iron	Hardware	Machine cut nail	2
						Wire Nail	1
				Whiteware	Ceramic Sherd		1
		10-20	A1	Copper Alloy	Hardware		1
				Glass	Curved Glass		2
					Flat glass		3
				Iron	Hardware	Machine cut nail	2
						Wire Nail	4
					Unidentified	Flat Metal	2
		20-30	A1	Glass	Curved Glass		3
					Flat glass	Window glass	6

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
Blasdell Farm	TA-02	20-30	A1	Iron	Hardware	Nail	1
						Square Nail	1
		30-40	A1/A2	Glass	Flat glass		1
	TB-01	10-20	A1	Brick	Construction		2
				Clay	Pipe	Pipe unmarked	1
				Glass	Flat glass	Window glass	3
				Iron	Hardware	Square Nail	1
		20-30	A1	Glass	Flat glass	Window glass	1
		40-50	A2	Glass	Flat glass		1
	TB-02	10-30	Demo. 2	Charred Wood	Unidentified		2
				Iron	Unidentified		4
				Stoneware	Food/drink storage	Crock	8
		20-30	Ao	Glass	Unidentified		1
				Iron	Hardware	Nail	3
				Stoneware	Food/drink storage	Crock	4
				Wood	Unidentified		2
		30-40	Demo. 1/2	Charred Wood	Unidentified		4
				Glass	Unidentified		1
				Iron	Hardware	Nail	6
				Stoneware	Food/drink storage	Crock	2
	TB-03	00-10	Ao/Fill	Glass	Unidentified		3
				Iron	Hardware	Nail	1
					Unidentified		3
		10-20	Fill	Glass	Unidentified		1
				Iron	Hardware	Square Nail	5
		20-30	Fill	Charred Wood	Unidentified		2
				Glass	Unidentified		1
				Iron	Hardware	Square Nail	3

Subtotal Blasdell Farm *123*

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
Cob Shop, TP3	JTP-01	00-10	Tailings	Brick	Construction		3
				Lithic	Unidentified		1
		10-20	Tailings	Iron	Unidentified		5
	JTP-02	30-40	Rstd. Ore	Brick	Construction		1
				Mortar	Construction		1
				Wood	Architecture		4
	TE-01	20-30	Waste Rock	Glass	Flat glass		1
		30-40	Waste Rock	Brick	Construction		1
				Glass	Flat glass		3
		40-50	Waste Rock	Glass	Flat glass		1
	TE-02	50-60	Waste Rock	Brick	Construction		3
				Glass	Flat glass		1
				Lithic	Industrial Waste		3
				Slag	Industrial Waste		1
Subtotal Cob Shop, TP3							*29*
East Village		00-00	Surface	Brick	Construction		1
						Firebrick	1
				Glass	Flat glass	Window glass	1
					Hardware	Machine cut nail	2
				Glass Molded	Food/drink storage	Jar	3
				Iron	Hardware		1
					Light/heat/cooking item	Stove item	2
				Ironstone	Beverage consumption	Saucer	1
				Porcelain	Food consump/service	Plate	1
				Stoneware	Ceramic Sherd		1
					Food/drink storage	Crock	2
				Tin	Food consump/service	Egg cup	1
				Whiteware	Ceramic Sherd		3
					Food consump/service	Plate	2

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
East Village		00-00	Surface	Yellow Ware	Ceramic Sherd		1
Subtotal East Village							*23*
Lower Copperas Factory		00-00	Surface	Brick	Construction	Firebrick	1
				Iron	Hardware		1
						Bracket	1
Subtotal Lower Copperas Factory							*3*
North Village		00-00	Surface	Iron	Hand tools	Axe	1
	JTP-03	00-10	Ae/A1	Glass	Flat glass		3
					Unidentified		1
	JTP-04	00-10	Ao	Iron	Hardware	Wire Nail	1
					Related Railroad	Railroad Spike	1
		20-30	Fill	Iron	Hardware	Wire Nail	1
		30-40	Fill	Brick	Construction		1
				Glass	Flat glass		2
	TF-01	10-20	Fill	Brick	Construction		8
				Metal	Food/drink storage	Can	1
				Whiteware	Food consump/service	Dish	1
		20-30	Fill	Brick	Construction		1
		30-40	Fill	Brick	Construction		2
				Iron	Household		2
		40-50	Fill	Brick	Construction		4
				Iron	Hardware	Unidentified Nail	4
		50-60	Fill	Brick	Construction		3
	TF-02	00-10	Ao	Brick	Construction		3
				Whiteware	Ceramic Sherd		1
		10-20	Ao/A1	Brick	Construction		5
				Creamware	Ceramic Sherd		1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
North Village	TF-02	10-20	Ao/A1	Whiteware	Ceramic Sherd		1
		20-30	A1	Brick	Construction		3
				Iron	Hardware	Unidentified Nail	1
				Red Bodied Coarse	Ceramic Sherd		1
				Whiteware	Ceramic Sherd		1
		30-40	A2	Brick	Construction		4
				Creamware	Ceramic Sherd		2
				Glass	Flat glass		1
				Slag	Industrial Waste		2
		40-50	A2/B	Brick	Construction		8
				Earthenware	Food consump/service	Dish	1
				Ironstone	Food consump/service	Dish	4
	TF-03	10-20	Ae	Brick	Construction		2
				Glass Molded	Bottle		1
				Iron	Hardware	Unidentified Nail	1
		20-30	Living Sur	Charred Wood	Unidentified		1
				Iron	Hardware	Unidentified Nail	1
				Whiteware	Food consump/service	Dish	1
		30-40	Living Sur	Brick	Construction		3
				Charred Wood	Unidentified		2
				Iron	Hardware	Unidentified Nail	1
	TF-05	30-40	Rock/A/B	Lithic	Unidentified		1
				Slag	Industrial Waste		1
	TF-06	10-20	Tailings	Brick	Construction		1
		20-30	Tailings	Brick	Construction		2
		30-40	Tailings	Glass Molded	Container		2
		40-50	Tailings	Earthenware	Ceramic Sherd		1
		60-70	Tailings	Glass	Flat glass	Window glass	4
		70-80	Tailings	Glass	Flat glass	Window glass	1
Subtotal North Village							*102*

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
Office	JTP-21	20-30	Fill 1	Brick	Construction		1
				Iron	Unidentified		1
						Flat Metal	6
	JTP-30	10-20	Fill	Brick	Construction	Handmade brick	1
	JTP-31	00-10	Ao	Iron	Unidentified	Flat Metal	6
		10-20	Ao/Fill 1	Iron	Unidentified	Flat Metal	6
		30-40	Fill 1/2	Glass	Flat glass	Window glass	2
				Glass Molded	Bottle	Food/Beverage	3
					Container		1
				Iron	Hardware	Wire	1
				Stoneware	Food/drink storage	Crock	5
				Wood	Architecture		1
		40-50	Fill 2	American Stoneware	Food/drink storage	Crock	1
				Brick	Construction		3
				Glass	Flat glass	Window glass	1
				Glass Molded	Bottle		2
						Food/Beverage	1
				Porcelain	Electrical Item	Insulator	1
				Slag	Industrial Waste		2
		50-60	Fill 2	American Stoneware	Food/drink storage	Crock	2
				Glass Molded	Bottle		3
					Curved Glass		2
				Iron	Hardware	Nail	2
						Wire	1
		60-70	Fill 3/Nat	Glass	Flat glass		2
				Glass Molded	Bottle		1
	JTP-32	20-30	Fill 1	Copper Alloy	Firearms and ammunition	Cartridge	1
				Slag	Industrial Waste		1
	JTP-33	00-10	Fill 1	Brick	Construction		3
		20-30	Dist. B1	Brick	Construction		1
Subtotal Office							*64*

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
Preston Farm Area	JTP-05	00-10	Tailings	Glass Molded	Container		1
				Lithic	Unidentified		1
		10-20	Tailings	Glass Molded	Bottle		1
					Unidentified		1
		20-30	Tailings	Brick	Construction		2
				Glass	Flat glass		1
				Glass Molded	Bottle		1
					Container		1
	JTP-06	00-10	Tailings	Brick	Construction		2
				Glass	Flat glass	Window glass	1
		10-20	Tailings	Brick	Construction		1
				Glass Molded	Container		1
		30-40	Tailings	Glass Molded	Container		2
					Household		1
					Unidentified		1
				Red Bodied Coarse	Unidentified		3
Subtotal Preston Farm Area							*21*
South Village	JTP-08	00-10	Ao	Brick	Construction		3
		10-20	A/Fill 1	Brick	Construction		2
				Glass	Curved Glass		1
		40-50	Fill 3	Wood	Unidentified		1
	JTP-09	10-20	Fill 1	Brick	Construction		5
						Handmade brick	3
				Glass	Flat glass	Window glass	1
				Iron	Hardware	Machine cut nail	3
				Mortar	Construction		1
		20-30	Fill 1	Bone	Unidentified		1
				Brick	Construction		5
						Handmade brick	1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
South Village	JTP-09	20-30	Fill 1	Glass	Flat glass		2
						Window glass	1
				Iron	Hardware	Machine cut nail	3
					Unidentified	Flat Metal	1
				Mortar	Construction		2
				Wood	Unidentified		1
		30-40	Fill 2	Brick	Construction		4
						Handmade brick	1
				Glass	Flat glass	Window glass	1
				Iron	Hardware	Square Nail	1
				Wood	Architecture		1
		40-50	Fill 2	Brick	Construction		2
				Glass	Flat glass		1
				Iron	Hardware	Square Nail	1
				Whiteware	Ceramic Sherd		1
				Wood	Unidentified		1
	JTP-10	00-10	Ao/Fill 1	Glass	Flat glass	Window glass	7
		10-20	Fill 1	Bone	Bird	Unidentified bird	1
					Unidentified		1
				Brick	Construction		1
				Glass	Flat glass	Window glass	10
				Iron	Hardware	Bracket	1
						Machine cut nail	7
						Wire Nail	1
		20-30	Fill 1	Bone	Mammal	Felis	9
						Unidentified mammal	4
				Brick	Construction		7
				Glass	Flat glass	Window glass	9
				Iron	Hardware		1
						Machine cut nail	12
						Wire	2

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
South Village	JTP-10	20-30	Fill 1	Iron	Hardware	Wire Nail	2
		30-40	Fill 2	Brick	Construction		1
		50-60	Fill 2	Bone	Unidentified		1
				Glass	Flat glass		1
				Iron	Hardware	Machine cut nail	1
						Wire Nail	1
					Unidentified	Flat Metal	1
	JTP-11	00-10	Fill 1	Clay	Pipe	Pipe marked	1
				Whiteware	Ceramic Sherd		3
		10-20	Fill 1	Pearlware	Ceramic Sherd		2
				Red Bodied Coarse	Ceramic Sherd		1
				Whiteware	Food consump/service		1
		20-30	Fill 1	Brick	Construction		1
				Charred Wood	Unidentified		1
				Copper Alloy	Unidentified	Flat Metal	1
				Glass	Flat glass		2
				Iron	Hardware		1
						Bracket	1
						Machine cut nail	3
					Unidentified	Flat Metal	1
				Lead	Unidentified	Flat Metal	1
				Whiteware	Ceramic Sherd		3
				Yellow Ware	Ceramic Sherd		3
		30-40	Fill 2	Brick	Construction	Handmade brick	1
				Iron	Hardware	Escutcheon	1
						Machine cut nail	1
					Unidentified		2
				Pyrite	Raw Material		1
		40-50	Fill 3	Brick	Construction		1
				Glass Molded	Bottle		5
				Iron	Hardware	Nail	1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
South Village	JTP-11	40-50	Fill 3	Iron	Unidentified	Flat Metal	6
				Whiteware	Ceramic Sherd		2
					Food consump/service		2
		50-60	Fill 3	Bone	Mammal historic	Pig historic	3
					Unidentified		2
				Glass Molded	Curved Glass		2
		60-70	Fill 3	Bone	Mammal	Unidentified mammal	1
	JTP-12	00-10	Fill	Whiteware	Ceramic Sherd		2
		10-20	Fill	Glass	Flat glass		1
				Iron Ore	Raw Material		1
				Red Bodied Coarse	Ceramic Sherd		1
				Stoneware	Ceramic Sherd		1
				Whiteware	Ceramic Sherd		5
		20-30	Fill	Charred Wood	Unidentified		2
				Earthenware	Ceramic Sherd		1
				Glass	Flat glass		1
				Pearlware	Ceramic Sherd		1
				Quartz	Unidentified		1
				Red Bodied Coarse	Ceramic Sherd		4
				Whiteware	Ceramic Sherd		5
		30-40	Fill	Brick	Construction		3
				Glass	Flat glass	Window glass	1
				Red Bodied Coarse	Ceramic Sherd		1
				Stoneware	Ceramic Sherd		1
				Whiteware	Ceramic Sherd		4
		40-50	Fill	Brick	Construction		1
				Glass	Flat glass	Window glass	10
				Stoneware	Ceramic Sherd		3
				Whiteware	Ceramic Sherd		8
		50-60	Fill	Bone	Mammal	Unidentified mammal	1
				Brick	Construction		3

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
South Village	JTP-12	50-60	Fill	Clay	Pipe	Pipe unmarked	1
				Glass	Flat glass		4
				Glass Molded	Bottle		1
				Iron	Unidentified	Flat Metal	1
				Lithic	Unidentified		1
				Pearlware	Ceramic Sherd		1
				Red Bodied Coarse	Ceramic Sherd		1
				Stoneware	Ceramic Sherd		1
				Whiteware	Ceramic Sherd		13
		60-70	Fill	Creamware	Ceramic Sherd		1
				Glass	Curved Glass		1
					Flat glass		1
				Iron	Unidentified		1
						Flat Metal	6
				Pearlware	Ceramic Sherd		1
				Whiteware	Ceramic Sherd		2
				Wood	Unidentified		1
	JTP-13	00-10	Ao/Fill 1	Brick	Construction		11
				Glass	Flat glass		3
				Iron	Farm/shop/home	Barbed Wire	6
					Hardware	Machine cut nail	3
						Staple	1
						Wire Nail	2
				Whiteware	Ceramic Sherd		1
		10-20	Fill 1/2	Brick	Construction		4
						Handmade brick	1
				Iron	Farm/shop/home	Barbed Wire	1
					Hardware	Machine cut nail	2
		20-30	Fill 2	Brick	Construction		6
						Handmade brick	1
				Glass	Flat glass		1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
South Village	JTP-13	20-30	Fill 2	Iron	Farm/shop/home	Barbed Wire	1
					Hardware		1
						Nail	1
		30-40	Fill 2	Brick	Construction		4
				Iron	Hardware	Nail	3
	JTP-14	00-10	Dev. A	Glass	Curved Glass		1
					Flat glass		2
				Iron	Hardware	Machine cut nail	1
		10-20	Fill	Glass	Flat glass		2
				Iron	Hardware	Machine cut nail	2
						Square Nail	1
				Slate	Construction	Roofing tile	1
		20-30	Fill	Brick	Construction		3
				Iron	Hardware	Machine cut nail	2
	JTP-15	00-10	Ao/Fill 1	Brick	Construction		1
				Iron	Hardware	Machine cut nail	1
		40-50	Fill 1	Iron	Hardware	Machine cut nail	1
	Surface	00-00	Surface	American Stoneware	Food/drink storage	Jug	6
Subtotal South Village							*366*
TP3		00-00	Surface	Iron	Machine part	Pulley	1
				Lead	Construction	Solder	1
					Mine Related Equipment		1
					Unidentified	Flat Metal	1
				Unidentified	Abrader	Whetstone	2
Subtotal TP3							*6*
The Farm	TC-01	10-20	A1	Iron	Unidentified	Flat Metal	7
	TC-02	40-50	A	Charred Wood	Unidentified		1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
The Farm	TD-01	00-10	Fill	Glass	Flat glass	Window glass	2
				Glass Molded	Bottle		3
				Iron	Hardware	Machine cut nail	4
						Wire Nail	1
				Ironstone	Ceramic Sherd		1
		10-20	Fill	Glass	Flat glass		1
				Glass Molded	Bottle		1
					Curved Glass		1
				Iron	Hardware	Machine cut nail	5
		20-30	Fill/B	Iron	Hardware	Machine cut nail	2
	TD-02	00-10	Fill 1	Earthenware	Unidentified		1
				Glass	Flat glass	Window glass	8
				Iron	Construction	Roofing Nail	2
					Hardware	Machine cut nail	35
						Wire Nail	8
		10-20	Fill	Charred Wood	Unidentified		5
				Earthenware	Unidentified		2
				Glass	Flat glass	Window glass	9
					Unidentified		1
				Iron	Construction	Roofing Nail	5
					Hardware	Machine cut nail	16
						Staple	1
						Wire Nail	1
				Paper	Unidentified		1
		20-30	Fill	Glass	Unidentified		5
				Iron	Construction	Roofing Nail	1
					Hardware	Machine cut nail	7
						Wire Nail	2
					Unidentified	Flat Metal	1
		30-40	Fill	Glass	Unidentified		6
				Iron	Construction	Roofing Nail	1

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
The Farm	TD-02	30-40	Fill	Iron	Hardware	Machine cut nail	7
						Wire Nail	5
					Unidentified	Flat Metal	1
		40-50	Fill	Iron	Hardware	Machine cut nail	2
						Wire Nail	1
		50-60	Fill	Iron	Hardware	Machine cut nail	5
	TD-03	00-10	A1	Brick	Construction		1
				Glass	Unidentified		1
				Glass Molded	Bottle		2
				Iron	Hardware	Hinge	1
						Machine cut nail	25
						Wire Nail	1
				Rubber	Unidentified		1
		10-20	A1/Ash	Glass	Unidentified		1
				Glass Molded	Bottle		1
				Iron	Hardware		1
						Machine cut nail	14
				Lead	Unidentified		3
				Rubber	Unidentified		1
		20-30	Ash/B1	Iron	Hardware	Machine cut nail	2
						Wire Nail	1
				Ironstone	Ceramic Sherd		2
		30-40	Unid.	Iron	Hardware	Machine cut nail	2
	TD-04	10-20	Apz	Glass Molded	Bottle		2
				Schist	Farm/shop/home	Whetstone	1
		20-30	Apz	Iron	Hardware		1
						Machine cut nail	1
						Wire Nail	1
Subtotal The Farm							*234*

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
Upper Copperas Factory	JTP-24	10-20	Fill	Brick	Construction		2
				Iron	Hardware	Machine cut nail	1
		20-30	Fill	Brick	Construction		2
	JTP-25	10-20	Fill 1/2	Glass	Flat glass	Window glass	1
		20-30	Fill 2/3	Glass	Flat glass	Window glass	1
				Yellow Ware	Ceramic Sherd		1
	JTP-26	10-20	Fill 1	Brick	Construction		1
						Handmade brick	1
		20-30	Fill 2	Brick	Construction		1
		30-40	Fill 2	Brick	Construction		1
				Mortar	Construction		2
		40-50	Fill 3	Brick	Construction		2
				Mortar	Construction		1
	JTP-27	10-20	Fill 1	Brick	Construction		1
		20-30	Fill 1	Brick	Construction	Handmade brick	1
		30-40	Fill 1	Brick	Construction	Handmade brick	2
		40-50	Fill 2/3	Brick	Construction		1
	JTP-28	00-10	Fill 1	Brick	Construction		2
		10-20	Fill 2	American Stoneware	Ceramic Sherd		2
				Brick	Construction		5
		20-30	Fill 3	Brick	Construction		6
						Handmade brick	1
				Earthenware	Ceramic Sherd		1
		30-40	Fill 3	American Stoneware	Ceramic Sherd		2
				Brick	Construction		3
				Slag	Industrial Waste		1
		40-50	Fill/Nat.	Brick	Construction		9
		50-60	Fill/Nat.	Brick	Construction		5
				Earthenware	Ceramic Sherd		1
		60-70	Dist. B	Brick	Construction		2
Subtotal Upper Copperas Factory							*62*

Appendix A. Catalog of Cultural Materials, Elizabeth Mine, Historic/Archaeological Mapping and Testing.

Site	Unit	Depth	Strata	Material	Function	Type	Count
World War I Smelter	TO-02	00-10	Fill	Brick	Construction		2
				Iron	Unidentified		2
		10-20	Fill	Brick	Construction		1
	TO-04	10-20	Demo.	Brick	Construction	Handmade brick	4
		20-30	Demo.	Brick	Construction		5
				Concrete	Construction		1
	TP-01	10-20	Fill	Iron	Unidentified		3
	TP-02	00-10	A	Brick	Construction		1
	TP-03	20-30	Fill 2	Iron	Unidentified		8
		30-40	Fill 2/B	Iron	Unidentified		2
				Slag	Industrial Waste		1
Subtotal World War I Smelter							*30*
TOTAL							**1109**

APPENDIX B

MAP OF IDENTIFIED CULTURAL RESOURCES
ELIZABETH MINE SITE STUDY AREA
(BACK POCKET)

APPENDIX C

VERMONT ADVISORY COUNCIL ON HISTORIC PRESERVATION ENVIRONMENTAL PREDICTIVE MODEL FOR LOCATING PRECONTACT ARCHAEOLOGICAL SITES FORMS

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 1 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	12
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	8
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	8
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			12
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	
			0
16) Valley edge features such as Kame/Outwash Terrace**		12	
			0
17) Marine/Lake Delta Complex**		12	
			0
18) Champlain Sea or Glacial Lake Shore Line**		32	
			0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	8
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	0
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	0

**** refer to 1970 Surficial Geological Map of Vermont** **Total Score:** 24
Other Comments :
0- 32 = Archeologically Non- Sensitive **32+ = Archeologically Sensitive**

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 2 **County** OR **Town** Thetford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	6
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	8
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	32
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	12
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	0
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	0
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	0
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	0
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	0

**** refer to 1970 Surficial Geological Map of Vermont**

Total Score: 66

Other Comments :

High sensitvity is due to the presence of a knoll and wetlands. "Knoll" is only a slight rise and "wetlands" are seasonal at best. Nearby pond on Tailings Pile 1 is a recent (less than 50 yrs.) phenomenon.

0- 32 = Archeologically Non- Sensitive
32+ = Archeologically Sensitive

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project
Name Elizabeth Mine Site, Area 3 **County** OR **Town** Strafford
DHP No. VT=OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	6
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	8
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	0
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	0
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	0
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	-32

** refer to 1970 Surficial Geological Map of Vermont **Total Score:** -42
Other Comments : Hillside exstensively graded for WWII era construction
0- 32 = Archeologically Non- Sensitive **32+ = Archeologically Sensitive**

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 4 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	6
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	0
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	4
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	0
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	8
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	32
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	0

**** refer to 1970 Surficial Geological Map of Vermont**

Total Score: 18

Other Comments :

Possible quartz quarry sites (historicaly utilized) west of North Open Cut.

0- 32 = Archeologically Non- Sensitive
32+ = Archeologically Sensitive

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 5 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	12
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	4
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	12
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	12
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	4
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	32
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	0

**** refer to 1970 Surficial Geological Map of Vermont**

Total Score: 52

Other Comments :

Associated wetlands are seasonal. Associated possible quartz quarry is within 180-m, but is at the top of a substantial slope relative to the bulk of the area.

0- 32 = Archeologically Non- Sensitive
32+ = Archeologically Sensitive

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 6 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	0
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	0
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	12
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	4
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	32
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	0
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	0

**** refer to 1970 Surficial Geological Map of Vermont**

Total Score: 56

Other Comments :

High score is based on the presence of quartz outcrops within the model area. The model area is rugged, only the most level areas are slightly under a 15% slope (app. 12% slope). There are few natural sources of water near these "flat" locations.

0- 32 = Archeologically Non- Sensitive
32+ = Archeologically Sensitive

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 7 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/0 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	12
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	8
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	8
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	0
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	0
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	0
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	0
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	-32

**** refer to 1970 Surficial Geological Map of Vermont** **Total Score:** -4
Other Comments : Model area is buried beneath 1-m (south) to45-m (north)of mine waste. Lake at southeast edge of model area is a modern (past 50 yrs.) feature.
0- 32 = Archeologically Non- Sensitive **32+ = Archeologically Sensitive**

APPENDIX C

Environmental Predictive Model for Locating Precontact Archeological Sites

Project Name Elizabeth Mine Site, Area 8 **County** OR **Town** Strafford
DHP No. VT-OR-28 **Map No.** _____ **Staff Init.** _____
Date 8/28/02 **Additional Information** _____

Environmental Variable	Proximity	Value	Assigned Score
A. RIVERS and STREAMS (EXISTING or RELICT):			
1) Distance to River or Permanent Stream (measured from top of bank)	0- 90 m 90- 180 m	12 6	12
2) Distance to Intermittent Stream	0- 90 m 90-180 m	8 4	0
3) Confluence of River/River or River/Stream	0-90 m 90 –180 m	12 6	0
4) Confluence of Intermittent Streams	0 – 90 m 90 – 180 m	8 4	4
5) Falls or Rapids	0 – 90 m 90 – 180 m	8 4	0
6) Head of Draw	0 – 90 m 90 – 180 m	8 4	0
7) Major Floodplain/Alluvial Terrace		32	0
8) Knoll or swamp island		32	0
9) Stable Riverine Island		32	0
B. LAKES and PONDS (EXISTING or RELICT):			
10) Distance to Pond or Lake	0- 90 m 90 -180 m	12 6	0
11) Confluence of River or Stream	0-90 m 90 –180 m	12 6	0
12) Lake Cove/Peninsula/Head of Bay		12	0
C. WETLANDS:			
13) Distance to Wetland (wetland > one acre in size)	0- 90 m 90 -180 m	12 6	0
14) Knoll or swamp island		32	0

D. VALLEY EDGE and GLACIAL LAND FORMS:			
15) High elevated landform such as Knoll Top/Ridge Crest/ Promontory		12	12
16) Valley edge features such as Kame/Outwash Terrace**		12	0
17) Marine/Lake Delta Complex**		12	0
18) Champlain Sea or Glacial Lake Shore Line**		32	0
E. OTHER ENVIRONMENTAL FACTORS:			
19) Caves /Rockshelters		32	0
20) [ ] Natural Travel Corridor [ ] Sole or important access to another drainage [ ] Drainage divide		12	0
21) Existing or Relict Spring	0 – 90 m 90 – 180 m	8 4	8
22) Potential or Apparent Prehistoric Quarry for stone procurement	0 – 180 m	32	32
23)) Special Environmental or Natural Area, such as Milton acquifer, mountain top, etc. (these may be historic or prehistoric sacred or traditional site locations and prehistoric site types as well)		32	0
F. OTHER HIGH SENSITIVITY FACTORS:			
24) High Likelihood of Burials		32	0
25) High Recorded Site Density		32	0
26) High likelihood of containing significant site based on recorded or archival data or oral tradition		32	0
G. NEGATIVE FACTORS:			
27) Excessive Slope (>15%) or Steep Erosional Slope (>20)		- 32	-32
28) Previously disturbed land as evaluated by a qualified archeological professional or engineer based on coring, earlier as-built plans, or obvious surface evidence (such as a gravel pit)		- 32	-32

** refer to 1970 Surficial Geological Map of Vermont Total Score: 4
Other Comments : Model area was stripped and modified extensively during the historic period.
0- 32 = Archeologically Non- Sensitive 32+ = Archeologically Sensitive

APPENDIX D

VERMONT DIVISION OF HISTORIC PRESERVATION ARCHAEOLOGICAL SITE FORM

VERMONT ARCHEOLOGICAL INVENTORY **Vermont Division for Historic Preservation**
DRAFT SITE SURVEY FORM (rev. 5/24/01) **National Life Building, Drawer 20**

Montpelier, Vermont 05602-0501

**** = pick list (see Data Dictionary)**

1. Site No. **[must be formatted w/caps]** _VT-OR-28
1. A. . Site segment or component
2. A. Site Name _Elizabeth Mine_____
2. B. Other Site Number** _____
3. Town **_Strafford_____ 4. County ** __Orange_____

5. Site Type ** ____Historic_____
6. Reported by ** __PAL_____

7. Reporter's Address ___210 Lonsdale Avenue, Pawtucket, RI 02860_____

8. Date Found / / 9. Date Submitted **1/ 16 /03**

10. Discovered by (if different than reporter]** **[**
_____

11. Project Sponsor ** _Environmental Protection Agency__ 12. Project Name __Elizabeth Mine Superfund Site_____

13. Study Phase **_N/A__

14. Map Location Data **
VT State Plane NAD 83 Coord. ____
UTMs __X___

15. If Orthophoto:
VCS 83 Coord. E _____N_____

16. If UTM: Zone: 18 _X____
19_____

17. If UTM:
Easting _714080_____ Northing ____4855100_____

18. USGS Format **
7.5' _X___
15' ____
7.5' x 15' ____

19. USGS Quad ** _South Strafford_____

20. Permanent Datum Coordinates_____

21. Directions to Site **[text]**
__From South Strafford: south and east on mine road to Copperas Road. South on Copperas Road_____

_____
_____

22. Landowner type **__Private_____

23. Landowner Name/Address
_____

24. Site Located By **_Other_____

25 How Located **__Visible foundations_____

26 Prehistoric Context **_____

27 Historic Context ** _Industry and Commerce_____

28 Historic Time Range** _ca. 1793-1958_____

29. Site Description and Environmental Setting

The Elizabeth Mine was established in the early nineteenth century and operated until the mid-twentieth century. It lies approximately one-half mile south of the West Branch of the Ompompanoosuc River, in the rugged uplands of east-central Vermont (Figure 1-2). This section of Orange County hosted mining activity in the approximately 20-mile long Copper Belt, and by the late nineteenth century was the location of several other mining operations, including the Ely Mine in Vershire (VT-OR-14) and Pike Hill Mines (Eureka and Union) (VT-OR-27) in the town of Corinth. Today, Elizabeth Mine contains major mining landscape features, numerous standing structures, and the aboveground and buried remains of structures and features related to several periods of mining operations at the site. There are also a number of non-mining historic period farmstead sites within the approximately 800-acre mine site.

30. Data Found

A total of 1109 artifacts were recovered from the site. Approximately 30 foundations were also identified in addition to a number of World War II era standing structures. The foundations are clustered with other supporting features into 18 clusters that represent the greatest concentrations of foundations and artifacts. The majority of these clusters are along the north/south oriented strike of the ore through the center of the site.

31. Greatest Depth Range of Material Found ** _70-80 cmbs_____

32. Data collection Methodology ** _Archival, surface collection, subsurface testing_____

33. Total Units Excavated _____

34. Positive Units Excavated ** _____

35. Estimated site area **[sq m]** 3237480_____

36. Dating methods (use uncalibrated): **
C-14 Dates/Lab Numbers [specify]_____
Diagnostic artifacts__X_____
Archival ___X_____
Other Dating Techniques _____

37. Artifact/Data Repository **
____Pending_____

38. Statement of Significance

Of the three Orange County copper mines, the Elizabeth Mine at South Strafford operated over the longest period of time, produced the highest tonnage of copper, and left the largest and most complex mining landscape. It was the location of a major U.S. copperas factory that began in 1809, operated for more than 70 years and eventually dominated domestic production of this important industrial chemical. It was a sporadic producer of various grades of metallic copper from the 1880s to 1919, however, during those years the mine was the scene of several important firsts in American copper metallurgy. After its revival during World War II it became one of the 20 most productive copper mines in the U.S. and the largest and most productive copper mine in New England. It was the scene of several important firsts in American copper metallurgy, including successful mineside smelting, large-scale smelting of sulfide ores, and smelting with hot blast and anthracite and successful use of chromite refractories. After its revival during World War II it became one of the 20 most productive copper mines in the U.S. and the largest and most productive copper mine in New England. Additionally, the site is one of the few known surviving examples of copperas production. In addition to being associated with such significant individuals as Isaac Tyson, Jr. and August Heckscher the mine was home to a substantial number of miners and laborers of numerous ethnic backgrounds.

39. a. State/National Register Status **_____
b. NR Criteria of Significance ** _____

40. Topographic setting **___Mountain or hillside_______________________________________-____________________________________

41. Slope ** __8 – 15%_________________

42. Elevation _1300 ft_________

43. Aspect ** __________

44. Original landform **_ ____

45. Current setting **____ Mixed woodland ____

46. NRCS soil map series ** ______________________________________

47. Drainage Basin ** ___White River_______________________________________

48. Watershed Affiliation ** _White River____

49. Closest water to site ** West Branch of Ompompanoosuc River

50. Closest existing water to site ** West Branch of Ompompanoosuc River

51. Closest relict water to site **

52. Site Integrity ** _Fair____

53. Report title **
not applicable _____
in progress ______
completed X

author(s) Suzanne G. Chereau, Suzanne G, Ben Ford, Matthew A Kierstead
date January 2003
full title *Historical/Archaeological Mapping and Testing, Elizabeth Mine Site*
prepared by PAL, Inc., Pawtucket, RI
prepared for U.S. Army Corps of Engineers, Concord, MA

54. Previous collections **
Not applicable __X___
Specify name/address ____

55. Other site information **
Historic Map References **
Artifact Catalog
Site Maps
Other Database Links
Digital Photos
Published paper
Unpublished manuscript
Other Data
/// | VDHP USE ONLY
|\\\

56. DHP Environmental Review Number **[text]**_________________

57. Act 250 Permit Number **[text]** _________________________________

58. 36 CFR 61 Certified **
** yes
no
reviewed by 36 CFR 61 DHP staff

59. Updated Site Form **[can use multiple dates]**__________

60. Management Status/Conservation Easements and Holders ** **[and text]**

** **conservation easement [specify name/address of easement holders]**
Underwater Historic Preserve
State Archeological Landmark

61. a. DHP staff QA/QC verification and database entry **[text: specify name]**
VDHP date entered **[4 digit year field]** / /

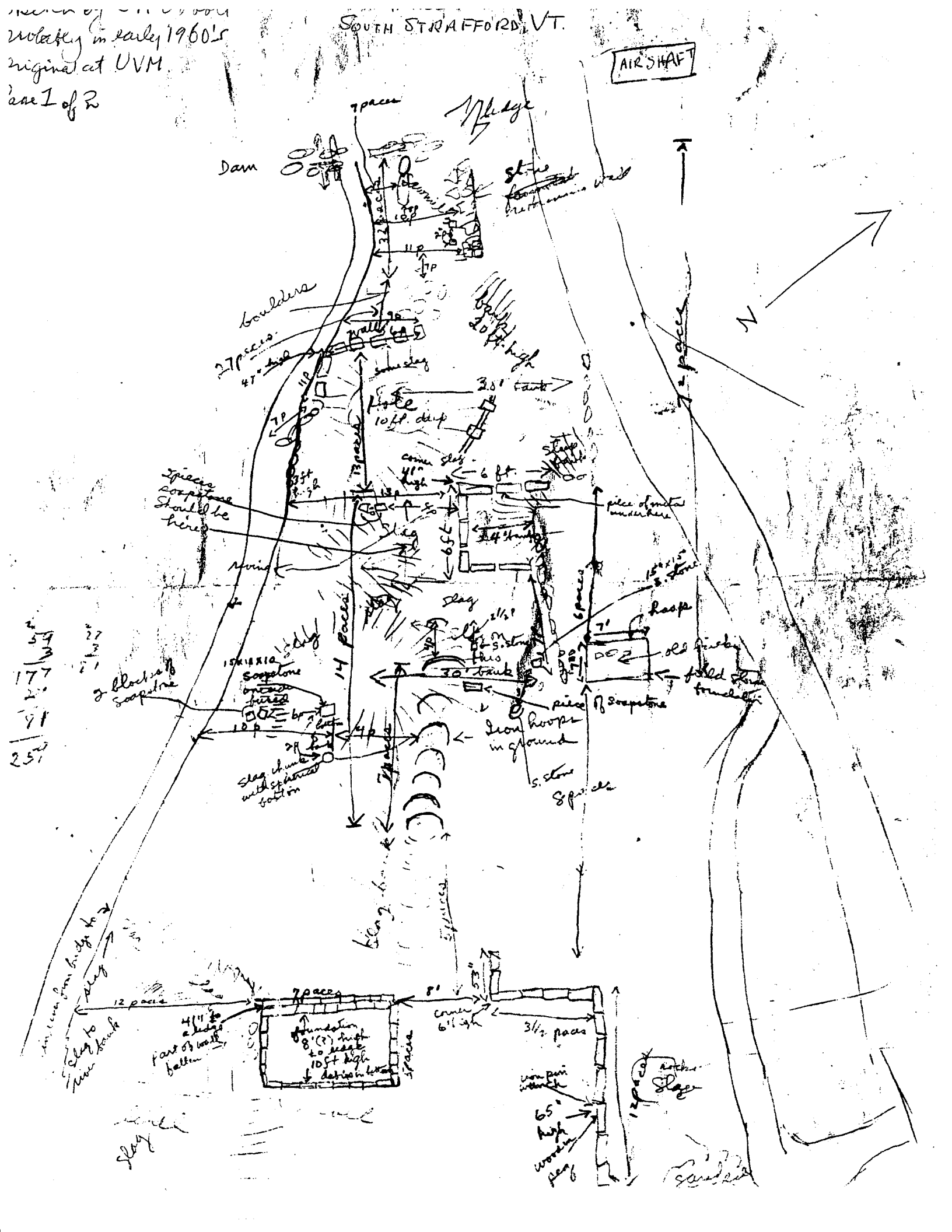
61. b. DHP staff QA/QC verification and database entry **[text: specify name]**
VDHP date entered **[4 digit year field]** / /

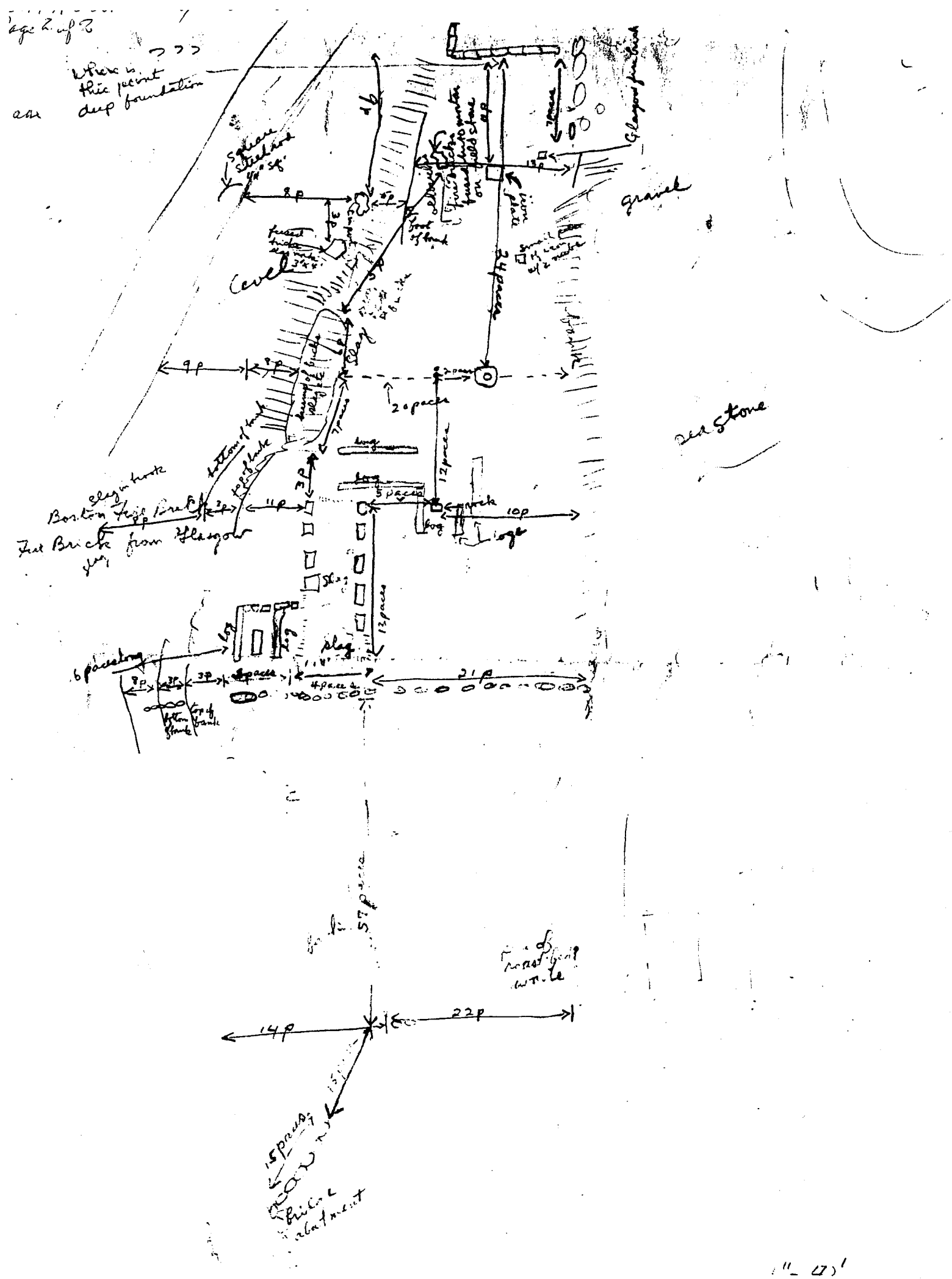
APPENDIX E

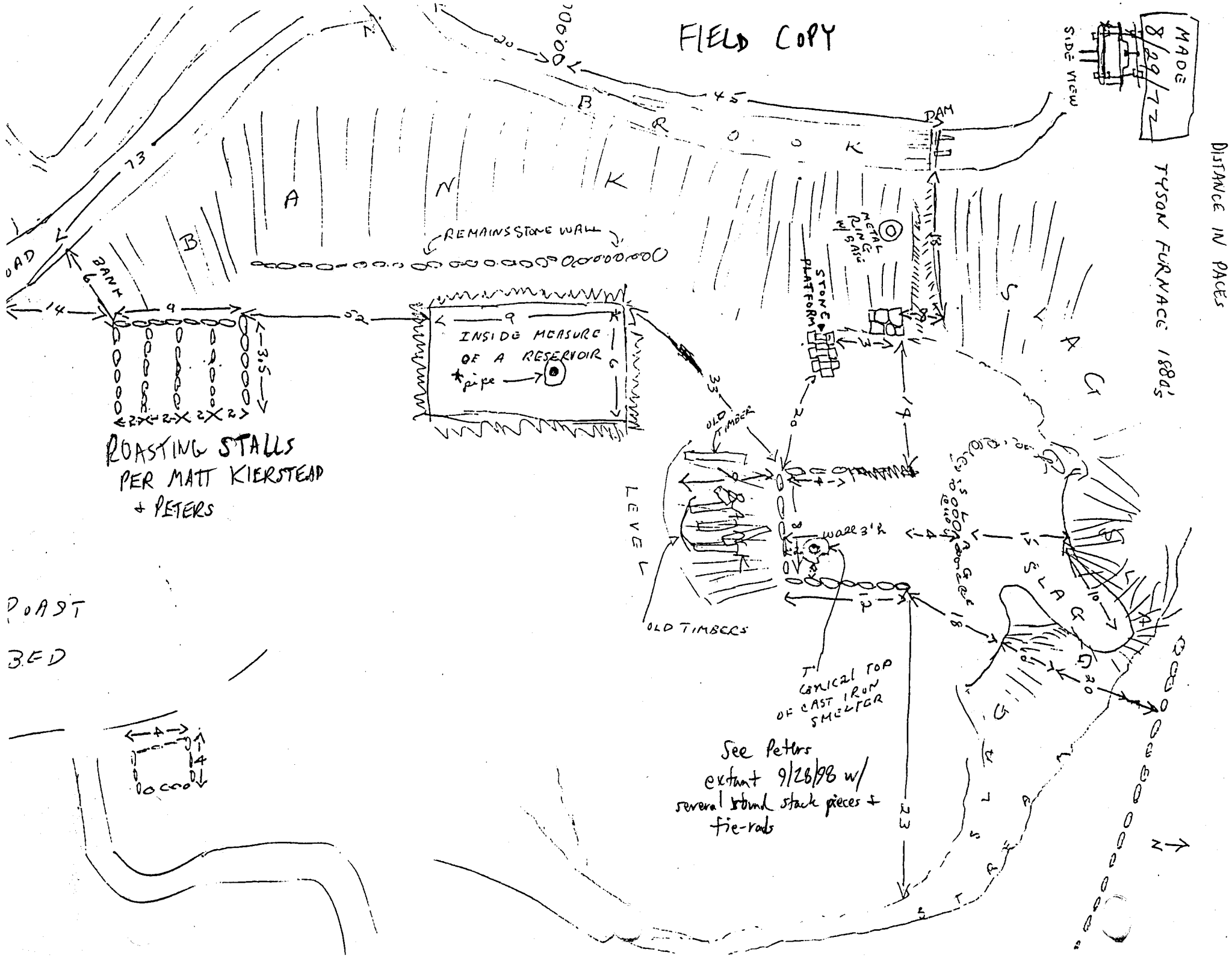
ABBOTT SKETCH MAPS FOR TYSON MINING ZONE/BLASDELL FARM/THE FARM, FURNACE FLATS NORTH, AND SARGENT BROOK SMELTER SITE

Sketch of Stafford
made by in early 1960's
original at UVM
Page 1 of 2

SOUTH STRAFFORD, VT.




Where is this point deep foundation
square stockade
gravel
level
clay
bottom of bank
top of bank
slag
log
sea stone
Boston Tea Pile
Fire Brick from Glasgow
6 parking
21p
14p
22p
15 spaces
Brick Embankment


FIELD COPY
MADE 8/29/77
SIDE VIEW
DISTANCE IN PACES
TYSON FURNACE 1880's
BROOK
DAM
REMAINS STONE WALL
BANK
INSIDE MEASURE OF A RESERVOIR
*pipe
ROASTING STALLS PER MATT KIERSTEAD + PETERS
METAL RING W/ BAR
STONE PLATFORM
OLD TIMBER
LEVEL
OLD TIMBERS
wall 3'h
CONICAL TOP OF CAST IRON SMELTER
SLAG
See Peters extant 9/28/98 w/ several bound stack pieces + tie-rods
POST BED
N

APPENDIX F

BIBLIOGRAPHY OF WORKS PERTAINING TO ELIZABETH MINE, VERMONT COPPER MINES, COPPERAS PRODUCTION, AND COPPER MINING, MILLING, AND SMELTING

VERMONT COPPER MINES BIBLIOGRAPHY (resources located during the course of research)

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APPENDIX G

HISTORIC COLLECTIONS SUMMARY

Appendix G. Orange County, Vermont, Copper Mine Historic Archives Summary

University of Vermont

The University of Vermont Bailey–Howe Library Special Collections Department contains several record groups pertaining to the Elizabeth Mine at South Strafford, the Ely Mine at Vershire, and the Pike Hill mines at Corinth. The most important collections are the Collamer Abbott Papers, the Records of the Vermont Copper Company, and the Westinghouse Papers. Several other collections include material associated with the mines, including the Governor Roswell Farnham, Governor Stanley C. Wilson, and Nash papers. Those materials were not examined for this report, although Collamer Abbott's transcribed notes from the Nash papers include revealing information about the operations of the copperas and copper works at the Elizabeth Mine in the mid-nineteenth century.

Collamer M. Abbott Papers

Collamer Abbott (1919–) was born in Wilder, VT, just a few miles from the Vermont copper mines. The history of the mines was a major subject of interest for Abbott, who spent considerable time and personal resources investigating their landscapes and researching their history. During the mid-1960s, Abbott synthesized much of his work in two manuscripts that remain unpublished and are now part of the UVM materials. "Appalachian Copper": Red Metal Mining in the Eastern United States," (1962, 397pp) provides an overview of the subject, including sections on colonial era, the early formation of the industry, the nineteenth century in the North and South, the early twentieth century, the financiers, geologists, engineers, technology, the influence of Cornish miners, and life at the mines. The manuscript includes a 48 page bibliography. "Green Mountain Copper" (1964, 475pp) focuses on copper mining in Orange County, Vermont, and includes sections on the Elizabeth, Ely and Pike Hill mines. An abbreviated (36pp) version of this manuscript, "Green Mountain Copper: Vermont's Red Metal" was published in 1973. A shorter manuscript, "The Ely Mine: A Case Study," focuses on the nineteenth-century "boom" years at the Ely Mine. Abbott also published numerous shorter articles on various Eastern U.S. copper mining subjects in a variety of economic and historical journals. The Collamer Abbott Papers include numerous typewritten versions of these manuscripts and articles. Abbott's research notebooks and cross-referenced index card files are included in the collection. The collection also includes roughly 4,000 photographs of the Orange County mines and surrounding communities. Most of these are still in negative format, however, many of the best ones been printed and are included in the collection. The photograph collection is also notable for its coverage of the Ely Mine workings and village, including an extensive photograph collection.

The Collamer Abbott Collection consists of eight cartons of papers, one carton of card files, one carton of notebooks, one box of oversize maps, two boxes of printed photographs, five boxes of glass plate negatives and one box of plastic negatives. The variety of material in this collection is too great to describe here. A finding aid was prepared for the papers in December 1980 by Mary Gelinas and is available online at the University of Vermont's website: (http://bailey.uvm.edu:6336/dynaweb/findingaids/abbott).

Vermont Copper Company Collection

The Records of the Vermont Copper Company consist of four cartons and one box of papers, ten bound volumes, and 16 oversize maps. The collection includes material on the unrelated nineteenth-century company of the same name that owned and operated the Ely Mine in Vershire. A finding aid was prepared for the papers in November 1980 by Mary Gelinas.

The papers consist mainly of business records of the Vermont Copper Company's 1942–1958 period of formation, growth, and demise at the Elizabeth Mine. The papers are divided into series by correspondence, financial, legal, and stockholder information. There are also folders for general information and printed matter. The maps are mostly of the Ely Mine, including 1943 maps of the underground workings and maps from 1900 of a proposed railroad route from Ely Station on the Connecticut River to the mine.

Westinghouse Papers

The Westinghouse Papers consist of records pertaining to the ca. 1900-1905 George Westinghouse operations at the Ely Mine. Although they were not closely examined for this report, they compliment the Westinghouse materials recently acquired by the Vermont Historical Society (see below) and shed light on early twentieth-century Ely smelting activities.

Additional Repositories

Vermont State Archives, Montpelier

The Vermont State Archives contain records pertaining to state government involvement in the Orange County copper mines, including articles of incorporation, nineteenth and twentieth century state geological survey reports, and World War I and World War II strategic production materials. The papers of Governor William H. Wills (1941-1945) include sorted materials on copper mines and his role as state defense mines coordinator.

Vermont State Library, Montpelier, Vermont

The Vermont State Library contains information pertaining to the Orange County mines and host communities including microfilmed census data for population, agriculture and industry for the late eighteenth, nineteenth and twentieth centuries. It also contains local, county and state histories and gazetteers, and bound copies of state agricultural and geological surveys and reports.

Vermont Historical Society Library, Barre, Vermont

The Vermont Historical Society Library includes a variety of scattered information on the Orange County copper mines. Although there is not a great volume of material, notable items such as Isaac Tyson, Jr.'s 1833 Elizabeth Mine journal or the 1822 Strafford property owner map indicate the potential value of individual items at this repository. The recently acquired Copperfield Mine Company Collection, which contains information associated with George Westinghouse's ca. 1900-1905 activities at the Ely Mine, contains information important to understanding Ely smelting activities at that time. The Ely Mine photograph collection includes a variety of views of the mining landscape and village, as well as photos of the smelting furnaces.

Strafford Historical Society, Strafford, Vermont

The Strafford Historical Society has compiled an extensive bibliography and collection of printed matter associated with the Elizabeth Mine. Their holdings include a large collection of photographs and slides of the late- nineteenth-century and twentieth-century Elizabeth Mine landscape and buildings.

United States Geological Survey, Reston, Virginia

The United States Geological Survey is temporarily holding a large collection of original Vermont Copper Company and Dartmouth College geological maps of the underground workings at the Elizabeth Mine for use in their studies of Appalachian sulfide ore deposits. These studies included reorganization and documentation of surviving drill cores now stored in the Wash House at the Elizabeth Mine.

Elizabeth Mine Study Group, Thetford, Vermont

The Elizabeth Mine Study Group, a local organization, has acquired additional materials from sources including Dartmouth College and from former mine workers.

APPENDIX H

GIS DATABASE AND CD

Appendix H. Elizabeth Mine GIS Database

The creation of a cultural resources database for the Elizabeth Mine constituted an additional component of documentation work conducted during the summer and fall of 2002. This GIS database was designed primarily to assist the characterization and analysis of the historic mining landscape, tapping the ability of GIS to display information at a wide range of scales, from which feature patterning could be made more apparent. The GIS database was also designed to be compatible with information generated as part of ongoing environmental monitoring work at the Elizabeth Mine. In so doing, a second aim of the cultural resource database is to aid future planning discussions regarding historic resources and environmental remediation by providing specific locational information. For the purposes of supplementing feature descriptions discussed in the technical report prepared by PAL and to permit cultural resources to be viewed interactively, a CD containing the cultural resource database is included in the report.

The GIS database combines feature-specific information acquired during the historical/archaeological mapping and testing survey (refer to Chapter 2 of the technical report for descriptions of the methodology, equipment used, and accuracy of results), with select information from previous PAL survey reports and historic documents assembled as part of ongoing cultural resource documentation. The database was generated using AutoCAD, ESRI ArcView 3.2 and 8.1 GIS, and Microsoft Excel software. From the CD included in this report, the database can be viewed graphically, using ArcExplorer (included with the CD), and in tabular form as an Excel document.

The GIS database presently identifies 719 cultural features located within and bordering the APE. Approximately 550 features derive from the GPS survey and archaeological mapping phases of research, with the remainder identified from contemporary topographic maps. Cultural features range in scale from the extensive WWII-era tailings piles and open cuts to isolated, portable artifacts (refer Table 1), and vary in age from the late-eighteenth century to near-present day. Historic use periods for individual features were ascertained through physical inspection and documentary research. In total, approximately 30 percent of cultural features are attributed to WWII-era mining operations and about half as many were (first) in use during the copperas-mining period. Ten percent of surveyed features postdate mining operations, and 23 percent could not be dated to any historic period with certainty. In addition to determinations of historic use periods, where possible the GIS database includes feature-specific information on historic function, physical dimensions, location, condition, and integrity (refer Table 2). Since no prehistoric period cultural resources were recovered during the historic and archaeological survey (refer Chapters 6 and 7 of the report), no information on such resources is incorporated into the database.

For some cultural features—including roads, stonewalls, ditches, small depressions, and artifact scatters—the GIS database provides more specific information than that presented in the preceding report. This is primarily a factor of logistics, given that not all features (such as power poles and fire hydrants, or post-mining artifact dumps overlying mining features) necessarily warrant individual treatment. This information has, nevertheless, been taken into account in general assessments of site integrity and information potential.

Table 1. Outline of GIS Feature Types.

FEATURE (FIELD_ID)*	TYPE (NAME)	No.
Artifact Scatter	Can Dump	5
	Domestic Scatter	4
	Equipment Dump	29
	Miscellaneous	4
Berm	Abutment	2
	Linear	3
Cemetery		1
Depression	Borrow Pit	3
	Prospect Pit	7
	Unknown	6
Depression, small	Privy	1
	Prospect Pit	2
	Unknown	25
Foundation	Cellar Hole	33
	Footing, Concrete	6
	Other	1
	Pad, Concrete	13
	Pad, Leveled	5
	Pad, Wooden	1
	Raised Wall	10
	Retaining Wall	8
Foundation Corner	Pad, Leveled	1
	Raised Wall	6
	Retaining Wall	7
Isolate	Drill, Exploratory	7
	Equipment	19
	Fire Hydrant	5
	Power Pole	29
	Small-Scale Feature	10
	Structural	6
	Vegetation, Exotic	1
	Vehicle	7
Mine Workings	Adit	4
	Air Passage	2
	Manway	1
	Open Cut	4
	Shaft	5
Ore Pile	Roasted Ore	5
	Unroasted Ore	4
Pipe	Electrical	1
	Sewer Pipe?	1
	Steam Pipe	3
	Tailings Pipe	2
	Water Pipe	3
	Water Pipe?	15
Quarry	Quartz Quarry	3
	Stone Quarry	2
Retaining Wall	Decking	22
	Fencing	2
	Retaining Wall	14
Road	Bulldozer	23
	Corduroy	1
	Driveway	23
	Tractor	7
	Wagon	45
Rock Pile	Fieldstone Pile	5
	Gravel Dump	2
Stone Wall	Stone Wall	80
Structure	Brick	1
	Steel	1
	Wood Frame	57
	Wood Frame, Collapsed	6
Structure Debris	Brick Scatter	5
	Foundation Materials	10
	Siding Materials	3
	Timber Scatter	14
Terrace	Building	4
	Charcoal Storage	1
	Roast Beds	1
	Unknown	2
Trench	Prospect Trench	13
	Unknown	8
Waste Dump	Ash Pile	1
	Cinder Pile	1
	Coke Pile	1
	Log Dump	1
	Slag Pile	4
	Tailings	2
	Waste Rock	10
Water Feature	Culvert	2
	Dam	8
	Decant Tower	3
	Ditch	8
	Water Tank	2
	Well	4
TOTAL		**719**

* "Field_ID" and "Name" refer to field headings used in the GIS database (refer Table 2)

Table 2. Key to Data Fields Used in the GIS Database.

DATA FIELD	DESCRIPTION
SURVEY_NO	Unique feature number

NUMBER	DESCRIPTION
1-499	Numbers assigned in field during GPS survey
500-699	Numbers assigned after field survey to those features not individually recorded by GPS
700-799	Roads
800-899	Stone Walls
900-999	Large Polygons (Includes ore piles, tailings piles, open cuts)
1000-1099	Buildings

FIELD_ID — Basic feature category, e.g., Quarry (Refer "**FEATURE**" Column, Table 1)

NAME — Additional feature identifier, e.g., Stone Quarry, Quartz Quarry (Refer "**TYPE**" column, Table 1)

HIST_FUNC — Historic function of feature.

LABEL	DESCRIPTION
Building Platform	Leveled areas or artificial platforms for buildings
Camping	
Cemetery	
Dump	Artifact and large-scale waste dumps
Extraction	Mining features: adits, shafts, open cuts etc
Field Boundary	Stone walls
Field Clearance	Stone piles
Fire Prevention	Fire hydrants
Habitation	Worker housing
Heating	
Maintenace/Repair	Blacksmith and machine shops
Managerial	Office buildings and associated materials
Maple Syrup Processing	
Ore Conveyance	Launders, tracks
Ore Dressing	Milling facilities
Ore Processing	Includes copperas factories, cob shop, ore piles
Ore Roasting	Roast beds
Ore Roasting/Leaching	Roast beds/leaching pads
Power Supply	Power poles
Prospecting	Trenches, pits, and exploratory drills
Sanitation	Privies and sewage pipes
Storage	Sheds, garages
Timber Supply	Sawmill, timber piles
Transportation	Vehicles, roads and other infrastructure
Unknown	
Waste Conveyance	Pipes and launders
Water Drainage	Pipes and ditches
Water Storage	Buildings, tanks, and dams
Water Supply	Wells, ditches, pump houses
Worker Amenities	Hospital, community center etc

HIST_NAME — Historically known name, e.g., Compressor Building, or specific feature label, e.g., Bridge Abutment

DIMENSIONS	In meters, length/diameter at compass orientation x width. For features with no easily defined boundaries, dimensions are given in NS and WE directions
AREA	In square meters
MATERIAL	Principal composition of feature/artifact
DESCRIPTION	Identification of other diagnostic elements of feature, variously including descriptions of artifact scatters, building construction styles, specific threats to integrity, and possible historical affiliation.
ASSOCIATION	Association of feature with agricultural, copperas or copper mining periods, or, when possible, specific companies.
USE_PERIOD	Date ranges for main period of use
COND	Physical condition of feature in relation to the influence of natural processes

LABEL	DESCRIPTION
Good	Little/minimal disturbance by natural processes
Fair	Moderate disturbance by natural processes
Poor	Significant disturbance by natural processes

INTEG — Physical condition of feature in relation to the influence of cultural processes

LABEL	DESCRIPTION
Unaltered	No significant disturbance from post-depositional cultural processes.
Slightly Altered	Minimal disturbance from post-depositional cultural processes.
Heavily Altered	Significant disturbance by post-depositional cultural processes.

ERA_CODE — Code letters corresponding to main historic periods at the Elizabeth Mine, and matching designations presented in PAL Report 9/10/01, *Addendum to Historical Context and Preliminary Resource Evaluation of the Elizabeth Mine, South Strafford, Orange County, Vermont*, Appendix A.

#	DESCRIPTION
A	Pre Mining Period, Eighteenth Century-1809
B	Copperas and Early Copper Mining, Copperas Hill, 1809-1880s
C	Copper Smelting, S. Furnace Flat, 1830-1839
D	Copper Smelting, N. Furnace Flat, 1854-1867, 1884
E	Copper Smelting, Sargent Brook, 1882-1890
F	Copper Mining and Smelting, Copperas Brook, 1895-1919
F1	Elizabeth Mining Company, 1895-1905
F2	Judson and Rowland, 1904
F3	Vermont Copper Corporation, 1905-1909
F4	Vermont Copper Corporation, 1916-1919
F5	American Metals Company, 1925
F6	National Copper Company, 1928-1930
G	WWII Era, Vermont Copper Co., Applachian Sulphides, 1941-1958
H	Post Mining Period
U	Unknown

TYPE	Point, Line, Polygon. How feature appears in GIS database.
GPS	Point, Line, Polygon. How feature was recorded by GPS survey
LOC	Location of GPS point(s) in relation to feature
PHOTO	Yes/No (To eventually hold roll number information)
RECDATE	Date Recorded
RECORDER	BLF Ben Ford, PJW Paul White
PAL_#	PAL Project Number
X_COORD	UTM
Y_COORD	UTM

GIS FILE STRUCTURE

Folder Name:

DATABASE	Excel (ElizData) and Tab delimited (ElizTab) versions of GIS database
BASE GIS	**ArcView Project: Base.apr** Main GIS layers: Poly.shp — All Polygons Line.shp — All Lines Point.shp — All Points Topos.shp — Topographic Layer Streams.shp — Streams
EXISTING CONDITIONS	**ArcView Project: Existing.apr** Selected layers from Poly, Line, and Point shapefiles, using GIS Database (refer below)

FILE NAME		NAME
Ezex	Arts	Artifact Scatter
Ezex	Bldg	Buildings
Ezex	Depr	Depressions
Ezex	Exdr	Exploratory Drills
Ezex	Fire	Fire Hydrants
Ezex	Fndn	Foundations
Ezex	Fndnl	Foundation (lines)
Ezex	Isol	Isolates
Ezex	Mine	Mine Workings (point)
Ezex	Ocut	Open Cuts
Ezex	Ore	Ore Piles
Ezex	Pipe	Pipes
Ezex	Pros	Prospecting Pits and Trenches
Ezex	Pwpl	Power Poles
Ezex	Quar	Quarry Sites
Ezex	Road	Roads
Ezex	Rock	Rock Piles
Ezex	Rtwl	Retaining Walls
Ezex	Stcl	Buildings, Collapsed
Ezex	Stdb	Building Debris
Ezex	Stwl	Stone Walls
Ezex	Trce	Terraces
Ezex	Trch	Trenches
Ezex	Well	Well Sites
Ezex	Wste	Waste Dumps
Ezex	Wtr	Water Ditches and Dams