U.S. ENVIRONMENTAL PROTECTION AGENCY
EPA NEW ENGLAND

RECORD OF DECISION

OPERABLE UNITS 2 AND 3

ELY COPPER MINE SUPERFUND SITE

June 2016

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DECLARATION FOR THE RECORD OF DECISION

A. SITE NAME AND LOCATION

Ely Copper Mine Superfund Site
Vershire, Orange County, Vermont
VTD988366571
Site ID No: 0102065
Operable Unit 2 and Operable Unit 3

B. STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Operable Unit 2 (OU2) and Operable Unit 3 (OU3) at the Ely Copper Mine Superfund Site (the Site) in Vershire, Vermont. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. § 9601 *et seq*., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300, as amended. The Director of the Office of Site Remediation and Restoration (OSRR), United States Environmental Protection Agency New England Region 1 (EPA) has been delegated the authority to approve this Record of Decision (ROD).

This decision is based on the Administrative Record, which has been developed in accordance with Section 113(k) of CERCLA, and which is available for review at the Vershire Town Office and at the United States Environmental Protection Agency (EPA) Region 1 OSRR Records Center in Boston, Massachusetts. The Administrative Record Index (Appendix D to the ROD) identifies each of the items comprising the Administrative Record upon which the selection of the remedial action is based.

The Vermont Department of Environmental Conservation (VT DEC) concurs with the selected remedy (Appendix B).

C. ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health and welfare or the environment from actual or threatened releases of hazardous substances into the environment.

D. DESCRIPTION OF THE SELECTED REMEDY

This ROD sets forth the selected remedy for OU2 and OU3 at the Site. This is the second response action selected for the Site, following a response action for OU1 that was selected in a September 2011 ROD. EPA may identify the need for additional response actions or additional operable units at the Site upon completion of the Operable Unit 4 (OU4) Remedial Investigation and Feasibility Study (RI/FS).

The selected remedy includes the permanent closure of the Deep Adit by filling in-place with grout and/or flowable fill to reduce the surface area available for Acid Mine Drainage (AMD) generation and greatly reduce or eliminate the release of AMD. The fill material may include neutralizing agents to further inhibit AMD creation and discharge from the Deep Adit. The other mine features, including the Burleigh Shaft, Shaft 4, and the Pollard Adit will be filled unless they are determined to be hibernacula for state- or federally-listed threatened or endangered bats. If bats are determined to be using any of the mine features as hibernacula, mitigation measures will be developed that will either preserve the feature(s) while addressing the contaminated mine discharges using other means[1] or adopt mitigation measures for the bats to address the loss of the feature(s) as hibernacula. Prior to any excavation or fill activities associated with the Deep Adit, Burleigh Shaft, Shaft 4, and the Pollard Adit, a pre-design investigation (PDI) will be performed to better understand the conditions within these mine features, including the extent to which these adits may be full of water and possibly under pressure. The investigations will also assess whether the water in these adits could discharge in an uncontrolled manner when the entrance is exposed. The design will consider engineering measures to prevent an uncontrolled release from these adits. The selected remedy also includes the use of low impact passive treatment to address the intermittent discharge from the Main Adit. A limestone drain or passive treatment system will be installed to increase the pH and precipitate and/or filter the metals within the discharge from the Main Adit so that there are no downstream impacts to water quality at the compliance points (where the streams become perennial).

The selected remedy includes a TI Waiver of the chemical-specific ARARs (Vermont Groundwater Quality Standards), which otherwise would apply to the groundwater in the Underground Workings. The selected remedy also includes a finding that it would be technically impracticable to clean up the groundwater in the Underground Workings to achieve federal risk-based standards. Because the groundwater within the Underground Workings cannot be restored to drinking water standards, the selected remedy includes the development of a groundwater use restriction area and the implementation of land use restrictions to prevent future consumption of the contaminated groundwater. The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The restrictions will include both the area over the Underground Workings and additional area sufficient to prevent the installation of wells that would have the potential to draw contaminated groundwater from the Underground Workings. The selected remedy will be designed to avoid any adverse impacts to the federally threatened Northern Long-Eared Bat, as well as State threatened and endangered bat species.

The selected remedy will consist of the following key components:

- Groundwater PDI to delineate a groundwater use restriction zone;
- PDI program for adits and shafts;
- Deep Adit, Burleigh Shaft, Pollard Adit, and Shaft 4 Filling and Closure;

[1] If the federally threatened Northern Long-Eared Bat is found to be using any of the features as hibernacula EPA, in consultation with the United States Fish and Wildlife Service, has already determined that the feature(s) would not be filled.

- Passive chemical treatment system of the discharge from the Main Adit;
- Institutional Controls;
- Long-term monitoring and Site inspections;
- Operation and Maintenance of the Passive Treatment System and other remedial features; and
- Five-year reviews.

The estimated total present value of the selected remedy approach, including construction, operation and maintenance, and long-term monitoring is approximately $3.375 million.

E. STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

The selected remedy is not able to achieve the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment) due to Site conditions and the balancing of all the CERCLA criteria for selecting remedial alternatives, although there will be some minor treatment during any dewatering activities and the discharge from the Main Adit will be treated. No principal threat wastes were identified at the Site.

Because this remedy will result in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action and, at a minimum, every five years after that date, to ensure that the remedy continues to provide adequate protection of human health and the environment.

F. SPECIAL FINDINGS

EPA is invoking a statutory Technical Impracticability Waiver, as permitted by Section 121(d)(4)(C) of CERCLA, 42 U.S.C. §9621(d)(4)(C), for the groundwater within the Underground Workings. EPA has determined that it is technically impracticable, from an engineering perspective, to achieve the Vermont Primary Groundwater Protection Standard for manganese, promulgated in the Vermont Groundwater Protection Rule and Strategy (VT Environmental Protection Rules, Chapter 12), for the water within the Underground Workings. Therefore, EPA is waiving these standards as applicable or relevant and appropriate cleanup requirements for the groundwater within the Underground Workings. This waiver applies to all potential groundwater contaminants that exceed these standards (specifically manganese) which have been detected in the groundwater of the Underground Workings at concentrations above the Vermont Primary Groundwater Protection Standards. The primary basis for this finding is that the source of the contamination, the wall rock and waste rock within the Underground Workings, will generate the condition that causes the water to exceed the standards for hundreds, if not thousands of years. EPA has determined that there are no practicable actions that would result in the water within the Underground Workings consistently achieving groundwater standards and being suitable for use as a drinking water supply. For the same reasons, EPA has also made a determination that federal risk-based standards for cobalt, iron and manganese cannot be achieved within the Technical Impracticability (TI) Zone. Therefore, the OU2/OU3 cleanup will not be expected to achieve the federal risk-based standards in the TI Zone. EPA retains the VT Primary Groundwater Quality Standards and federal risk-based standards (along with Federal drinking water standards) as action-specific monitoring standards for the groundwater beyond the edge of the TI Zone and as the basis for requiring Institutional Controls that will prevent potential exposure to the contaminated groundwater within the TI Zone. EPA has determined that contaminated groundwater within the Underground Workings is not causing the adjacent bedrock aquifer to exceed federal or state drinking water or groundwater standards. The selected remedy also includes a well-restriction zone around the TI Zone that will prevent wells from being installed that may draw contaminated groundwater out from the Underground Workings. Therefore, the selected remedy incorporating this waiver is protective of human health and the environment as long as Institutional Controls are implemented and maintained to prevent the extraction of groundwater from locations within the Underground Workings or in a location that could cause the contaminated groundwater in the Underground Workings to migrate to any well outside of the well-restriction zone. A more detailed discussion of the Technical Impracticability Waiver can be found in Appendix A of the OU2/OU3 RI/FS. The final boundary of the area to be restricted will be determined as part of the Remedial Design process.

Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. § 470f), requires EPA to take into account the effects of all actions on historic properties that are eligible for the National Register of Historic Places. The EPA has determined that Ely Copper Mine and its associated on-site historic structures are eligible for the National Register of Historic Places. The areas with potential impacts to historic resources relating to the selected remedy are within the area delineated in the OU1 Record of Decision as the Area of Potential Effect. The design and implementation will attempt to minimize the adverse effect of the cleanup action on these features, to the extent practicable. To the extent adverse effects are unavoidable, mitigation measures may be taken, in consultation with the Vermont SHPO. More detailed information on impacts to historic resources at the Site can be found in the OU2/OU3 RI/FS.

Any potential wetland and floodplain impacts associated with the selected remedy are expected to be minimal, and also would be within downstream areas being remediated by the OU1 remedy. These impacts, if any, will be addressed under the OU1 ROD.

The Main Shaft and the associated Pollard Shaft and Shaft 2 at the Ely Copper Mine are known hibernacula for the Northern Long-Eared Bat (NLEB), a species listed as threatened in accordance with the Endangered Species Act (ESA) of 1973, 16 U.S.C. §1531 *et seq*. (listing published in 80 Fed. Reg. 17974 (April 2, 2015)). Final ESA 4(d) rules, pertaining to protecting the species and its habitats, went into effect in February 2016 (50 C.F.R. Part 17(o)). The forested area surrounding the Main Shaft, Pollard Shaft, and Shaft 2 are also assumed to be potential summer habitat for the NLEB. As part of the development of the selected remedy, EPA consulted with the United States Fish and Wildlife Service (USFWS) in accordance with Section 7 of the ESA, 16 U.S.C. §1536, regarding EPA's finding that the OU2/OU3 selected remedy is not likely to jeopardize or adversely affect the species given the mitigative measures that will be employed. The USFWS concurred with the EPA finding provided that EPA documents whether the Burleigh Shaft or Shaft 4 may be considered hibernacula. EPA will continue to coordinate with the USFWS to develop mitigative measures relating to the OU1 cleanup as well. This finding also applies to threatened and endangered bats subject to protection under state law.

G. ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record file for this Site.

1. Chemicals of concern (COCs) and their respective concentrations.
2. Baseline risk represented by the COCs.
3. Cleanup levels established for COCs and the basis for the levels.
4. How source materials constituting principal threats are addressed.
5. Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD.
6. Potential land and groundwater use that will be available at the Site as a result of the selected remedy.
7. Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected.
8. Key factor(s) that led to selecting the remedy (i.e., a description of how the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria under the NCP, highlighting criteria key to the decision).

H. AUTHORIZING SIGNATURES

Issuance of this ROD embodies specific determinations made by the Director of the Office of Site Remediation and Restoration pursuant to CERCLA, the National Historic Preservation Act, and the Endangered Species Act.

This ROD documents the selected remedy for OU2 and OU3 at the Ely Copper Mine Superfund Site. This remedy was selected by EPA with concurrence of the VT DEC.

Concur and recommend for immediate implementation:

U.S. Environmental Protection Agency

By: ______________________ Date: 6/23/16

Bryan Olson, Director
Office of Site Remediation and Restoration
EPA New England, Region 1

RECORD OF DECISION SUMMARY

A. SITE NAME, LOCATION AND BRIEF DESCRIPTION

Ely Copper Mine Superfund Site
Vershire, Orange County, Vermont
VTD988366571
Site ID No: 0102065
Operable Unit 2 and Operable Unit 3

The Ely Copper Mine Superfund Site (the Site) is an abandoned copper mine located in Vershire, Orange County, Vermont and encompasses approximately 350 acres where historic mining activities took place, including about 30 acres of waste material containing an estimated 172,000 tons of waste rock, tailings, ore roast beds, slag heaps, and smelter wastes. The Site also includes over 3,000 linear feet of Underground Mine Workings along with the associated shafts and adits. No buildings remain at the Site. Remnant foundations, pads, and stone walls, including a 1,400 foot long smoke flue, demark the location of former Site structures including a former flotation mill and the smelter plant. The Site has been determined to be eligible for listing in the National Register of Historic Places by EPA in consultation with the State Historic Preservation Officer (SHPO).

The Site was added to the EPA National Priorities List in September 2001 due to environmental impacts from acid mine drainage from the Site on Ely Brook and Schoolhouse Brook (SHB) (47583 – 47591 Federal Register / Vol. 66, No. 178 / Thursday, September 13, 2001 Rules and Regulations). Site coordinates are 43° 55' 9.264" north latitude and 72° 17' 10.6434" west longitude. The general location of the Site is shown in Figure 1.

A more complete description of the Site can be found in Section 2 of the Operable Unit 2 (OU2) and Operable Unit 3 (OU3) Remedial Investigation (RI) Report and Section 1 of the OU2 and OU3 Feasibility Study (FS) Report.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

1. History of Site Activities

The Ely Copper Mine is one of three major historic copper mines, the other two being the Elizabeth Mine and Pike Hill Copper Mine, within a 20 mile long area from south to north that comprise the Vermont Copper Belt. Ely Copper Mine was among the top ten copper producing operations in the United States for a period of its history, with an average annual production of 500 tons of ingot copper and an estimated total copper production of 20,000 tons.

The Ely Cooper Mine ore body was discovered in 1813 and explored in the 1830s. Significant mine activities began in 1853 and lasted until 1905. In 1866, a tramway was built to carry ore down the valley, the main alignment of which is still apparent today. In 1867, the Ore

Roast Beds (ORB) were constructed along the lower portion of the tramway and the initial construction of the smelter began at this time. The ORB reduced the sulfur content prior to smelting. By 1868, four smelter furnaces were in operation. Mine operations experienced a boom between 1872 and 1880 when the Ely Village expanded and the Town of Vershire grew to a population of about 1,900 in contrast to today's population of about 630 people. By 1877, the smelter building was 300 feet long with 14 furnaces, and was expanded in 1879 to a length of 700 feet with 24 furnaces to accommodate ore from the Pike Hill Mines. During this time the smelter slag pile was expanding south of the building toward Schoolhouse Brook (SHB). Political events and falling copper prices in the early 1880s led to a worker revolt known as the Ely War in 1883 and collapse of the Vermont Copper Mining Company. Between 1883 and the close of the mine in 1905, ownership changed hands several times and production was sporadic.

In 1900, George Westinghouse upgraded mine equipment to rejuvenate copper production to support the Westinghouse Electric Company but was unsuccessful due to multiple factors including the lack of ore at the 3,500 feet downdip limit of the mine and low copper prices. In 1905, equipment was stripped from the Ely Copper Mine by Mr. Westinghouse and buildings were sold, moved, or demolished. In 1917, the Ely-Copperfield Association of New York, NY attempted to recover copper from the mine dumps with construction of a flotation separation mill which operated for a short period until the end of World War I, when the price of copper fell, closing the operation. In 1949-50, attempts were made to recover copper from the mine waste piles and 60,000 tons of waste rock/ore assayed at about 1 percent (%) copper was transported to the Elizabeth Mine for processing.

Since 1950, the Site has been used for timber management and recreational activities, including hunting, snowmobile riding, and horseback riding. The Site is often visited by those interested in the remnants of the mining activities or the Site geology. All-terrain vehicle tracks are observed on several of the waste piles. Figure 2 shows the remnant historic features at the Site. A more detailed description of the Site history can be found in Section 2 of the OU1 RI Report, which is part of the OU2 and OU3 Administrative Record.

2. History of Federal and State Investigations and Removal and Remedial Actions

The Site is undergoing investigation and clean-up activities pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act, as amended (CERCLA), 42 USC § 9601 *et seq.*, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the Site is VTD988366571. EPA began the RI/FS at the Site in 2001. The key findings of the OU2 and OU3 RI/FS are presented in Section E of this ROD. The OU1 RI/FS was completed in September 2011 at the time of the OU1 ROD. A supplemental RI was performed for OU2 and OU3 from 2011 to 2015 to focus on the Underground Workings. The OU2 and OU3 Proposed Plan for this ROD was released to the public in September 2015. The OU4 RI/FS is ongoing.

Prior to the start of the EPA RI/FS, the VT DEC inventoried fish species and evaluated the aquatic benthic macroinvertebrate and fish communities in SHB and determined that the aquatic benthic macroinvertebrate and fish communities in SHB were impacted by mine drainage due to copper concentrations. Preliminary evaluations of surface water and mine wastes from the Site were conducted by United States Geologic Survey (USGS) between 1998 and 2002, prior to the RI-associated investigations. The USGS research primarily focused on mine wastes (i.e., waste ore, tailing, and slag) and their effects on Site surface water. As part of these early investigations, the USGS evaluated bulk geochemistry, mineralogy, distribution of trace elements, and reactivity of waste materials. Based on these early investigations, the USGS concluded that the mine waste at the Ely Copper Mine is a combination of host rock and discarded ore, some of which has undergone various stages of metallurgical processing, including roasting, milling, and smelting. The USGS confirmed that the mine waste tends to be acid generating from the presence of sulfides (i.e., jarosite and efflorescent sulfate salts) and that the metals leaching from the mine waste include copper, cadmium, cobalt, nickel, and zinc. All of these metals were found to leach from waste materials at concentrations that may adversely impact soils and streams and have a deleterious effect on the environment. The USGS also concluded that the mine waste at the Ely Copper Mine is geochemically similar to the historic mine waste at the nearby Elizabeth Mine, which is located approximately 10 miles southeast of the Site.

3. History of CERCLA Enforcement Activities

To date, enforcement activities have been limited at the Site. The former owners and operators of the Site are deceased or defunct. The property comprising OU1, OU2, and part of OU4 are currently owned by one entity, Ely Mine Forest, Inc. This entity did not participate in any of the mining activities and purchased the Site property after mining activities ceased. EPA reached a settlement with Ely Mine Forest, Inc. in 2011. Through the settlement, the landowner agreed to provide access to EPA to implement the OU1 and OU2 remedy on their land, and also agreed to implement Institutional Controls to ensure the long-term protection of the remedy. Another entity, Green Crow Corporation, owns the OU3 portion of the Site. A proposed settlement with Green Crow Corporation is currently in the public comment phase.

C. COMMUNITY PARTICIPATION

The OU2 and OU3 Proposed Plan, along with the OU2 and OU3 RI Report and OU2 and OU3 FS Study were made available to the community in September 2015. These documents, and others relating to the Site, can be found in the Administrative Record file, which is available at the following information repositories: the Vershire Town Office and the EPA Region 1 OSRR Records Center in Boston, MA. The notice of the availability of the OU2 and OU3 RI/FS, Proposed Plan, and Administrative Record was published in the Valley News on August 30, 2015. A public comment period was held from September 8, 2015 to October 8, 2015. An extension to the public comment period was not requested. EPA held a public meeting and public hearing on September 22, 2015 to accept comment regarding the Proposed Plan. Notice of the September 22, 2015 public hearing, and the availability of the OU1 Proposed Plan was also included in a public notice on the Town of Vershire website. On September 14, 2015, the Valley News released an article summarizing the cleanup and announcing the public meeting. The OU1 Proposed Plan was available at the information repository and was posted on the EPA website for the Ely Copper Mine Superfund Site.

EPA has worked with concerned and interested members of the community. While there has been a low/moderate level of community interest, the local historical society has been very interested in the Site activities. EPA has kept the community and other interested parties apprised of Site activities through informational meetings, fact sheets, press releases and public meetings.

EPA's response to the comments received during the comment period is included in the Responsiveness Summary, which is Appendix C to this ROD. None of the comments received opposed the cleanup action proposed for the Main Adit or Deep Adit (the OU2 component of the remedy). However, some concerns were raised regarding the potential impact on the historic resources at the Site. The only comment received regarding the proposed OU3 land use restrictions requested that the extent of the land use restriction be reduced.

D. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The cleanup action presented in this ROD for OU2 and OU3 will be the second cleanup action for the Site. EPA often creates operable units (OUs) to enable cleanup actions to move forward on certain areas of a site while allowing additional investigation in other areas of a site. For this Site, EPA is creating four Operable Units. The OUs for the Ely Copper Mine are shown in Figure 3.

OU1 includes the areas that are the primary source of the surface water and sediment contamination that is responsible for the ecological impacts to Ely Brook, Pond 4, Pond 5, and SHB. These areas are also the major source of soil and groundwater contamination within the OU1 area. The OU1 areas of the Site include:

- <u>Lower Waste Area (LWA) and Upper Waste Area (UWA)</u>- waste rock (sulfide ore-bearing rock) that did not contain enough copper to process;
- <u>Tailings Area (TA)</u>- tailings (finely ground sulfide ore) that were left behind from copper extraction processes at the flotation mill;
- <u>Ore Roast Bed (ORB)</u>- waste rock from ore roasting, a process that makes it easier to remove the copper from the rock; and
- <u>Sediment of Ely Brook, its tributaries, and Pond 4 and Pond 5</u>- eroded mine waste from the Site has built up as bottom sediment, where it leaches metals into the water.

OU2 includes the Underground Workings on property currently owned by Ely Mine Forest, Inc. and associated discharge from shafts and adits. This OU is one of the subjects of this proposed cleanup plan. The OU2 Study Area covers about 25 acres.

OU3 includes the Underground Workings on property currently owned by Green Crow Corporation. This OU is the other subject of this proposed cleanup plan. The OU3 Study Area covers about 165 acres.

Operable Unit 4 (OU4) will address all other areas and media at the Site where risks to human health or the environment are present that are not addressed by OU1, OU2, or OU3. The OU4 areas include:

- Smelter/Slag Area- waste rock, oxidized ore, slag and building demolition debris, most of which are associated with on-site smelting operations;
- Sediment of Schoolhouse Brook (SHB) and East Branch of Ompompanoosuc River (EBOR)- eroded mine waste from the Site has built up as bottom sediment, where it leaches metals into the water (a limited area of SHB at its confluence with Ely Brook will be addressed under OU1);
- Site Groundwater- groundwater contaminated by metals and acids that have leached from waste source areas at the Site, excluding the contaminated groundwater associated with the Underground Workings which are part of OU2 and OU3; and
- Surface water of SHB and EBOR- surface water contaminated by metals and acids that have leached from waste source areas at the Site.

It should be noted that while the surface water of SHB and EBOR and Site groundwater will be addressed in OU4, significant improvement to both surface water and groundwater quality is anticipated from the cleanup of OU1 and OU2 areas, which are the major contributing sources to the surface water and groundwater contamination. The remediation of Ely Brook under OU1 is also expected to significantly improve the ecological health of SHB and downstream waterways prior to the waterways being addressed under OU4. The OU4 RI/FS will determine the need for any response actions other than the OU1 remedial action.

EPA selected an Early Action for OU2 groundwater located within the current Ely Mine Forest Inc. property. This area is now part of OU4. The OU2 Early Action is described in a separate 2011 OU2 CERCLA decision document. The OU2 Early Action will prevent exposure to contamination identified in the Site Human Health Risk Assessment (HHRA) within the OU2 area using land use restrictions that will prevent residential development and the installation of wells for any use other than the monitoring or implementation of a response action.

E. SITE CHARACTERISTICS

Chapter 1 of the OU2 and OU3 Feasibility Study Report contains an overview of the OU2 and OU3 RI. The significant findings of the OU2 and OU3 Remedial Investigation Report are summarized below.

1. Remedial Investigation Program

A detailed description of the Site investigations prior to the 2011 OU1 ROD can be found in the OU1 RI, which is part of the OU2 and OU3 Administrative Record. To supplement the OU1 RI and to support the OU2/OU3 Feasibility Study, OU2/OU3 field investigations were implemented from 2012 through 2015, and included additional surface water sampling; bedrock outcrop studies; photolineament studies; deep bedrock borehole and monitoring well installation; borehole geophysical surveys; and groundwater and porewater sampling. A detailed description of this work can be found in the OU2/OU3 RI. Table 1, which is included with the attached Site figures in Appendix A, presents a summary of investigations conducted at the Site. Figure 4 depicts the investigation locations included in the OU2/OU3 RI.

2. General Site Characteristics

A brief summary of the area wide characteristics is presented below followed by a more specific discussion of the Site source areas along with the nature and extent of contamination. Only the media and areas that relate to the OU2 and OU3 remedial action are discussed in this ROD. Available information pertaining to other media and areas of the Site can be found in the OU1 RI Report, which is part of the Administrative Record.

The OU2 and OU3 landscape is a combination of barren open areas containing mine waste and mixed hardwood and evergreen forest. The OU2 area topography is dominated by the peak and steep south slope of Dwight Hill extending from an elevation of approximately 1,600 feet above mean sea level down to SHB at an elevation of approximately 940 feet above mean sea level (amsl), some 660 feet of relief. The main shaft and several adits leading to the mine Underground Workings are located along the steep, upper portion of this slope at the head of the valley. The Underground Workings extend approximately 3,000 feet to the northeast of the mine openings beneath and beyond the top of the ridge.

The OU3 area is located primarily within a west facing drainage that is generally bounded by Dwight Hill to the south, another hill ridgeline at about 1716 amsl in elevation to the east, and a third ridge line at about 1440 amsl elevation to the north. This drainage contains an unnamed stream designated as Ompompanoosuc River Tributary 1 (ORT-1) for the purpose of the OU2 and OU3 RI/FS. The OU3 area extends from the 1716 amsl elevation to about 900 amsl at the Ompompanoosuc River along Route 113.

a. Regional Bedrock Geology

The Site lies within the Vermont Copper Belt, which includes a group of Silurian-Devonian rocks comprising the western portion of the Connecticut Valley-Gaspe Trough, which extends from Massachusetts to Quebec, Canada. Stratigraphic units in east-central Vermont include (from oldest to youngest) the Northfield Formation, Waits River Formation, Standing Pond Volcanics, and the Gile Mountain Formation. The massive sulfide deposits of the Ely Mine lie within the Devonian-age Gile Mountain Formation. These rocks were deformed during three stages of folding and amphibolite-grade metamorphism during the Acadian Orogeny.

b. Regional Surface Water Hydrology

The crest of Dwight Hill occurs along a northwest trending ridge, which forms the northern boundary of the Ely Brook watershed. North-south trending ridges to the west and east of the mine areas define two smaller upland valleys that merge into an open U-shaped valley facing south-southwest (SSW) and define the Ely Brook watershed. The small upland valley located on the western side of the watershed contains the headwaters for Ely Brook. The other small upland valley drains the eastern side of the watershed into a series of beaver ponds (Ponds 1 through 5).

Ely Brook is a first order stream and the primary drainage pathway from the Site. Its watershed encompasses approximately 0.42 square miles with the highest elevation above 1,350 feet. Ely Brook flows about 1 mile and descends over 380 feet from the headwater along the southern slope of Dwight Hill to its confluence with SHB at an elevation of 970 feet. Ely Brook is fed on the east by three significant tributary streams referred to as the Ely Brook Tributary 1 (EBT1), Ely Brook Tributary 2 (EBT2), and Ely Brook Tributary 4 (EBT4) that divide Ely Brook into four reaches referred to as the Ely Brook Headwaters, the Ely Brook-Upper Reach (EB-UR), Ely Brook-Middle Reach (EB-MR), and the Ely Brook-Lower Reach (EB-LR). Ely Brook Tributary 3 (EBT3) combines with EBT2 prior to reaching Ely Brook.

SHB originates south of Vershire Center and has a drainage area encompassing 9.73 mi^2. SHB drops approximately 886 feet in elevation from its headwaters to its confluence with the EBOR. Ely Brook joins SHB at the base of the Ely Brook valley along the south side of South Vershire Road. Below the confluence, SHB forms the southern margin of the Site adjacent to the Slag Pile Area and flows 1.75 mi before its confluence with the EBOR. USGS descriptions of stream reaches developed using flow characteristics and stream bottom composition show that a majority of the stream is characterized by cobble bottom with limited depositional areas for fine sediment to accumulate.

The EBOR is one of two main branches that meet to form the 23-mi long Ompompanoosuc River system, whose drainage area encompasses 136 mi^2. The EBOR headwaters are located in the northwest corner of Vershire; the river then flows east and south into Thetford. The confluence of the EBOR and the West Branch of the Ompompanoosuc River (WBOR) is just upstream of the Union Village Dam in Thetford. A USGS gauging station is maintained just below the dam. The Ompompanoosuc River then flows southeast to its confluence with the Connecticut River in Norwich, Vermont.

An unnamed, first order stream, designated ORT-1 for the purposes of the RI, drains the watershed located north of Dwight Hill. The ORT-1 watershed overlies the majority of the Main Shaft. It encompasses approximately 0.30 square miles with a highest elevation equal to approximately 1,716 feet. ORT-1 descends over 660 feet and flows approximately 1 mile from the headwater along the northern slope of Dwight Hill to its confluence with the EBOR at an elevation of approximately 800 feet.

c. Site Hydrogeology

Site-wide water level measurements from 2012 to 2014 for the OU2 and OU3 RI and the OU1 Remedial Design confirm the general overburden and bedrock groundwater flow directions noted in the OU1 RI Report for the Ely Brook watershed. Figure 5 depicts updated water levels and shows shallow bedrock groundwater flow south of Dwight Hill as generally southward converging on Ely Brook and SHB. Although no monitoring wells were installed in the ORT-1 drainage, overburden and shallow bedrock flow is expected to parallel topographic slope and flow toward ORT-1 (from both north and south) and then eastward toward the EBOR. Flow in the bedrock system will occur only if permeable bedrock fractures are connected to a source of recharge and to other permeable fractures. The average fracture length measured in Site outcrops is greater than the average fracture spacing measured in the outcrops and borings. This means that intersections between potentially permeable fractures likely occur in the rock mass. Such intersections themselves have been observed both in outcrops and in acoustic televiewer (ATV) logs. The fractures measured in the outcrop study have the potential for groundwater flow, although no direct evidence of groundwater flow in these outcrop fractures was observed. Bedrock fracture and flow conditions in the OU3 area are assumed to be similar to those drilled south of the crest of Dwight Hill, except that if a borehole were to intercept the Underground Workings directly, it would do so at a depth greater than approximately 400 feet, and progressively deeper to the northeast. Water levels in boreholes that intercept the Underground Workings in the OU3 area would be expected to be approximately 1,276 feet amsl, which is the upper elevation of the water within the Underground Workings. Water levels in other boreholes would depend on the heads in water-bearing fractures that might be intercepted by the boreholes.

Groundwater movement within the Underground Workings is controlled by the configuration of the Underground Workings themselves and the characteristics of the surrounding bedrock. The Underground Workings are recharged by infiltration of groundwater from precipitation through the overburden and from there to bedrock fractures. Water can also enter the Underground Workings through overland flow into the open entrances. The water contained within the Underground Workings is referred to as a mine pool. The primary mine pool at the Ely Copper Mine is contained within the Main Shaft and the associated Underground Workings, including the Main Adit. This mine pool will be referred to as the “Main Shaft Mine Pool” hereafter. A separate mine pool system exists for the Deep Adit and the related Burleigh Shaft as well as Shaft 4 and the Pollard Adit. Because the Deep Adit, Shaft 4, and Pollard Adit are dead end features that do not connect to the Main Shaft system, these features contain smaller scale mine pools that are representative of the local groundwater conditions. The Deep Adit, Shaft 4, and Pollard Adit are most likely collecting surface infiltration from the Upper Waste Area as well as groundwater.

Given the apparent stability of the Main Shaft Mine Pool water level in comparison with nearby bedrock monitoring wells, as well as the equivalence of the Main Shaft Mine Pool elevation with the Main Adit discharge elevation, the Main Adit is inferred to be the decant point for the Underground Workings. The rate of recharge to the Main shaft was estimated at approximately 11.6 gallons per minute (gpm), while the observed discharge from the Main Adit varied from no flow to 11 gpm.

Contamination from the Main Shaft Mine Pool may be released by transport through bedrock fractures. However, water-bearing fracture frequency and yield rates observed in the Underground Workings bedrock are very low. Additionally, geochemical results suggest the Main Shaft Mine Pool water is stagnant and not well mixed. These results indicate that the Main Shaft Mine Pool groundwater flux is very low. The results of the air photolineament and bedrock outcrop fracture investigations presented in the OU2 and OU3 RI indicate that the two most prominent lineaments in the study area coincide with secondary statistical peaks in the outcrop fracture data. These lineaments include north-northeast (NNE) to south-southwest (SSW) lineaments south of the Main Shaft and an east-southeast - west-northwest (ESE-WNW) lineament coinciding with ORT-1. These lineaments may represent bedrock fracture zones that could intersect the trace of the Underground Workings. Figure 6 shows these potential fracture zones.

d. Wetland Resources

A preliminary wetland assessment to identify State and Federal jurisdictional wetlands was performed as part of the OU1 RI/FS. The wetland assessment was updated as part of the OU2 and OU3 RI/FS. The OU2 and OU3 RI/FS did not identify any wetlands that may be directly impacted by Site activities. Wetlands have been delineated downstream with areas being remediated by the OU1 remedy. The updated wetland delineation is shown on Figure 2-1 of the OU2 and OU3 FS Report.

e. Historic Resources

As part of the OU1 RI/FS, EPA completed a historic resources assessment of the Site as part of compliance with the National Historic Preservation Act, 16 U.S.C. 470 *et seq.*, and the Vermont Historic Preservation Act, 10 V.S.A. Chapter 123. The Ely Copper Mine was determined to be eligible for listing in the National Register of Historic Places under Criterion A at the local, state and national levels for its contributions to the history of Vershire, the State of Vermont and the United States. These areas of significance include commerce, economics, engineering, industry, invention, and labor. At its peak the Ely Copper Mine was the largest single copper producing mine east of the Mississippi River. It was the largest copper mine working in sulfide ores for a long period of time in which most of the rest of U.S. copper production came from native copper ores. Its only other close rival was the Union Consolidated Mining Co. at Ducktown, TN, which produced 1 million lbs annually during Ely's period of operation, but often from several smaller mines rather than just one shaft as at Ely. The Ely Copper Mine was among the top ten producing U.S. copper mines between 1866 and 1881. The Ely Copper Mine was the only copper mine in New England, and one of a handful east of the Rocky Mountains, where all technological aspects of refined pig copper production, from mining of raw ore to smelting of refined copper, were successfully integrated on a large scale. The Ely Copper Mine was the site of a major early eastern U.S. copper smelting plant that was second in output next to the more productive Michigan copper district for a time during the late nineteenth century. The Ely Copper Mine was the scene of experiments that may have contributed incrementally to the development of the copper converter, one of the most important developments in early twentieth-century copper metallurgy. During its approximately 130-year life, the mine became a seat of political power and spawned and supported the growth of a sizeable rural industrial community. The Ely Copper Mine was significant as a regionally anomalous extractive industrial mono-economy that supported a community akin to a Western mining boom town, with its only near rivals the contemporaneous, but smaller and shorter-lived Blue Hill, ME, copper and Ammonoosuc, NH, gold mining booms. It was the scene of labor unrest during the 1882 "Ely War."

Remnants of the former copper mining operations occur throughout the Site, although no standing buildings still exist. The OU2 and OU3 RI/FS included consultation with the Vermont State Historic Preservation Officer. The historic features at the Site are shown in Figure 2.

f. Underground Workings Description

Surface features related to the Underground Workings are located along the steep, upper portion of Dwight Hill at the head of the valley that contains Ely Brook. There are approximately 12 shafts, adits, vents or other openings that have been identified on maps of the Site. Of these, eight are associated with the Main Shaft and four that are separate from the Main Shaft. The locations of the mine openings and related surface features are shown in Figure 7 and are shown in cross-section in Figure 8.

The Main Shaft and its associated features are described below:

The Main Shaft of the mine begins at the uppermost opening of the Underground Workings. The Main Shaft opening is located along the steep slope above the Upper Waste Rock Piles at an elevation of approximately 1,385 feet amsl. From this point, the Main Shaft followed the ore body that extended approximately 3,000 feet northward and descended some 1,500 feet vertically along a trend of approximately N40E at an inclination averaging approximately 25 degrees over the length of the mine. There are no known mine openings north of the Main Shaft. Based on observations from the 1943 survey by the U.S. Bureau of Mines, and anecdotal evidence provided by spelunkers visiting the mine, the flooded level of the mine was estimated by prior investigators at approximately 1,275 feet. The eight surface features associated with the Main Shaft are discussed below:

- The Main Shaft entrance is approximately 10 feet high and 30 feet wide, and descends underground into the hillside at an angle of approximately 25 degrees. The portion of the mine shaft visible from the outside includes wood and stone packwall roof props, with rubble on the mine floor from chunks of schist that have spalled off the roof of the opening.

- The Back Stopes entrance is located west of the Main Shaft entrance. The floor of the Back Stopes is steeply inclined from the entrance and connects with the western edge of the Main Shaft underground.

- An air shaft for the Back Stopes is located to the west of the entrance and consists of a rectangular, 5 x 2.5 foot stone pit.

- Shaft 2, also known as the 1850s Pollard Shaft II, was used as a ventilation shaft for the now-collapsed Tyson Adit. Shaft 2 is a ragged hole approximately 13 feet in diameter, which opens into a room that connected with the Tyson Adit. From the Shaft 2 entrance, three openings are visible, including the former Tyson Adit openings and an opening in the floor (winze) which leads down to the Main Adit. Another inclined shaft with a 10-foot opening is located approximately 80 feet south of Shaft 2 and extends down to the roof of the Main Adit.

- Pollard Shaft is an approximately 10 foot diameter open hole that extends down to the roof of the Main Adit.

- Tyson Adit ("Tyson/Pollard Adit"). Now collapsed, entrance obscured. Also known as the 1834 Tyson/1854 Pollard Adit.

- Adit A, also known as the 1850's Pollard Adit A, is now collapsed and the entrance is covered.

- The Main Adit (also known as 1861 Pollard Adit) consists of a stone-lined tunnel with sloping sides. The original stonework has partially collapsed, partially obscuring the entrance. The downhill portion of the tunnel (from the entrance to the open portion of the tunnel at location SW-100) may have open air flow and is likely to provide habitat for bats and other wildlife. The portion of the Main Adit uphill from SW-100 appears to be partially intact, but the extent of the collapse and structural integrity of the tunnel is unknown. Based on ongoing bat population surveys performed by the State of Vermont Fish and Wildlife Department (VTFWD), the Main Adit is believed to be a critical bat habitat (including Vermont and federal endangered or threatened species). Ponded surface water is typically visible in the collapsed entrance with intermittent flow. This flow is periodically substantial enough to result in discharge away from the immediate vicinity of the adit. The surface water station SW-100 is located as the discharge point (or pooled water). Discharge from the Main Adit is presumed to infiltrate to overburden groundwater and be transported downgradient to a surface water discharge point within the Ely Brook watershed, presumably in a location between the UWA and Lower Waste Area (LWA). The potential surface water receptors for this discharge are Ely Brook Tributary 2 (EBT-2) and/or Ely Brook Tributary 3 (EBT-3). However, given the intermittent nature of this discharge and the low measured flow rates, the contribution of the Main Adit discharge to the water budget of the UWA is assumed to be minor in comparison to groundwater and surface water flows resulting from precipitation and infiltration. The average flow discharging from the Main Adit during the OU2 and OU3 RI was 1.8 gpm with a peak flow of 11 gpm.

The Underground Workings features that are not known to connect with the Main Shaft are described below.

- Shaft 4 is located along the western edge of the Upper Waste Area. The entrance has collapsed and is not visible on the surface, but the shaft is believed to plunge a short distance to the northeast. It is not a likely habitat for bats or other wildlife, but further investigation/documentation is necessary

- Pollard Adit, also known as 1850s Pollard Adit, entrance is obscured by waste rock and may be collapsed. Based on historical information, an adit in this location was installed 19 feet into bedrock. The adit is currently completely covered by waste rock within the Upper Waste Area. The surface water station ES-4 is a seep directly adjacent to the mapped (inferred) location of this adit. The source of the seep could be overburden water daylighting from the base of the pile or discharge from the adit, or a combination of both. Discharge from the 1850s Pollard Adit and ES-4 is transported in surface water and overburden groundwater within the Ely Brook watershed. The likely surface water receptors for this discharge are EBT-2 and/or EBT-3. The average flow discharging from the 1850s Pollard Adit during the OU2 and OU3 RI was 0.2 gpm with a peak flow of 2 gpm. It is not a likely habitat for bats or other wildlife.

- Burleigh Shaft is located in an approximate 7 foot by 10 foot, bowl-shaped depression and descends to the east at an approximate 15-degree angle. The roof of the shaft is supported by a wooden support post inside the shaft. The condition of the Burleigh Shaft beyond the entrance is unknown. It is not a likely habitat for bats or other wildlife, but further investigation/documentation is necessary.

- The Deep Adit is located at the southern end of the Upper Waste Area is separate from the Main Shaft. This adit has collapsed, but its approach is visible as a north-south gully with a low retaining wall. Water discharges from the adit, but it is believed to be inaccessible to bats or other wildlife. The Deep Adit discharges the largest volume of surface water that is directly attributed to the Underground Workings. The surface water station ES-8 is located directly at the Deep Adit point of discharge. This discharge forms an ephemeral stream that flows to its discharge point at Pond 5, and ultimately to EBT-2. The average flow discharging from the Deep Adit during the OU2 and OU3 RI was 3.3 gpm with a peak flow of 8 gpm.

g. Bat Habitat

The Underground Workings are critical habitats for threatened or endangered bat populations, specifically as winter hibernacula. Previous bat surveys conducted at the Site by the VTFWD have observed the Northern Long-Eared Bat, Eastern Small-Footed Bat, Big Brown Bat, Little Brown Bat, and Tri-Colored Bat. The Indiana Bat was identified once several decades ago. Of these bat species, the Eastern Small-Footed Bat is listed as threatened under the Vermont Endangered Species Act (VESA, 10 V.S.A. Chapter 123), and the Indiana Bat, Tri-Colored Bat, and Little Brown Bat are listed as endangered under the VESA. The Northern Long-Eared Bat is listed as endangered in Vermont and is federally listed as a threatened species, while the Indiana Bat is listed as endangered in Vermont and federally under the federal Endangered Species Act (ESA), 16 U.S.C. 1531 *et seq*. (VTFWD, 2015).

Portions of the Underground Workings have collapsed; however, some are still open and allow for air circulation. The Underground Workings entrances with open entrances, which are or may be accessible to bats and other wildlife, include the following:

- The Main Shaft and Back Stopes have open entrances and are connected underground. The airshaft for the Back Stopes appears to be partially collapsed and may provide air circulation to the Underground Workings. It is unclear if the airshaft is still open enough at the bottom to permit wildlife entrance;
- Shaft 2 has an open entrance that is readily accessible to wildlife. This shaft opens into a room that connected with the Tyson Adit. From the Shaft 2 entrance, three openings are visible that connect to other Underground Workings (the Tyson Adit and a winze leading to the Main Adit), but the condition of these features and the degree of current connection is unknown. Research work performed in 2014 confirmed that bats do use the Pollard Shaft during the summer months;
- The Main Adit entrance is open and accessible to wildlife. Uphill of the Main Adit, the roof has partially collapsed;
- The Pollard Shaft, which has an open entrance, originally extended to the roof of the Main Adit. However, the current condition of this feature and the extent of connection are unknown;
- The Burleigh Shaft entrance is open and accessible to wildlife. The Burleigh Shaft intercepts the Deep Adit. The extent of the Underground Workings for the Burleigh Shaft beyond the entrance is unknown; and
- Shaft 4 appears to be full of water but a small opening exists at the collapsed entrance. The extent of any Underground Workings for Shaft 4 beyond the entrance is unknown.

Based on the known conditions of the Underground Workings, the Main Shaft complex is likely to have several points of air circulation, while the Burleigh Shaft and Shaft 4 have only one entrance point and somewhat limited air circulation.

3. Nature and Extent of Contamination

The OU2 and OU3 RI/FS focused on the nature and extent of contamination associated primarily with the Underground Workings and any associated groundwater and surface water contamination. For groundwater, the nature and extent of contamination evaluated the contaminant sources responsible for the groundwater contamination within the Underground Workings, particularly the Main Shaft. The OU2 and OU3 RI/FS also evaluated the nature and extent of contamination associated with the discharge of water from the Underground Workings, specifically the Deep Adit and Main Adit. A brief summary of the nature and extent of contamination associated with the Underground Workings and Adits is presented below. Additional detail is presented in the OU2 and OU3 RI/FS. Figure 9 shows the sample locations and analytical concentrations for the Underground Workings and adits.

a. Mine Pool Geochemistry

The ore deposits of the Ely Copper Mine are stratiform massive sulfide deposits composed primarily of the sulfide minerals pyrrhotite and chalcopyrite. The sulfide minerals are present in unmined ore within the intact wall rock of the Underground Workings shaft and adits, as well as unconsolidated waste rock (i.e. boulder, cobbles, sand etc.) that remains within the Underground Workings. When exposed to water and oxygen, these sulfide minerals react to generate iron, sulfate, and acidity. This acidity in turn causes many of the metals bound within the ore and waste rock to solubilize into groundwater or surface water, resulting in elevated levels of base metals such as aluminum, cadmium, cobalt, copper, iron, manganese, and zinc. These dissolved metals are conveyed to receiving aquifers and streams, resulting in metals, sulfate, and acid impacts.

Because of the presence of unmined ore and naturally occurring minerals disseminated within the Underground Workings wall rock, the acid mine drainage (AMD) contaminant mass source of the Underground Workings is essentially unlimited. Consequently, the Underground Workings have the geochemical capacity to produce AMD for an indefinite period of time. The primary contaminant sources responsible for groundwater impacts within the Underground Workings are:

- Unmined ore and naturally occurring sulfide minerals disseminated within the Underground Workings wall rock;
- Residual waste rock remaining within the Underground Workings; and
- AMD inflow to the Mine Pool because of groundwater infiltration and seepage from the fractured bedrock overlying the Underground Workings.

Consistent with these conditions, AMD from the Underground Workings has mixed with the bedrock groundwater to form the 32.4 million gallon Main Shaft Mine Pool along with a smaller scale mine pool within the Deep Adit, Shaft 4, and Pollard Adit. The overall result is that the groundwater within the Underground Workings contains metals (cobalt, iron, and manganese) at levels exceeding federal and state criteria for groundwater and drinking water.

The term "upper" Main Shaft Mine Pool is used to generally describe the shallow Main Shaft Mine Pool, where geochemical reactions may be influenced by the interaction of water and oxygen. The upper Mine Pool is characterized by the August and November 2014 results for MW-UP2 collected directly from the Main Shaft Mine Pool at a depth interval of 205 to 210 feet below ground surface (bgs). Conversely, the term "lower" Mine Pool is used to describe the deeper and fully submerged portion of the Main Shaft Mine Pool, where geochemical reactions are less likely to be influenced by the Main Shaft Mine Pool air-water interface. The lower Mine Main Shaft Pool is characterized by the August and November 2014 results for MW-DP1 collected directly from the Main Shaft Mine Pool at a depth interval of 380 to 401 feet bgs.

The Main Shaft plunges steeply, which would require drilling wells of a substantial depth (up to 1,500 feet) to intercept the lower portion of the Main Shaft Mine Pool. Even though a significant portion of the Main Shaft Mine Pool is deeper than MW-DP1, this monitoring location provides data for the Main Shaft Mine Pool that was considered representative of conditions not impacted by contact with exposure to surface water and oxygen. The lack of groundwater data for depths below MW-DP1 introduces some uncertainty with respect to the quality of the water deeper in the Main Shaft Mine Pool. Stratification of the Main Shaft Mine Pool based on density and temperature differences has been observed in other mine pools, and it is possible that the deeper portions of the Main Shaft Mine Pool below 401 feet bgs exhibit a geochemistry distinct from the conditions observed in MW-DP1. If stratification were occurring, the deeper water would be denser, more saline groundwater. This increased salinity would be the result of increased cation and anion concentrations. Therefore, it is reasonable to assume that water quality in the Main Shaft Mine Pool does not improve with depth.

The Main Shaft Mine Pool groundwater is characterized by the following concentrations:

- Total and/or dissolved cobalt, iron, and manganese at concentrations ranging 3.7, 9, and 6 times greater than EPA risk-based standards for cobalt, iron, and manganese, respectively; and
- Manganese concentrations at 3 times greater than Vermont Groundwater Protection Rule and Strategy standards (VT Environmental Protection Rules, Chapter 12).

b. Adit Discharge Geochemistry

Contamination from the Main Shaft Mine Pool associated with the Main Shaft is released via surface water discharge at the Main Adit. Small mine pools which are known to discharge to surface water are also found in other Underground Workings features, which include the Deep Adit and Pollard Adit.

The water quality of the discharge from the Main Adit is different from the Main Shaft Mine Pool associated with the Main Shaft groundwater in several respects: dissolved aluminum and copper are one to three orders of magnitude higher in the adit discharge, while iron, sulfate, and major cations are much lower. The pH in the adit discharge is also significantly lower than the Main Shaft Mine Pool. The lower concentrations of most of the metals in the adit discharge can be explained by exposure to air or more-oxygenated water, which cause iron oxide and oxy-hydroxide precipitation within the Underground Workings before discharging. The adit discharge may also be diluted by mixing with shallow, unimpacted groundwater. The elevated aluminum and copper in adit discharge may be from the influence of non-Main Shaft Mine Pool sources, such as waste rock within the upper Underground Workings and waste rock piles on the surface above the Underground Workings. The RI evaluated several discharge locations and concluded that only three sampling locations (from the Pollard Adit, Deep Adit, and Main Adit) were representative of adit discharge. Of these, the Deep Adit and Main Adit represent 90% of the total observed Underground Workings discharge. The surface water cleanup levels for Site-wide surface water established in the OU1 ROD were used to evaluate the surface discharge from the adits.

The contaminant composition of the Main Adit discharge from 2007 to 2014 is characterized by the following:

- All samples analyzed exceeded the OU1 surface water cleanup levels for aluminum, copper, and zinc. The most significant exceedance was copper, which was more than 300 times the OU1 ecological cleanup level; and

- Iron and cadmium exceeded the OU1 surface water cleanup level in most of the samples, and the average exceedance was 2 to 3 times the OU1 ecological cleanup level.

The chemical composition of the Deep Adit discharge from 2007 to 2014 is characterized by the following:

- All samples analyzed exceeded the OU1 surface water cleanup levels for aluminum, cadmium, copper, nickel, and zinc. Aluminum was more than two orders of magnitude above the OU1 surface water cleanup level, and copper was three orders of magnitude above the OU1 ecological cleanup level; and

- Iron exceeded the OU1 surface water cleanup in earlier samples (pre-2014), and the average iron value for all the samples was approximately 2 times the OU1 ecological cleanup level.

In summary, the groundwater within the Underground Workings Main Shaft Mine Pool contains cobalt, iron, and manganese above levels considered acceptable for human consumption. The surface water discharging from adits associated with the Underground Workings contains aluminum, cadmium, copper, nickel, iron, and zinc above levels considered protective for aquatic receptors. The different contaminants of concern are due to the different geochemistry of the Main Shaft Mine Pool and the adits as well as the fact that the Main Shaft Mine Pool groundwater was evaluated as a potential source of human health exposure based on future consumption of drinking water and the adit discharge was evaluated as a potential source of ecological exposure in surface water.

4. Conceptual Site Model

The Conceptual Site Model (CSM) is a diagram of the sources of contamination, release mechanisms and exposure pathways to receptors for the contaminated media at the Site, as well as other Site-specific factors. The CSM is a three-dimensional "picture" of Site conditions that illustrates contaminant sources, release mechanisms, exposure pathways, migration routes and potential human and ecological receptors. It documents current and potential future Site conditions and shows what is known about human and environmental exposure through contaminant release and migration to potential receptors. Site receptors include individuals and organisms that may come into contact with contaminated soils/waste; ingest contaminated soil/waste; consume the groundwater; come into contact with or ingest surface water, sediment interstitial (pore) water or sediment; or consume organisms that have accumulated contamination. The risk assessment and response action for the Site are based on this CSM. The CSM for OU2 and OU3 has two components. With respect to the contaminated groundwater within the Underground Workings, there is no current exposure and future exposure would require the installation of a water supply well within or sufficiently close to the Underground Workings to result in a contaminated water supply. The second component of the CSM is the discharge of water from the Underground Workings via the adits and shafts into Pond 4, Pond 5, the tributaries of Ely Brook and subsequently Ely Brook.

As part of the CSM, any principal threat wastes at the Site are identified. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied. Wastes generally considered to be principal threats are liquid, mobile and/or highly-toxic source material.

Low-level threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. Wastes that are generally considered to be low-level threat wastes include non-mobile contaminated source material of low to moderate toxicity, surface soil containing chemicals of concern that are relatively immobile in air or ground water, low leachability contaminants, or low toxicity source material.

No principal threat wastes were identified in the OU2/OU3 areas of the Site. The wastes within the OU2/OU3 areas of the Site are low-level threat wastes that are causing AMD or represent a widespread hazard to individuals or biota.

F. CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The former Site is currently abandoned and unoccupied. Access is unrestricted, and the Site property is used for recreation (e.g., hiking, rock collecting, and ATV riding). Land use in the vicinity of the Site is rural residential and open space. The land surrounding the Site includes residences and forests. Adjacent land cover types consisting mostly of mixed hardwood and softwood and softwood-dominated woodlands sloping towards Ely Brook. There is no use of, or exposure to, groundwater within the Site. There is no current development within the Site property, although future residential use of portions of the Site property is possible. Table 2 provides a summary of the Site use assumptions and future use after cleanup.

Based on a review of the Vershire Town Plan, adopted in 2006, land use areas in the Town were divided into three main categories: the Village Center, Open Space, and Rural Residential. The Site is located in the Rural Residential District, where primary development for permanent residences is limited to main roadways. The residents surveyed for the plan overwhelmingly indicated that significant development should be limited to the Village Center in order to preserve the rural character of the Town. The plan emphasizes the preservation of the areas outside the Village Center for forestry-related activities such as timber harvesting. As a result, uses of the Site and surrounding area could include limited residential development, but also will likely include timber harvesting from the surrounding forested land as the primary land use. Furthermore, the steep topography, rural location, stable population, and lack of utilities in the vicinity of the Site will limit significant future development. Neither communication between EPA and local officials nor the Vershire Town Plan indicates any specific, significant plans for targeted development of the Site. Potential future use could also include solar energy generation in the open space areas on the Site. Restoration of the Site is more likely to attract users in the local population who are primarily interested in the Site's history and open space, and as such, might engage in passive recreational activities like walking, hiking, horseback riding, spelunking, or all-terrain vehicle (ATV) use. There are physical hazards to the Site as a result of the presence of the shafts and adits associated with the underground workings. The features attract those interested in exploration, evaluating the bat population, and viewing the historic mine features. A recent fatality caused by an individual falling into one of the open former mine holes further emphasizes the physical hazards.

Evidence of recreational and general public access to, and use of, the mine area is apparent. These areas are accessed by foot and by ATV by recreational visitors to the area, and by geology enthusiasts. Area residents, sportsmen, and visitors to the area may access the adjacent forested areas by foot or by ATV. There has been interest in residential development for some portions of the Site. The land use of the Site within OU2/OU3 is not expected to change in the future.

Community and stakeholder input was sought and incorporated through active outreach during the OU2/OU3 RI/FS. EPA also solicited the views of the Potentially Responsible Parties (PRPs).

Table 2
Current and Future Potential use of Site

	Current On-Site Use	Current Adjacent Use	Reasonable Potential Beneficial Use of Site	Basis for Potential Beneficial Use of Site	Time Frame to Achieve Potential Beneficial Use
Land **Source Areas**	Undeveloped property with timber harvesting recreational uses (walking, horseback riding, ATV riding, historic mine viewing, rock collecting, scenic views)	Undeveloped forest and rural residential	Limited residential and passive recreational use along with historic resource viewing and interpretation. Former shafts and adits could be important habitat for bats. Timber harvesting and possible maple syrup production.	Town Plan and knowledge of Site developed during RI.	Upon cleanup of the waste piles, the Site surface areas outside the containment cells will be safe for unrestricted use. The groundwater contamination will remain and will be addressed as part of OU4.
Surface Water	Limited since Ely Brook is shallow and not suitable for recreational use. Primary value is ecological habitat.	SHB may be used for wading and limited fishing at downstream locations and is ecological habitat.	Ely Brook restoration for ecological habitat value.	Physical constraints at Site.	Upon completion of OU1, OU2, and OU3 cleanup action, Ely Brook should begin to recover its ecological health.
Groundwater – Bedrock	There is no groundwater use within the source areas.	Drilled wells for water supply. These wells have not been impacted by the Site.	Some areas of the Site may be suitable for installation of water supply wells. Most areas will not have clean groundwater until decades after completion of cleanup action, but groundwater within the Underground Workings is never expected to meet drinking water standards.	No current groundwater use on the Ely Copper Mine property. No zoning restrictions preventing water supply wells. Groundwater use will be restricted as part of an OU2 and OU3 remedy.	Completion of source area cleanup and OU2 and OU3 cleanup.

G. SUMMARY OF SITE RISKS

A baseline risk assessment for OU2 and OU3 was performed to estimate the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Site assuming no remedial action was taken. Because the baseline ecological risk assessment (BERA) for OU1 evaluated the entire Site, including the impacts associated with the discharge from the OU2 and OU3 Underground Workings, the key findings of the OU1 BERA are repeated in this ROD along with additional supporting information.

The results of the OU2 and OU3 human health risk assessment (HHRA) provide the basis for taking action and identify the contaminants and exposure pathways that need to be addressed by the remedial action. The human health and ecological risk assessments followed a four step process: (1) hazard identification, which identified those hazardous substances which, given the specifics of the Site, were of significant concern; (2) exposure assessment, which identified actual or potential exposure pathways, characterized the potentially exposed populations and determined the extent of possible exposure; (3) effects assessment, which considered the types and magnitude of adverse effects associated with exposure to hazardous substances; and (4) risk characterization and uncertainty analysis, which integrated the three earlier steps to summarize the potential and actual risks posed by hazardous substances at the Site, including carcinogenic and non-carcinogenic risks and a discussion of the risk at background levels of contamination and the uncertainty in the risk estimates.

The Risk Assessments, both human health and ecological, for the Site were based on the data collected in support of the OU1, OU2, and OU3 RI/FS program. Data collected for the OU2 and OU3 RI were selected for use in the HHRA using the criteria established by EPA in "Guidance for Data Usability in Risk Assessment" (USEPA, 1992). The data presented in the OU2 and OU3 RI and selected for use in the HHRA were a product of laboratory analyses performed in accordance with EPA Region 1 methods and associated Quality Assurance/Quality Control (QA/QC) procedures, as described in the Quality Assurance Project Plan (QAPP). The majority of data for the Site were developed through the RI field programs. The data validation process confirmed that the available data were suitable for use in risk assessment. Sample quantitation limits (SQLs) were generally below risk-based screening values (used for Contaminants of Potential Concern (COPC) selection), indicating that analytical methods were sensitive enough to detect concentrations that could be a potential concern from a health risk perspective. In addition, the principal contaminants at the Site are metals, and most metals were detected in nearly all the samples within each data set. Therefore, overall, detection limits do not have a substantial effect on the data sets.

A summary of those aspects of the human health risk assessment that support the need for remedial action is provided below, followed by a summary of the ecological risk assessment. The entire OU2 and OU3 HHRA is available as part of the Administrative Record.

1. Human Health Risk Assessment

The OU2 and OU3 RI and HHRA focused only on the groundwater within the underground workings. All other pathways had been fully evaluated in the OU1 RI and HHRA. For the OU2 and OU3 areas, the only pathway that was identified as having an unacceptable risk was future exposure to groundwater within the Underground Workings.

Six of the 22 constituents detected in the Underground Workings groundwater at the Site were selected for evaluation in the HHRA as COPCs. The COPCs were selected to represent potential Site-related hazards based on toxicity, concentration, frequency of detection, and mobility and persistence in the environment. The COPCs are in Table 4-1 of the OU2 and OU3 Human Health Risk Assessment. From this, a subset of the chemicals were identified in the OU1 RI/FS as presenting a significant current or future risk and are referred to as the contaminants of concern (COCs) in this ROD and summarized in Table 3 below. These Tables contain the exposure point concentrations used to evaluate the reasonable maximum exposure scenario (RME) in the baseline risk assessment for the chemicals of concern. Estimates of average or central tendency exposure concentrations, maximum concentrations, and the 95% Upper Confidence Limit (UCL) of the arithmetic mean for the COCs and all COPCs can be found in Table 5-3 of the OU2 and OU3 Human Health Risk Assessment and Table 3 below.

Table 3
Summary of Chemicals of Concern and
Medium Specific Exposure Point Concentrations
Future Exposure to Underground Workings Groundwater

Exposure Point	Chemical of Concern	Concentration Detected (ug/l)		Concentration Detected (ug/l)		Frequency of Detection	Exposure Point (EPC) Concentration	EPC units	Statistical Measure
Source Area Surface Soil/Waste		Min	Max	Avg	UCL				
	Cobalt	1.4	22.3	6.7	NC	7/8	22	ug/l	Max
	Iron	84,200	132,000	121,033	NC	8/8	132,000	ug/l	Max
	Manganese	592	2,460	1,004	NC	8/8	2,460	ug/l	max

Key:
Min: Minimum concentration
Max: Maximum concentration
Avg: Arithmetic average concentration
NC: Not Calculable
EPC: Exposure Point Concentration
UCL: 95% Upper Confidence Limit on the arithmetic mean
ug/l: microgram per liter which is also parts per billion

This table presents the chemicals of concern (COCs) and exposure point concentrations for each COC detected in the Underground Workings groundwater. The table includes the range of concentrations detected for each COC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the Site), the exposure point concentration (EPC), and how the EPC was derived. The table indicates that cobalt, iron, and manganese were all frequently detected at the Site. The maximum concentration for each COC was used as the exposure point concentration for cobalt, iron, and manganese due to the limited data set available.

Potential human health effects associated with exposure to the COPCs were estimated quantitatively or qualitatively through the development of several hypothetical exposure pathways. These pathways were developed to reflect the potential for exposure to hazardous substances based on the present uses, potential future uses, and location of the Site. The current and future potential use of the Site is discussed in Section F of this ROD. The exposure pathways evaluated as part of the OU2 and OU3 RI/FS are summarized below. A more thorough description of all exposure pathways evaluated in the risk assessment, including estimates for an average exposure scenario, can be found in Section 5 of the OU2 and OU3 HHRA. Table 5-1 of the OU2 and OU3 HHRA present the exposure factors for the exposure pathways evaluated in the HHRA.

- Future residents - It is possible that the Site could be used for residential purposes in the future. Future residents were assumed to install a drinking water well and ingest groundwater within the Underground Workings. The total exposure duration for the reasonable maximum exposure was 26 years (6 years for young child and 20 years for adult) with an exposure frequency of 350 days/year. The groundwater ingestion rate used was 0.78 liters per day for a child (1-6 years old) and 2.5 liters per day for an adult.

The HHRA was conducted using an exposure point concentration (EPC) for each COPC. Each EPC represents the concentration of a COPC to which a receptor was assumed to be continuously exposed while in contact with an environmental medium. Because only two rounds of groundwater data were available, the maximum detected concentration was used as the EPC.

Excess lifetime cancer risks were determined for each exposure pathway by multiplying a daily intake level by the chemical specific cancer potency factor. Cancer potency factors have been developed by EPA from epidemiological or animal studies to reflect a conservative "upper bound" of the risk posed by potentially carcinogenic compounds. That is, the true risk is unlikely to be greater than the risk predicted. The resulting risk estimates are expressed in scientific notation as a probability (e.g., 1×10^{-6} for 1/1,000,000) and indicate using this example that an average individual is not likely to have greater that a one in a million chance of developing cancer over 70 years as a result of Site-related exposure (as defined) to the compound at the stated concentration. All risks estimated represent an "excess lifetime cancer risk" – or the additional cancer risk on top of that which we all face from other causes such as cigarette smoke or exposure to ultraviolet radiation from the sun. The chance of an individual developing cancer from all other (non-Site related) causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for Site-related exposure is 10^{-4} to 10^{-6}. Current EPA practice considers carcinogenic risks to be additive when assessing exposure to a mixture of hazardous substances. Because none of the final COCs for OU2 and OU3 have cancer potency factors the cancer risk summary tables are not included.

In assessing the potential for adverse effects other than cancer, a hazard quotient (HQ) is calculated by dividing the daily intake level by the reference dose (RfD) or other suitable benchmark. Reference doses have been developed by EPA and they represent a level to which an individual may be exposed that is not expected to result in any deleterious effect. RfDs are derived from epidemiological or animal studies and incorporate uncertainty factors to help ensure that adverse health effects will not occur. An HQ $\leq$ 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic non-carcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g. liver) within or across those media to which the same individual may reasonably be exposed. An HI $\leq$ 1 indicates that toxic non-carcinogenic effects are unlikely. Unlike other non-carcinogens, the non-carcinogenic risks from exposure to lead are evaluated using the Integrated Exposure and Uptake Biokinetic (IEUBK). The IEUBK lead model was used to evaluate the hazard potential posed by lead exposure of young children less than 7 years of age as the most sensitive receptor group. It is EPA policy to protect 95% of the sensitive population against blood lead levels in excess of 10 ug/dl (deciliter) blood. The IEUBK model used was IEUBK win v1.0 build 264. The IEUBK model was run to assess exposure to lead contaminated soil using default assumptions for ingestion and concentration inputs for drinking water, air, and diet. A summary of the non-carcinogenic toxicity data relevant to the chemicals of concern is presented in Table 4.

Table 4

Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal

Chemical of Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Dermal RfD	Dermal RfD Units	Primary Target Organ	Combined Uncertainty/ Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ
Cobalt	Chronic	0.0003	Mg/kg-day	0.0003	Mg/kg-day	Thyroid	3000	PPRTV	8/25/2008
Iron	Chronic	0.7	Mg/kg-day	0.7	Mg/kg-day	Gastro-intestinal	1.5	PPRTV	9/11/2006
Manganese	Chronic	0.024	Mg/kg-day	0.00096	Mg/kg-day	Nervous system	3	IRIS	12/10/2014

Key
IRIS: Integrated Risk Information System, U.S. EPA
PPRTV – Provisional Peer-Reviewed Toxicity Value
RfD: Reference Dose
Mg/kg: milligram per kilogram

Summary of Toxicity Assessment: This table provides non-carcinogenic risk information which is relevant to the contaminants of concern in soil. The COCs have toxicity data indicating their potential for adverse non-carcinogenic health effects in humans. The chronic toxicity data available all three for oral exposures, have been used to develop oral reference doses (RfDs). As was the case for the carcinogenic data, dermal RfDs can be extrapolated from the oral RfDs applying an adjustment factor as appropriate. At this time, inhalation reference concentrations are only available for cobalt.

Only those exposure pathways deemed relevant to the remedy are discussed in detail in this ROD. Readers are referred to Section 5 of the OU2 and OU3 HHRA for a more comprehensive risk summary of all exposure pathways evaluated for all COPCs and for estimates of the central tendency risk. Tables 5 and 6 list the non-carcinogenic risk summary for the COCs in the Underground Workings groundwater to reflect potential future ingestion of contaminated groundwater by a child corresponding to the reasonable maximum exposure (RME) scenario. As shown below in Table 5 and 6, only the future residential child and adult exposure scenarios indicated a potential threat to human health from exposure to the contaminants at the Site. There were not any carcinogenic contaminants of concern for any of the exposure pathways evaluated in the HHRA.

Table 5

Risk Characterization Summary – Non-Carcinogens								
Scenario Timeframe: Future **Receptor Population: Resident** **Receptor Age:** Child (1-6 years old)								
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Primary Target Organ**	**Non-Carcinogenic Hazard Quotient**			
					Ingestion	**Inhalation**	**Dermal**	**Exposure Routes Total**
Groundwater	Groundwater	Underground Workings Groundwater	Cobalt	Thyroid	3.7		0.0065	3.7
			Iron	Gastrointestinal	9.4		0.042	9.4
			Manganese	Nervous System	5.1		0.56	5.7
Groundwater Hazard Index Total =								18.5
Maximum Tissue-Specific Hazard Index (gastrointestinal) =								9.7
Maximum Tissue-Specific Hazard Index (thyroid) =								3.7
Maximum tissue specific Index (nervous system)								5.7
Key Toxicity criteria are not available to quantitatively address inhalation route of exposure.								

Risk Characterization

This table provides hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance (RAGS) for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects. The estimated HI of 18.5 indicates that the potential for non-cancer effects could occur from exposure to contaminated groundwater containing cobalt, iron, or manganese.

Table 6

Risk Characterization Summary – Non-Carcinogens								
Scenario Timeframe: Future **Receptor Population: Resident** **Receptor Age: Adult**								
Medium	**Exposure Medium**	**Exposure Point**	**Chemical of Concern**	**Primary Target Organ**	**Non-Carcinogenic Hazard Quotient**			
					Ingestion	**Inhalation**	**Dermal**	**Exposure Routes Total**
Groundwater	Groundwater	Underground Workings Groundwater	Cobalt	Thyroid	2.2		0.0053	2.2
			Iron	Gastrointestinal	5.7		0.034	5.7
			Manganese	Nervous System	3.1		0.46	3.5
Groundwater Hazard Index Total =								11.4
Maximum Tissue-Specific Hazard Index (gastrointestinal) =								5.7
Maximum Tissue-Specific Hazard Index (thyroid) =								2.2
Maximum tissue specific Index (nervous system)								3.5
Key Toxicity criteria are not available to quantitatively address inhalation route of exposure.								

Risk Characterization

This table provides hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance (RAGS) for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects. The estimated HI of 11.4 indicates that the potential for non-cancer effects could occur from exposure to contaminated groundwater containing cobalt, iron, or manganese.

The HHRA for OU2 and OU3 at the Ely Copper Mine identified the following areas with estimated cancer, non-cancer, and/or lead exposure risks in excess of EPA risk management criteria (excess lifetime cancer risk greater than 10^{-4}, hazard index (HI) greater than 1, and/or 5 percent or more of exposed population with a geometric mean blood lead level of 10 micrograms per deciliter [μg/dl] or greater) at the following areas:

- Ingestion of groundwater within the Underground Workings in the OU2 and OU3 area containing levels of cobalt, iron, and manganese that could represent an unacceptable threat to human health for adults and children who may reside on the Site in the future and consume the groundwater within the Underground Workings 350 days per year.

2. Ecological Risk Assessment

The Operable Unit 1 Baseline Ecological Risk Assessment (OU1 BERA) was prepared as part of the OU1 RI/FS and summarized in the OU1 ROD. The OU1 BERA fully evaluated the potential threats to terrestrial and aquatic ecological receptors using, whenever possible, multiple lines of evidence. The objective of the ecological risk assessment was to identify and estimate the potential ecological impacts associated with the COCs at the Site for OU1, OU2, OU3, and OU4.

The technical guidance for the aquatic BERA and terrestrial BERA came primarily from two sources, namely: *Ecological risk assessment guidance for Superfund: Process for designing and conducting ecological risk assessments*, EPA/540/R-97/006; and *Guidelines for ecological risk assessment*, EPA/630/R-95/002F.

The OU2 Underground Workings discharge to Ponds 4 and 5, Ely Brook tributaries 2, 3, and 4 and Ely Brook. The OU1 aquatic BERA documented severe ecological impacts to these surface water bodies as a result of the combined discharge from the OU1 source areas and the OU2 Underground Workings. As a result, the OU1 BERA was relied upon as the BERA for OU2 and OU3 ROD. The OU1 aquatic BERA was finalized in 2010. To confirm that the OU2 surface water discharges continues to be an ecological threat, a streamlined risk evaluation was performed by comparing the contaminant concentrations detected in the surface water discharging the OU2 and OU3 Underground Working with the cleanup levels for the OU1 cleanup, which are also Federal and State water quality standards and are considered effects concentrations "Effects" concentrations (i.e., concentrations above which adverse ecological effects would be expected).

OU3 is the deeper portion of the Main Shaft Mine Pool beneath the Green Crow property. There are no known ecological exposures within the OU3 area. OU4 will address the ecological risk associated with the sediments of Schoolhouse Brook and the East Branch of the Ompompanoosuc River along with any surface water ecological risk that may remain after the implementation of OU1, OU2, and OU3.

a. Identification of Contaminants of Concern

Aquatic habitats

The OU1 Aquatic BERA identified Chemicals of Potential Ecological Concern (COPECs) in sediment, surface water, and pore water. A metal became a COPEC if its maximum concentrations (or the maximum detection limit for non-detects) exceeded its screening benchmark, or if a benchmark was not available.

Table 7 presents the screening analysis for surface water COPECs for the Pond 4, Pond 5, and the main stem of Ely Brook as presented in the OU1 ROD. Table 8 presents a similar evaluation for the Main Adit and Deep Adit based on data collected since the 2011OU1 ROD and using updated screening criteria. Sediment COPECs were not included because the OU2 and OU3 discharge is ephemeral. As a result a sediment exposure assessment was not performed. Only key COPECs were included in those tables for the sake of brevity. The benchmark sources are provided as footnotes. The OU1 Aquatic BERA report summarized all the COPECs in Tables 4.13 to 4.16 (pond surface water) and 4.17 (Ely Brook surface water). A summary of the surface water data relating to OU2 can be found in Table 6-8 of the OU2 and OU3 Remedial Investigation Report.

Table 7
OU1 Surface Water
Contaminants of Potential Ecological Concern
Pond 4, Pond 5, and Ely Brook

COPEC	Frequency of Detection	Minimum Detected Concentration (ug/l)	Maximum Detected Concentration (ug/l)	Concentration Used for Screening (ug/l)	Screening Benchmark	Screening Hazard Quotient	Reference for Screening Benchmark
Pond 4 – surface water (dissolved metals)							
Copper	8/10	3.7	64.0	64	9	7.1	3
Zinc	8/10	6.8	186	186	120	1.5	3
Pond 5 - surface water (dissolved metals)							
Copper	4/4	240	670	670	9	74.4	3
Zinc	4/4	224	376	376	120	3.1	3
Ely Brook – surface water (dissolved metals)							
Copper	35/35	12.6	6,628	6,628	9	736	3
Iron	32/35	42	74,600	74,600	1,000	75	3
Zinc	34/34	16.9	1,213	1,213	120	10	3

References:
1. USEPA, 2003. Region V Ecological Screening Levels. www.epa.gov/RCRIS-region-5\ca\ESL.PDF
2. Buchman,M.F., NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Coastal Protection Division, National Oceanic and Atmospheric Administration. 12 pp.
3. US EPA, 2006. National Recommended Water Quality Criteria: 2006
4. Suter, G.W. and C.L.Tsao. 1986. Toxicological Benchmarks for screening potential contaminants of concern for effects on aquatic biota: 1996 revision. ES/ER/TM-96/R2. Oak Ridge National Laboratory.

Table 8
OU2 and OU3 Surface Water
Contaminants of Potential Ecological Concern
Main Adit and Deep Adit

COPEC	Frequency of Detection	Minimum Detected Concentration (ug/l)	Maximum Detected Concentration (ug/l)	Concentration Used for Screening (ug/l)	Screening Benchmark	Screening Hazard Quotient	Reference for Screening Benchmark
Main Adit– surface water (dissolved metals)							
Aluminum	3/3	752	5,000	5,000	87	57	1
Cadmium	2/3	1.1	2.7	2.7	1.1	2.5	2,3
Copper	3/3	1,440	2,130	2,130	8.6	247	2,3
Iron	3/3	135	427	427	1,000	0.4	1
Zinc	3/3	287	340	340	106	3.2	2,3
Deep Adit - surface water (dissolved metals)							
Aluminum	3/3	14,400	24,200	24,200	87	278	1
Cadmium	3/3	8.8	13.5	13.5	1.1	12.3	2,3
Copper	3/3	7,660	10,500	10,500	8.6	1,221	2,3
Iron	3/3	380	541	541	1,000	0.5	1
Zinc	3/3	1,240	2,120	2,120	106	20	2,3

References:
1. US EPA, 2006. National Recommended Water Quality Criteria: 2009
2. Vermont Water Quality Criteria, Vermont Water Quality Standards: Appendix C, December 2011
3. Site specific cleanup-level Ely Copper Mine OU1 Record of Decision. The cleanup levels are based on a hardness of 100 mg/l. If the hardness of the receiving water is greater than 100 mg/l, the cleanup level will be adjusted accordingly, as allowed by the regulation. Vermont Water Quality Standards, Appendix C (Nat. Res. Brd, Water Res. P. 12-004-052)

b. Exposure Assessment

<u>Ecological setting</u>

The Deep Adit and Main Adit are the primary sources of surface water discharge in the OU2 area. The Deep Adit discharge flows along a forested drainage channel and discharges directly to Pond 5 and may feed Pond 4 as a result of the surface water entering the shallow groundwater. The Main Adit discharge enters the Upper Waste Area which is the source of Ely Brook tributary 3 and Ely Brook tributary 4.

The ponds are located in a small, poorly-drained, swampy valley. Pond 1, the most upstream of the five, is the largest (about 0.94 acres) and is the source for Ely Brook tributary 2. The four other ponds are downstream of each other and are all hydraulically connected.

- Pond 1 (max depth: 5 feet) supplied water to the mining facilities. It is spring-fed and not impacted by past mining activities.
- Ponds 2 and 3 are more ephemeral and less well defined.
- Pond 4 (max depth: 4 feet) has an active beaver dam; it is impacted by AMD.

- Pond 5 is shallow (< 3 feet) and impacted by AMD from a waste rock pile located next to the pond.

Ely Brook is a small high-gradient stream (max width: 5-7 feet) which is the major drainage feature at the Site. The main stem is the lower half of the 0.9 mile-long brook. Several small, highly-impacted tributaries, including the east branch, flow into it from the Site. The surface water in the main stem has pH < 4.0 and Cu levels 100-1000 times above the chronic benchmark. The main stem appears visually to be devoid of living organisms. The substrate is entirely mine-derived waste and has an orange-red color from metal precipitation.

Complete exposure pathways

Aquatic habitats

Aquatic invertebrates, fish, and/or amphibians exposed to metals in sediment, pore water, and surface water were the receptors of concern in the ponds and Ely Brook for the OU1 Aquatic BERA. The OU1 Aquatic BERA Exposure Point Concentrations (EPCs) were calculated in terms of Reasonable Maximum Exposures (RMEs) and Central Tendency Exposures (CTEs). RMEs were either the maximum detected value or the 95% Upper Confidence Limit (UCL) of the mean, depending on the structure of the data set. Arithmetic means were used as CTEs.

Table 9 summarizes the OU1 Aquatic BERA aquatic EPCs for surface water and Table 10 provides the aquatic EPCs for the OU2 discharge locations (Main Adit and Deep Adit) using data collected after the 2011 OU1 ROD. The 2010 Aquatic BERA report summarized all the EPCs in Tables 5.18 to 5.22 (pond surface water, plus reference) and Tables 5.23 and 5.34 (Ely Brook surface water, plus reference).

Table 9
Aquatic Exposure Point Concentrations from OU1 Aquatic BERA
Pond 4, Pond 5, and Ely Brook

COPEC	Frequency of Detection	Arithmetic Mean Concentration (ug/l)	Maximum Detected Concentration (ug/l)	95% UCL of Mean (ug/l)	Reasonable Maximum Exposure Point Concentration (ug/l)	Central Tendency Exposure Point Concentration (ug/l)
Pond 4 – surface water (dissolved metals)						
Copper	8/10	29.6	64.0	Not calculated	64.0	29.6
Zinc	8/10	89.9	186	Not calculated	186	89.9
Pond 5 – surface water (dissolved metals)						
Copper	4/4	446	670	Not calculated	670	446
Zinc	4/4	318	376	Not calculated	376	318
Ely Brook – surface water (dissolved metals)						
Copper	35/35	2532	6,628	5,530	5,530	2,532
Iron	32/35	9762	74,600	39,994	39,994	9,762
Zinc	34/34	496	1,213	588	588	496

Table 10
Aquatic Exposure Point Concentrations
OU2 and OU3 Data
Main Adit and Deep Adit

COPEC	Frequency of Detection	Arithmetic Mean Concentration (ug/l)	Maximum Detected Concentration (ug/l)	95% UCL of Mean (ug/l)	Reasonable Maximum Exposure Point Concentration (ug/l)	Central Tendency Exposure Point Concentration (ug/l)
Main Adit						
Aluminum	3/3	3,432	5000	Not calculated	5,000	3,432
Cadmium	2/3	1.6	2.7	Not calculated	2.7	1.6
Copper	3/3	1,723	2130	Not calculated	2,130	1,723
Iron	3/3	300	427	Not calculated	427	300
Zinc	3/3	317	340	Not calculated	340	317
Deep Adit						
Aluminum	3/3	18,533	24,200	Not calculated	24,200	18,533
Cadmium	3/3	11	13.5	Not calculated	13.5	11
Copper	3/3	8,987	10,500	Not calculated	10,500	8,987
Iron	3/3	454	541	Not calculated	541	454
Zinc	3/3	1,587	2,120	Not calculated	2,120	1,587

c. Ecological Effects Assessment

One surface water sample was collected each from Pond 4, Pond 5, and the main stem of Ely Brook, plus one reference sample, to perform toxicity testing of the surface water. All samples were tested for seven days undiluted using larval fathead minnows (*Pimephales promelas*). The test water was renewed daily. The results showed significant mortality and reduced growth in the samples from Pond 4 (20% survival), Pond 5 (0% survival) and the main stem of Ely Brook (0% survival) as compared to the reference location in Ely Brook upstream of the mine impacts (92.5% survival). The fathead minnow larvae exposed to the surface water from the ponds (both of which are fishless) were used as laboratory surrogates for amphibian tadpoles.

To further assessment potential impacts to amphibians, fertilized eggs of the wood frog (*Rana sylvatica*) were exposed in floating cages *in-situ* for eight days in Ponds 1 (on-Site reference), 4, and 5. The eggs came from an off-Site pond. Hatching success in the on-Site ponds did not differ from that in the off-Site pond – all above 80%. However, all but one tadpole died in Pond 5 shortly after hatching, whereas tadpole survival within 48 hours of hatching (= end of the field exposure) in the other two on-Site ponds was unaffected. The assumption is that the gelatinous eggs protected the embryos from the toxic surface water in Pond 5 prior to hatching, but the tadpoles died quickly when exposed to ambient conditions.

A second assessment of amphibians evaluated the survival, growth, and development of a fresh batch of wood frog tadpoles exposed in floating cages *in-situ* was tracked in Ponds 1, 4, and 5 for up to four weeks. The test was compromised by persistent reference mortality which may have resulted from poor surface water quality due to excessive feeding and inadequate water circulation in the cages. The early trends in the data, however, confirmed that Pond 5 was highly toxic, with 0% tadpole survival after eight days. Survival in Pond 4 dropped to 37.5% after eight days versus 87.5% in Pond 1. This evaluation reveals that in addition to Pond 5 (0% survival), Pond 4 (37.5% survival) also showed severe toxicity to tadpoles. The results from the first eight days were used qualitatively in the risk characterization because the off-site reference only had 87.5% survival and Pond 1 only had 86% survival after eight days.

Ely Brook was periodically assessed by the State of Vermont, the USGS, and others for macroinvertebrate community health starting in 1987. The counts were used to calculate metrics which were compared to values from VT reference streams. The data showed severe stress to the benthic community in Ely Brook. In addition, a qualitative multi-habitat sample (QMH) assessment was performed for the ponds by the USGS in 2006 to characterize the epifaunal invertebrate assemblages that were most closely associated with the vegetation along the littoral areas of the ponds, which typically supports assemblages with the greatest abundance and diversity in lentic systems. QMH samples were collected in the littoral areas along the edges of the ponds that were dominated by vegetation, wood snags, or both, to characterize the invertebrate assemblage structure within the pond. The QMH samples were collected with an invertebrate kick-net sampler with a 500-micrometer mesh designed to cover 0.1 square meter of substrate. At each location, a composite QMH sample was collected by making four sweeps of equal effort in each of four locations. Although these samples were designated as “qualitative”, using equal effort in collecting the samples resulted in an approximate relative-abundance measure that could be compared among locations (VTDEC, 2006). QMH invertebrate data for Pond 1 reflected a good ecological structure and function. Invertebrate richness at Pond 1 was

59 taxa. Invertebrate abundance was high in Pond 1 (1,950 individuals). An evaluation QMH invertebrate data sampled within the ponds indicated that impairment sequentially increased from Pond 1 to 5, but that impairment was most severe beginning at Pond 4, and continued down-gradient from that location to Pond 5. Invertebrate richness at Pond 1 was 56 taxa, which decreased to 47 at Pond 3 (20 percent loss), but further decreased to 26 at Pond 4 (56 percent loss) and 14 taxa at Pond 5 (75% loss). Although QMH-based invertebrate abundance is typically not considered a definitive metric of condition, it can often be used to indicate a relative degree of ecosystem function when sampling effort is standardized. Invertebrate abundance was highest at Pond 1 (1,950 individuals), but was severely reduced at Pond 4 (194 individuals – 90% reduction) and Pond 5 (47 individuals – 98% reduction). Decreases in the values of abundance and richness were closely associated with the increase in surface water metal concentrations, as characterized by the hazard indices derived for the sites.

Exhibit 6.2 of the 2010 aquatic BERA report summarized all the toxicity benchmarks for surface water that were used in the aquatic BERA and are listed below in Table 11. Table 12 lists the screening criteria used in the OU2 and OU3 RI/FS to confirm that OU2 and OU3 surface discharge is an ecological threat. The concentrations in Table 12 reflect the calculated Vermont Water Quality Standards based on a hardness of 100 and are the cleanup levels identified in the OU1 ROD.

Table 11

	Toxicity Values: Surface Water Benchmarks from OU1 Aquatic BERA			
COPEC	Acute	Source	Chronic	Source
Copper	13	3	9	3
Iron	Na		1,000	3
Zinc	120	3	120	3

References:
1. Buchman,M.F., NOAA Screening Quick Reference Tables, NOAA HAZMAT Report 99-1, Coastal Protection Division, National Oceanic and Atmospheric Administration. 12 pp.
2. US EPA National Recommended Water Quality Criteria: 2009

Table 12

Toxicity Values: Surface Water Benchmarks used for OU2 Screening Evaluation for Deep Adit and Main Adit		
COPEC	Chronic	Source
Aluminum	87	1
Cadmium	1.1	2,3
Copper	8.6	2,3
Iron	1,000	1
Zinc	106	2,3

References:
1. US EPA, National Recommended Water Quality Criteria: 2009
2. Vermont Water Quality Criteria, Vermont Water Quality Standards: Appendix C, December 2011
3. Site specific cleanup-level Ely Copper Mine OU1 Record of Decision. The cleanup levels are based on a hardness of 100 mg/l. If the hardness of the receiving water is greater than 100 mg/l, the cleanup level will be

adjusted accordingly, as allowed by the regulation. Vermont Water Quality Standards, Appendix C (Nat. Res. Brd, Water Res. P. 12-004-052)

d. Ecological Risk Characterization

Introduction

The OU1 Aquatic BERA used Hazard Quotients (HQs) to estimate risk at for aquatic receptors from direct exposure to surface water. An HQ shows how much a COPEC exceeds its benchmark or Toxicity Reference Value (TRV). Risk is possible if an HQ is above 1.0. HQs were calculated as follows: HQ = estimated exposure level /benchmark or TRV

The aquatic toxicity tests did not lend themselves to an HQ analysis. Instead, the responses were compared statistically to their reference samples to determine significance. Other measures of ecological risk included fish, benthic, and littoral community assessments.

The aquatic receptors relevant to the OU2 and OU3 surface water discharge are amphibians in Pond 4 and Pond 5, invertebrates in Pond 4 and Pond 5, and fish and invertebrates within Ely Brook and Ely Brook tributary 2, 3, and 4. The relevant information from the OU1 Aquatic BERA along with information collected since the OU1 ROD is presented in this section.

Aquatic habitats

Pond 4 and Pond 5

The receptor groups associated with Pond 4 and Pond 5 that were evaluated in the OU1 Aquatic BERA included water column invertebrates (littoral) and amphibians. Risk to the water column invertebrate receptor group was assessed using a qualitative multi-habitat invertebrate community survey and the development of hazard quotients using surface water toxicity benchmarks as compared to surface water concentrations. The surface water toxicity test for fish for Pond 4 and Pond 5 also provided insight into the potential ecological threats from the contaminants in Pond 4 and Pond 5. The amphibian receptor group was assessed using the same surface water hazard quotients and the surface water toxicity tests that were used for the water column invertebrates. In addition, site-specific *in-situ* toxicity tests were performed to assess survival and development of wood frog eggs and tadpoles.

Both the surface water toxicity tests and the hazard quotients derived from surface water concentrations documented that ecological impacts are likely to both the water column invertebrates and amphibians in Pond 4 and Pond 5, with Pond 5 identified as the most impaired. The surface water toxicity testing targeted fish (fathead minnows) but provides insight in the potential impact on biota. The toxicity test revealed 0% survival in Pond 5 within 3 days of exposure and only 20% survival in Pond 4 at the end of the test (seven days). The hazard quotient analysis also documents that the concentration of copper and zinc are above concentrations that could induce acute and chronic toxicity on the aquatic organisms within Pond 4 and Pond 5.

In addition, the qualitative multi-habitat littoral invertebrate assessment shows a distinct decline in taxa with 59 taxa identified at Pond 1 (considered the reference) declining to 26 taxa at Pond 4 and 14 taxa at Pond 5. Invertebrate abundance was highest at Pond 1 (1,950 individuals), but was severely reduced at Pond 4 (194 individuals – 90% reduction) and Pond 5 (47 individuals – 98% reduction).

For amphibians, the two *in-situ* assessments offered significant insight into the potential toxicity to amphibians residing in Pond 4 and Pond 5. The initial test indicated that while the woods frog egg masses were able to survive to hatching in both Pond 4 and Pond 5, the newly hatched tadpoles all died upon exposure to the water and sediment with Pond 5. An *in-situ* toxicity test using tadpoles also showed complete mortality to the tadpoles placed in Pond 5 and substantial mortality to the tadpoles in Pond 4. This test was viewed as qualitative due to mortality of about 20% in the reference locations.

For OU2 and OU, the Deep Adit discharges to Pond 5 and possibly Pond 4. The OU1 Aquatic BERA documented that invertebrate and amphibian community in Pond 5 is severely impaired due to the discharge of copper and zinc and Pond 4 is also significantly impaired. The hazard quotients for copper and zinc in the surface water of the Deep Adit discharge to Pond 4 and Pond 5 supports that this discharge is contributing to the ecological impacts identified in the OU1 Aquatic BERA. These hazard quotients are shown in Table 13.

Table 13
Aquatic Risk Characterization Hazard Quotients

	Acute Benchmarks		Chronic Benchmarks	
	RME	CTE	RME	CTE
Pond 4 – surface water				
Copper	4.9	2.3	7.1	3.3
Zinc	1.5	0.7	1.5	0.7
Pond 5 – surface water				
Copper	52	34	74	50
Zinc	3.1	2.6	3.1	2.6
Deep Adit – surface water				
Aluminum			57	39
Cadmium			2.4	1.4
Copper			248	200
Iron			0.4	0.3
Zinc			3.2	3
Main Adit – surface water				
Aluminum			278	213
Cadmium			12	10
Copper			1,221	1,045
Iron			0.54	0.45
Zinc			20	15

Ely Brook

The receptor groups associated with Ely Brook that were evaluated in the OU1 Aquatic BERA included fish and benthic invertebrates. Risk to the benthic invertebrate receptor group was assessed using a benthic community survey and the development of hazard quotients using surface water toxicity benchmarks as compared to surface water concentrations. Other measurement endpoints included sediment toxicity tests, pore water hazard quotients, and sediment chemistry. The OU1 Aquatic BERA contains the evaluation of these other measurements endpoints. Only the measurement endpoints that relate to the OU2 and OU3 discharge are discussed in this ROD.

Both the surface water toxicity tests and the hazard quotients derived from surface water concentrations documented that ecological impacts are likely to both the benthic community and fish in Ely Brook. The surface water toxicity testing targeted fish (fathead minnows, *Pimephales promelas*) but provides insight in the potential impact on biota. The toxicity test revealed 0% survival in Ely Brook within three days of exposure. The hazard quotient analysis also documents that the concentration of copper and zinc are above concentrations that could induce acute and chronic toxicity on the aquatic organisms within Ely Brook. No fish have been found in Ely Brook further documenting the ecological impact to this receptor group.

In addition, a benthic invertebrate assessment shows a distinct decline in taxa with 43 taxa identified at the upstream reference location in Ely Brook declining to 3 taxa in the middle reach of Ely Brook and 3 taxa near the confluence of Ely Brook with Schoolhouse Brook. Invertebrate abundance was highest at upstream reference location in Ely Brook (1,756 individuals), but was severely reduced by the middle reach of Ely Brook (8 individuals – >99% reduction) and near the confluence with Schoolhouse Brook (38 individuals – 98% reduction).

For OU2 and OU3, the Main Adit discharges to the Upper Water Area and contributes to the contaminant impacts in Ely Brook Tributary 3 and Ely Brook Tributary 4. The OU1 Aquatic BERA documented that invertebrate and fish community in Ely Brook is severely impaired due to the discharge of copper and zinc. The hazard quotients for copper and zinc in the surface water of the Main Adit supports that this discharge could be contributing to the ecological impacts identified in the OU1 Aquatic BERA.

3. Overall Risk Assessment Conclusion—Basis for Response Action

The baseline HHRA for OU2 and OU3 documented that an unacceptable human health risk would exist for children or adults as a result of future ingestion of water found within the Underground Workings.

The OU1 aquatic BERA documented that an unacceptable ecological risk to aquatic receptors (invertebrates, fish, amphibians) in Ely Brook, its tributaries, Pond 4 and Pond 5 as a result of the release of contamination from the OU1 source areas. The hazard quotients developed for the discharge from the Deep Adit and Main Adit strongly suggest that the discharge from the OU2 Underground Workings is also contributing to the overall ecological impacts in Pond 4, Pond 5, Ely Brook and its tributaries.

As such, actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

H. REMEDIATION OBJECTIVES

Based on preliminary information relating to the types of contaminants, environmental media of concern and potential exposure pathways, Remedial Action Objectives (RAOs) were developed to aid in the development and screening of alternatives. These RAOs were developed to mitigate, restore and/or prevent existing and future potential threats to human health and the environment.

EPA develops RAOs for each cleanup action. The RAOs developed for this ROD are summarized below:

Groundwater RAOs:

- Prevent potential exposure from ingestion/dermal contact by a future resident to concentrations of contaminants in excess of ARARs and/or risk-based standards in groundwater within the Underground Workings or that is associated with the Underground Workings.
- Prevent migration of Site contaminants in groundwater from beyond the edge of the Underground Working and compliance boundary of the Technical Impracticability (TI) Zone.

Surface Water RAOs:

- Prevent the discharge from the Underground Workings from causing Pond 4, Pond 5, Ely Brook, and its perennial tributaries to fail to comply with Vermont's numerical and biological criteria for a Class B surface water and Class B numerical criteria in Pond 5.

RAOs to restore Underground Workings groundwater were not identified because EPA has determined that it is technically impracticable to achieve groundwater cleanup standards for the groundwater within the Underground Workings.

I. DEVELOPMENT AND SCREENING OF ALTERNATIVES

1. Statutory Requirements/Response Objectives

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. §9621, establishes several other statutory requirements and preferences, including: a requirement that EPA's remedial action, when complete, must comply with all standards, requirements, criteria or limitations required under a Federal environmental law and more stringent State environmental and facility siting law, unless a waiver is invoked; a requirement that EPA select a remedial action that is cost-effective and that utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and a preference for remedies in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances is a principal element over remedies not involving such treatment. Response alternatives were developed to be consistent with these statutory mandates.

2. Technology and Alternative Development and Screening

CERCLA and the NCP set forth the process by which remedial actions are evaluated and selected. In accordance with these requirements, a range of alternatives were developed for the Site. The OU2 and OU3 FS developed a limited number of remedial alternatives that attain Site cleanup levels within different time frames using different technologies, as well as a no action alternative.

As discussed in Section 2 of the OU2 and OU3 FS Report, technology options were identified, assessed and screened based on implementability, effectiveness and cost. Section 3 of the OU2 and OU3 FS Report presented the remedial alternatives, developed by combining the technologies identified in the previous screening process, that fit the alternative categories identified in Section 300.430(e)(3) of the NCP. The purpose of the initial screening was to narrow the number of potential remedial actions for further detailed analysis while preserving a range of options. Each alternative was then evaluated in detail in Section 4 of the OU2 and OU3 FS Report.

J. DESCRIPTION OF ALTERNATIVES

EPA considers a full range of alternatives to clean up a Superfund site before selecting a remedy. Many options are screened out early in the process because site-specific conditions render them ineffective and/or technically or administratively infeasible. Others are eliminated because they are cost-prohibitive to implement. Under CERCLA and the NCP, EPA must consider a no action alternative to compare with alternatives where remedial action will be taken, even though a no action alternative does not meet the screening criteria. The cleanup alternatives that survived the initial screening were subject to a detailed evaluation and comparative analysis in the OU2 and OU3 FS.

This Section provides a brief, narrative summary of each alternative that was evaluated for OU2 and OU3 at the Site. A more complete, detailed presentation of each alternative can be found in Sections 3 and 4 of the OU2 and OU3 FS Report.

The source control alternatives analyzed for OU1 of the Site include:

- Alternative UW-1: No Action
- Alternative UW-2: Deep Adit Filling and Groundwater Use Restrictions (SELECTED REMEDY)
- Alternative UW-3: Deep Adit Discharge Active Treatment and Groundwater Use Restrictions
- Alternative UW-4: Deep Adit Discharge Passive Treatment and Groundwater Use Restrictions

These cleanup alternatives are summarized below. The costs for each alternative include the estimated capital costs, the estimated annual operation and maintenance (O & M) cost, and the present value of the combined capital and maintenance costs based on a 30-year time period and 7% discount rate.

UW-1 (No Action):

This alternative would involve no action to prevent consumption of contaminated groundwater within the Underground Workings. This alternative would also involve no action to prevent the discharge of contaminated surface water from the Deep Adit and Main Adit. There are no capital or annual monitoring or maintenance costs associated with this alternative. There would be a cost to perform five year reviews of the alternative.

Capital Costs: Not applicable
Operation and Maintenance Cost: Not applicable
30 year present value: $86,863 (Includes Five-Year Reviews)
Time to Complete Construction: Not applicable.
Time to Achieve Remedial Action Objectives: Will not achieve Remedial Action Objectives.

UW-2 (Deep Adit Filling and Groundwater Use Restrictions) (the Selected Remedy):

This alternative includes the permanent closure of the Deep Adit by filling in-place with grout and/or flowable fill to reduce the surface area available for AMD generation and greatly reduce or eliminate the release of AMD prior to discharge to a surface water channel that drains to Pond 5. The fill material may include neutralizing agents to further inhibit AMD creation and discharge from the Deep Adit. The other mine features, in particular the Burleigh Shaft, Shaft 4, and the Pollard Adit will be filled unless they are determined to be hibernacula for the state- or federally-listed threatened or endangered bats. If bats are determined to be using any of the mine features as hibernacula, mitigation measures will be developed that will either preserve the feature(s) while addressing the contaminated mine discharges using other means[2] or adopt mitigation measures for the bats to address the loss of the feature(s) as hibernacula. Prior to any excavation or fill activities associated with the adits, a pre-design investigation (PDI) will be performed to better understand the conditions within the adits, including the extent to which the adit is full of water. The investigations will also assess whether the water in the adits could discharge in an uncontrolled manner when the entrance to the adits is exposed. The design will consider engineering measures to prevent an uncontrolled release from the adit, including the removal of water prior to filling or excavation.

This alternative also includes the use of low impact passive treatment to address the intermittent discharge from the Main Adit. A limestone drain or passive treatment system would be installed to increase the pH and precipitate and/or filter the metals within the discharge from the Main Adit. This alternative includes the TI Waiver of the chemical-specific ARAR (Vermont Groundwater Quality Standards), which otherwise would apply to the groundwater in the Underground Workings. This alternative also includes a finding that it would be technically impracticable to clean up the groundwater in the Underground Workings to achieve federal risk-based standards. Because the groundwater within the Underground Workings cannot be restored to drinking water standards, this alternative includes the development of a groundwater use restriction area and the implementation of land use restrictions to prevent future consumption of the contaminated groundwater. The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The restrictions would include both the area over the Underground Workings and additional area sufficient to prevent the installation of wells that would have the potential to draw contaminated groundwater from the Underground Workings. The alternative would be designed to avoid any adverse impacts to the federally threatened Northern Long-Eared Bat, as well as State threatened and endangered bat species. The estimated cost of the alternative is $3.4 million. Figure 10 shows the schematic for the filling of the Deep Adit, Figure 11 shows the Passive Treatment System for the Main Adit, Figure 12 shows the extent of the TI Zone for the Underground Workings and preliminary extent of the area that would be subject to land use restrictions, and Figure 13 shows a cross-section of the TI Zone for the Underground Workings. A detailed analysis of Alternative UW-2 is included in Section 4.2 of the OU2 and OU3 FS Report.

Capital Costs: $2.6 million
Operation and Maintenance Cost: $40,000 year.
30 year present value: $3.4 million (Includes Five-Year Reviews)
Time to Complete Construction: 2-3 years
Time to Achieve Remedial Action Objectives: 2-3 years

[2] If the federally threatened Northern Long-Eared Bat is found to be using any of the features as hibernacula EPA, in consultation with the United States Fish and Wildlife Service, has already determined that the feature(s) would not be filled.

UW-3 (Deep Adit Discharge Active Treatment and Groundwater Use Restrictions):

This alternative includes the same low impact passive treatment to address the intermittent discharge from the Main Adit as UW-2. A limestone drain or passive treatment system would be installed to increase the pH and precipitate and/or filter the metals within the discharge from the Main Adit. This alternative includes the collection and active treatment of the water discharged from the Deep Adit to eliminate the release of acid mine drainage from this feature. The treatment system would remove metals from the water by increasing pH and precipitating metals prior to discharge to a surface water channel that drains to Pond 5. For the purpose of alternative evaluation, a rotating contactor treatment system (RCTS) or similar system would be used for active treatment. As with UW-2, the Burleigh Shaft, Shaft4, and the Pollard Adit may be filled or made safe. In addition, some of the Deep Adit may be filled to limit the volume of water that would require treatment. As with UW-2, this alternative includes the TI Waiver of the chemical-specific ARAR (Vermont Groundwater Quality Standards), which otherwise would apply to the groundwater in the Underground Workings. This alternative also includes a finding that it would be technically impracticable to clean up the groundwater in the Underground Workings to achieve federal risk-based standards. Because the groundwater within the Underground Workings cannot be restored to drinking water standards, the alternative includes the development of a groundwater use restriction area and the implementation of land use restrictions to prevent future consumption of the contaminated groundwater. The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The restrictions would include both the area over the Underground Workings and additional area sufficient to prevent the installation of wells that would have the potential to draw contaminated groundwater from the Underground Workings. The alternative would be designed to avoid any adverse impacts to the federally threatened Northern Long-Eared Bat and State threatened and endangered bat species. The estimated cost of the alternative is $5.2 million. Figure 14 shows the schematic for the active treatment of the Deep Adit, Figure 11 shows the Passive Treatment System for the Main Adit, Figure 12 shows the extent of the TI Zone for the Underground Workings and preliminary extent of the area that would be subject to land use restrictions, and Figure 13 shows a cross-section of the TI Zone for the Underground Workings. A detailed analysis of Alternative UW-3 is included in Section 4.3 of the OU2 and OU3 FS Report.

Capital Costs: $3.4 million
Operation and Maintenance Cost: $119,000 per year.
30 year present value: $5.2 million (Includes Five-Year Reviews)
Time to Complete Construction: 2-3 years
Time to Achieve Remedial Action Objectives: 2-3 years

UW-4 (Deep Adit Discharge Passive Treatment and Groundwater Use Restrictions):

This alternative includes the same low impact passive treatment to address the intermittent discharge from the Main Adit as UW-2. A limestone drain or passive treatment system would be installed to increase the pH and precipitate and/or filter the metals within the discharge from the Main Adit. It includes the collection and passive treatment of the water discharged from the Deep Adit to eliminate the release of acid mine drainage from this feature. The treatment system would use a sulfide reducing bacteria approach to remove metals from the water prior to discharge to a surface water channel that drains to Pond 5. As with UW-2, the Burleigh Shaft, Shaft #4, and the Pollard Adit may be filled or made safe and a low impact passive treatment would address the intermittent discharge from the Main Adit. As with UW-2 and UW-3, this alternative includes a TI Waiver of the chemical-specific ARAR (Vermont Groundwater Quality Standards), which otherwise would apply to the groundwater in the Underground Workings. This alternative also includes a finding that it would be technically impracticable to clean up the groundwater in the Underground Workings to achieve federal risk based standards. Because the groundwater within the Underground Workings cannot be restored to drinking water standards, the alternative includes the development of a groundwater use restriction zone and the implementation of land use restrictions to prevent future consumption of the contaminated groundwater. The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The restrictions would include both the area over the Underground Workings and additional area sufficient to prevent the installation of wells that would have the potential to draw contaminated groundwater from the Underground Workings. The alternative would be designed to avoid any adverse impacts to the federally threatened Northern Long-Eared Bat and State threatened and endangered bat species. The estimated cost of the alternative is $3.6 million. Figure 15 shows the schematic for the passive treatment of the Deep Adit, Figure 11 shows the Passive Treatment System for the Main Adit, Figure 12 shows the extent of the TI Zone for the Underground Workings and preliminary extent of the area that would be subject to land use restrictions, and Figure 13 shows a cross-section of the TI Zone for the Underground Workings. A detailed analysis of Alternative UW-4 is included in Section 4.4 of the OU2 and OU3 FS Report.

Capital Costs: $2.7 million
Operation and Maintenance Cost: $55,000 per year
30 year present value: $3.62 million (Includes Five-Year Reviews)
Time to Complete Construction: 2-3 years
Time to Achieve Remedial Action Objectives: 2-3 years

K. SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Section 121(b)(1) of CERCLA presents several factors that, at a minimum, EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives.

A detailed analysis was performed on the alternatives using the nine evaluation criteria in order to select a Site remedy. The following is a summary of the comparison of each alternative's strengths and weaknesses with respect to the nine evaluation criteria. These criteria are summarized as follows:

Threshold Criteria

The two threshold criteria described below must be met in order for the alternatives to be eligible for selection in accordance with the NCP:

1. Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether or not a remedy will meet all standards, requirements, criteria or limitations required under a Federal environmental law and more stringent State environmental and facility siting law, unless a waiver is invoked.

Primary Balancing Criteria

The following five criteria are utilized to compare and evaluate the elements of one alternative to another that meet the threshold criteria:

3. Long-term effectiveness and permanence addresses the criteria that are utilized to assess alternatives for the long-term effectiveness and permanence they afford, along with the degree of certainty that they will prove successful.

4. Reduction of toxicity, mobility, or volume through treatment addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the Site.

5. Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until cleanup goals are achieved.

6. Implementability addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

7. Cost includes estimated capital and Operation and Maintenance costs, as well as present-worth costs.

<u>Modifying Criteria</u>

The modifying criteria are used as the final evaluation of remedial alternatives, generally after EPA has received public comment on the RI/FS and Proposed Plan:

8. State acceptance addresses the State's position and key concerns related to the preferred alternative and other alternatives, and the State's comments on ARARs or the proposed use of waivers.

9. Community acceptance addresses determining which components of the alternatives interested persons in the community support, have reservations about, or oppose based on the public's response to the alternatives described in the RI/FS and Proposed Plan.

Following the detailed analysis of each individual alternative, a comparative analysis, focusing on the relative performance of each alternative against the nine criteria, was conducted. This comparative analysis can be found in Section 5 of the OU2 and OU3 Feasibility Study Report.

The section below presents the nine criteria and a brief narrative summary of the alternatives and the strengths and weaknesses according to the detailed and comparative analysis. Only those alternatives that satisfied the first two threshold criteria were balanced and modified using the remaining seven criteria.

Comparative Analysis of Alternatives

Each alternative is evaluated in detail using the two threshold and five balancing criteria as part of the FS. After completion of the detailed evaluation of alternatives, a comparative analysis of the alternatives was performed to identify the alternative that satisfies the two threshold criteria of protection of human health and the environment and compliance with ARARs. Then the alternatives are assessed to determine which is the best option based on the five balancing criteria. The comparative analysis from the OU2 and OU3 FS is summarized below. Finally the modifying criteria of State and Community Acceptance are assessed based on comments received and responded to in the Responsiveness Summary to this ROD (Appendix C) and the State Letter of Concurrence (Appendix B).

Threshold Criteria

1. Overall Protection of Human Health and the Environment.

According to CERCLA, this criterion must be met for a remedial alternative to be chosen as a final Site remedy.

Alternative UW-1, the No Action Alternative, would not prevent the future use of the contaminated groundwater within the Underground Workings and would, therefore, not be protective of human health. In addition, UW- 1 would not reduce the discharge of AMD from the Deep Adit and Main Adit allowing continued discharge of contaminants to surface water. These discharges would continue to have negative ecological impacts on Pond 4, Pond 5, Ely Brook, and the tributaries to Ely Brook. Therefore, this alternative is not protective of human health and the environment and cannot be chosen as a final remedy. Alternatives UW-2 (the selected remedy), UW-3, and UW-4 would each be protective of human health and the environment. All three alternatives include Institutional Controls (ICs) to prevent wells from being installed within the TI Zone and groundwater use restriction area, thereby preventing consumption of contaminated groundwater. Each of the alternatives would also treat the discharge from the Main Adit. The three alternatives differ in the approach to the discharge from the Deep Adit. Alternative UW-2 would include the filling of the Deep Adit, which would greatly reduce, and potentially eliminate, the volume of water discharging from the Deep Adit. In the event that some residual discharge continues from the Deep Adit, or new seeps appear that have AMD characteristics, a small passive biological treatment system could be constructed to provide polishing treatment as necessary. Alternatives UW-3 and UW-4 both include provisions for treatment of water from both known significant discharge points (the Deep Adit and Main Adit), and are generally similar in terms of overall protection of human health and the environment. However, a passive system for the Deep Adit (UW-4) is more sensitive to being overwhelmed by a storm flows or spring run-off. The batch system for the Deep Adit (UW-3) with a sufficiently large pre-treatment reservoir has more flexibility to handle anticipated extreme flow conditions.

The relative ranking of protectiveness is that UW2 is the most protective of the alternatives since it includes a more permanent solution to address the discharge from the Deep Adit, whereas UW-3 and UW-4 rely on treatment. UW-3 would be slightly more protective than UW-4 since the active treatment system is considered more reliable. UW-2, UW-3, and UW-4 are all equivalent with respect to the groundwater within the Underground Workings and the discharge from the Main Adit. UW-1 would not protect human health or the environment since it would take no actions to prevent exposure to contaminated groundwater within the Underground Workings nor would it take any action to address the discharge of acid mine drainage from the Main Adit or Deep Adit.

2. Compliance with ARARs.

CERCLA requires that a selected alternative must also meet a second threshold criterion of compliance with ARARs, or a waiver must be obtained if the criterion cannot be met. According to CERCLA, this criterion must be met for a remedial alternative to be chosen as a final remedy. The ARARs identified for each alternative are identified in the OU2 and OU3 FS in Table 4-1 (UW-1), Tables 4-3 (UW-2), Tables 4-5 (UW-3), Tables 4-7 (UW-4). Alternatives UW-2 (the selected remedy), UW-3, and UW-4 would all be designed and implemented to comply with the ARARs identified in the OU2/OU3 FS and OU2/OU3 ROD, with the exception of the ARARs subject to the TI Waiver. Alternative UW-1 would not meet any ARAR standards.

Location-Specific ARARs.

Alternative UW-1 does not include any actions; therefore, this alternative does not trigger location specific ARARs. The surface water discharge remedial actions under Alternatives UW-2, UW-3, and UW-4 would mostly fall within the footprint of the OU1 RA, so the primary impacts of the OU2/OU3 remedy are generally equivalent to the OU1 remedy impacts that are currently being addressed under that remedy. Each of the alternatives would be designed and implemented to minimize any impacts on threatened or endangered bats. Each of these three alternatives would have the same general impact on historic resources. Alternative UW-4 would have the largest treatment system footprint, but the placement of the system does not directly impact protected resource areas since it will be in an area that has been remediated under the OU1 remedy. Alternatives UW-2, UW-3, and UW-4 would all be equivalent in achieving location specific ARARs.

Chemical-Specific ARARs and To Be Considered (TBC) guidances.

The only chemical-specific legal standard for groundwater that is exceeded in the Underground Workings is the Vermont Groundwater Protection Rule and Strategy, Primary Groundwater Standard (VT Env. Prot. R. Ch. 12, Appendix One, Table 1) for manganese. As a result, EPA has waived the standard so that it is not a chemical specific ARAR for the groundwater within the Underground Workings.

In addition, EPA has made a determination that it is technically impracticable to achieve federal risk-based groundwater standards for cobalt, copper, and iron that were derived using EPA TBC guidances for assessing risk.

Therefore, the only chemical-specific ARARs pertain to surface water. Alternative UW-1 would not attain protective concentrations for Site contaminants in surface water and would not comply with chemical-specific ARARs and TBCs. Alternatives UW-3 and UW-4 would each be designed to achieve treatment of discharge from both the Main Adit and the Deep Adit in compliance with chemical-specific ARARs and TBCs at the downstream compliance points, where the stream becomes perennial. Alternative UW-2 would greatly reduce and potentially eliminate the Deep Adit discharge and treat the Main Adit discharge in the same manner as UW-3 and UW-4. UW-3, as an active system, can be designed and maintained to more exactly address short-term fluctuations in influent flow and chemistry when compared to the passive system of UW-4. UW-2, UW-3, and UW-4 would each comply with chemical specific ARARs that have not been waived. Alternatives UW-2, UW-3, and UW-4 would all be equivalent in achieving chemical-specific ARARs. Alternative UW-1 would not comply with chemical-specific ARARs.

Action-Specific ARARs.

Because Alternative UW-1 does not include any actions, the alternative does not trigger action specific ARARs. Alternatives UW-2, UW-3, and UW-4 are equally compliant with their respect to action-specific ARARs regarding long-term monitoring, including State and federal groundwater standards for the TI Zone over the Underground Workings and federal and state surface water standards for adit discharge(s). All three alternatives may result in the production of precipitate with high metals concentrations as a result of the passive treatment of the Main Adit. UW-3 and UW-4 may also result in the production of precipitate with high metal concentrations as a result of the active or passive treatment of the Deep Adit. Although the bulk of the mass is expected to be non-hazardous (primarily aluminum and iron), there is a possibility that a precipitate sludge with elevated metals may be produced that may be exceed hazardous waste standards and would require compliance with hazardous waste management regulations. Alternative UW-2 involves the least amount of water treatment, and would produce the least amount of potentially hazardous precipitate. The adit filling included in Alternative UW- 2 would also produce the least volume of discharge from the Deep Adit, so it would have the least downstream impact in terms flow alteration. Action-specific ARARs related to construction impacts, such as construction erosion control, are most sensitive to the area of impact and the extent of earthwork. Alternative UW-3 would have the most construction activity, associated with the settling ponds, treatment plant construction, access/haulage roads, and utilities. Alternative UW-4 would have less construction activity than UW-3, assuming that the passive treatment system is relatively shallow (as expected with an aerobic wetland). Alternative UW-2 would have the least construction, and the effects of drilling boreholes would be temporary and could be minimized with appropriate siting of access roads and injection locations. Alternatives UW-2, UW-3, and UW-4 would all be equivalent in achieving action-specific ARARs.

Balancing Criteria

3. Long-term Effectiveness and Permanence.

This criterion evaluates the magnitude of residual risk and the reliability of controls after response objectives have been met.

Alternative UW-1 would not be effective nor permanent. Alternatives UW-2 (the selected remedy), UW-3, and UW-4 would reduce the amount of recharge entering the Deep Adit by grouting surface fractures and diverting surface water flow away from Underground

Workings entrances. As a result, the rate of discharge from the Underground Workings should also be reduced.

Alternative UW-2 includes the filling of the Deep Adit and potentially other associated Underground Workings. This option would greatly reduce or eliminate the surface area available for AMD-generating chemical reactions, and depending on the flowable fill used, may provide alkalinity to increase pH. Therefore, the source of contamination (AMD-impacted water) would be considerably reduced or eliminated. UW-2 is the only alternative that provides a potential permanent closure of the Deep Adit without the need for ongoing treatment in perpetuity. Alternatives UW-3 and UW-4 do have contingencies to add material to fill Underground Workings as needed, but would use smaller volumes of material. Because these alternatives do not include complete closure of the Deep Adit source AMD zone, the treatment systems would need to be operated and maintained indefinitely. Because the Alternative UW-4 Deep Adit passive system is not dependent on power and regular O&M, it would be less prone to complete system shutdown than UW-3.

The relative ranking of protectiveness is that UW2 achieves the most long-term effectiveness and permanence of the alternatives since it includes a more permanent solution to eliminate the source of contamination that discharges from the Deep Adit, whereas UW-3 and UW-4 rely on treatment. UW-4 would offer slightly more long-term effectiveness than UW-3 since the passive treatment system can be more cost-effectively maintained than for the long-term. UW-2, UW-3, and UW-4 are all equivalent with respect to the groundwater within the Underground Workings and the discharge from the Main Adit. UW-1 would not achieve any long-term effectiveness or permanence since it would take no actions to prevent exposure to contaminated groundwater within the Underground Workings nor would it take any action to address the discharge of acid mine drainage from the Main Adit or Deep Adit.

<u>4. Reduction of Toxicity, Mobility, or Volume through Treatment.</u>

This criterion evaluates whether the alternatives meet the statutory preference for treatment under CERCLA. The criterion evaluates the reduction of toxicity, mobility, or volume of contaminants, and the type and quantity of treatment residuals.

Alternative UW-1 does not contain any components to reduce the toxicity, mobility, or volume of contaminants through treatment.

Alternative UW-2 (the selected remedy) includes the filling of the Deep Adit and potentially other associated Underground Workings. Depending on the flowable fill used, the alternative may also include limited treatment by providing alkalinity to increase pH. Therefore, the Deep Adit AMD contaminant source may be reduced or eliminated. Alternatives UW-2, UW-3, and UW-4 all include treatment of the discharge from the Main Adit. Both UW-3 and UW-4 would treat metals discharge from the Deep Adit by precipitation, using different methods, and precipitates from both would require handling and removal (via recycling or off-site disposal). UW-3 would use an active treatment system in which the reactants would be metered and controlled, allowing for better control of the discharge output and precipitated material. Because UW-3 and UW-4 provide direct treatment to reliably and rapidly achieve ARARs, they better meet the treatment criterion than UW-2.

The relative ranking of the alternatives at reducing the toxicity, mobility, or volume of contaminants through treatment is that UW-3 includes the greatest degree of treatment as a result of the active treatment system for the Deep Adit, followed by the passive treatment system for UW-4. UW-3 may not include any treatment of the Deep Adit discharge of the source control eliminates the source of contamination. UW-2, UW-3, and UW-4 would all use treatment to address the discharge from the Main Adit. UW-1 does not include any treatment and does not achieve this criterion. Treatment is not a component of any of the alternatives with respect to the Underground Workings groundwater.

<u>5. Short-term Effectiveness.</u>

CERCLA requires that potential adverse short-term effects to workers, the surrounding community, and the environment be considered during implementation of an RA and until response objectives have been met. Under this criterion, the time period to achieve protectiveness is also evaluated.

Alternative UW-1 does not lead to any exposure risks and, therefore, results in no short-term effects; however, it never achieves protectiveness of human health or the environment and therefore is not effective in the short-term.

Alternatives UW-2 (the selected remedy), UW-3, and UW-4 would all achieve the RAOs and any applicable cleanup levels and performance standards within the same time frame for the Main Adit and groundwater in the Underground Workings. UW-2 is expected to achieve its RAOs and cleanup levels for the Deep Adit upon completion of the construction activities. UW-3 would require some period of time after construction for the system to demonstrate compliance as would UW-4, with a longer time period necessary for the passive treatment system.

Alternative UW-2 would have the most short-term effect on workers, the surrounding community, and the environment. The PDI for UW-2 includes a geophysics and drilling program that is more extensive than UW-3 and UW-4. In addition, the filling of the Deep Adit and associated Underground Workings would have two separate short-term impacts. First, in order to fill the Underground Workings, the material must be transported to the Site on local roads. This increases impacts on infrastructure and uses more resources. Second, if the flowable fill is injected into Underground Workings spaces that are fully or partially filled with water, this displaced water would either be forced out of existing discharge points, or would be pushed upward into Underground Workings that had been otherwise dry, possibly exiting the Underground Workings through previously dry fractures or other discharge points.
UW-3 would have the most extensive constructed infrastructure, including a treatment plant, utilities, and the treatment system itself. In addition, the reagents and metering system used for

UW-3 during the start-up phase of operation may need to be adjusted, involving more potential contact with hazardous materials. UW-4 would have less of an immediate impact on the local environment and local workers.

The relative ranking of the alternatives with respect to short-term effectiveness, particularly with respect to the time to achieve RAOs is that UW-2 is expected to achieve the RAOs for the Deep Adit in the shortest time period followed by UW-4 and UW-3, which require construction, start-up, and successful operation of a treatment system before RAOs for the Deep Adit can be achieved. UW-2, UW-3, and UW-4 would all achieve RAOs for the Underground Workings groundwater and the Main Adit in a similar timeframe. UW-1 would never achieve RAOs for the Deep Adit, Main Adit, or Underground Workings Groundwater. UW-4 would have the lowest short-term impacts because less material must be brought to the Site to implement this alternative. Alternative UW-3 would have slight less short-term impacts than UW-2 due to the quantity of material required. UW-1 would have no short-term impacts.

6. Implementability.

This criterion evaluates each alternative's ease of construction and operation, and availability of services, equipment, and materials to construct and operate the alternative. Also evaluated is the ease of undertaking additional RAs and administrative feasibility.

Alternative UW-1 does not include any actions, other than five-year reviews, and, therefore, would be technically easy to implement. No permits would be required, and administrative feasibility would be high. Ongoing bat mitigation assessment and mitigation throughout the design and implementation phases of all three active alternatives will require ongoing consultation with federal and State wildlife officials in order to implement the alternatives. Services and equipment are available to implement Alternatives UW-2 (the selected remedy), UW-3, and UW-4. All three alternatives require PDIs to support the designs and ICs. UW-4 is readily implementable. Once the PDI is complete and the passive system is designed, the elements of the settlement basin, passive system, and discharge piping do not require any specialized knowledge and materials. The reactive materials (assumed to be limestone and organics) would be sourced locally. Replacement of used reactants and precipitates could be performed with standard construction equipment, and monitoring requirements are similar to those used for Site environmental investigations. UW-3 is also readily implementable. A RCTS has been used at the nearby Elizabeth Mine for acid mine drainage treatment for a similar ore body, and the operating reports and "lessons learned" from that site can be used to improve system design and the shakedown period for UW-3. The treatment settling pond would allow for treatment in batches to accommodate variable discharge rates. The treatment plant and RCTS would require more effort to implement than a passive system because they would not be "off the shelf" units, but this does not pose a barrier to implementation. The implementability of UW-2 is more dependent on Site conditions and material availability than that of the other alternatives. The known configuration of the targeted Underground Workings is based on historical information and correlation with surveyed surface features. Although drilling was able to successfully penetrate the Main Shaft in the RI, the Deep Adit and associated features are smaller and may be more difficult to target. Even if the Underground Workings could be entered directly, the features are known to be at least partially collapsed. Implementability of the fill used would likewise depend on the available material. The ideal fill material would be locally derived to minimize truck traffic, and would be available in sufficient quantities to complete injections within the construction schedule required to not impact the bat population.

While each of the alternatives is implementable, the relative ranking of the alternatives for implementability is that taking no action (UW-1) would be the most implementable. UW-4 would be slightly more implementable than UW-3 and UW-2. UW-2, UW-3, and UW-4 are equal with respect to implementability regarding the Underground Workings groundwater.

7. Cost.

Of the three alternatives that would protect human health and the environment and comply with ARARs, UW-2 is the less expensive one that meets these threshold criteria. Costs for alternatives are presented in Table 14 below.

Table 14
Costs for Alternatives

Cost Category	UW-1	UW-2 (selected remedy)	UW-3	UW-4
Capital Costs	$0	$2,615,000	$3,417,112	$2,710,713
Annual O&M	$0	$40,250	$199,397	$55,035
Total Present Worth (30 years @ 7 percent)	$87,000	$3,375,000	$5,157,582	$3,619,705

Modifying Criteria

8. State Acceptance.

VT DEC has actively participated in the planning, implementation, and assessment of the OU2 and OU3 RI/FS and the development of the cleanup plan presented in this OU2 and OU3 ROD. VT DEC has notified EPA that it concurs with the cleanup approach (UW-2) as called for in this OU2 and OU3 ROD (Appendix B).

9. Community Acceptance.

EPA provided the community with an opportunity to review and comments on the OU2 and OU3 RI/FS and Proposed Cleanup. Only a few comments were received and these comments are addressed in the Responsiveness Summary to this ROD (Appendix C). The comments did not result in any changes to the selected remedy, described below.

L. THE SELECTED REMEDY

1. Summary of the Rationale for the Selected Remedy

The selected remedy, identified as Alternative UW-2 in the OU2 and OU3 Feasibility Study and Proposed Plan, will protect human health and the environment by: preventing exposure to contaminated groundwater within the Technical Impracticability Zone and associated groundwater use restriction zone; reducing the source of AMD at the Deep Adit, Pollard Adit, Burleigh Shaft, and Shaft 4; and treating the discharge of AMD from the Main Adit. The selected remedy will also take measures to mitigate any potential impacts to federal and state threatened and endangered bats and to minimize the impact of the selected remedy on historic resources. The selected remedy will address groundwater contamination through Institutional Controls (land use restrictions), rather than through cleaning up the water in the Underground Workings to the risk-based standards. Institutional Controls will prevent consumption of, or contact with, contaminated groundwater within the Underground Workings. Preventing the installation of water extraction wells within the land use restriction area will also eliminate any pumping stress that could cause the migration of the contaminated groundwater within the Underground Workings into surrounding areas of uncontaminated groundwater. The Deep Adit and Main Adit are two features of the OU2/OU3 Underground Workings that are known to discharge contaminated water to surface water. The selected remedy for the Deep Adit includes actions to minimize the generation of AMD as a source control action. A similar approach will be implemented for the Burleigh Shaft, Pollard Adit, and Shaft 4 unless they are determined to be hibernacula for the federally threatened Northern Long-Eared Bat. If any of these features are determined to be habitat for threatened or endangered bats, the cleanup approach for that feature will change. The Main Adit is connected to the Main Shaft, which is habitat for threatened and endangered bats. As a result, the selected remedy includes a passive surface water treatment system to treat the discharge from the Main Adit without changing the air flow in the Main Shaft.

2. The Selected Remedy

The selected remedy includes the permanent closure of the Deep Adit by filling in-place with grout and/or flowable fill to reduce the surface area available for AMD generation and greatly reduce or eliminate the release of AMD. The fill material may include neutralizing agents to further inhibit AMD creation and discharge from the Deep Adit. The Burleigh Shaft, Shaft 4, and the Pollard Adit will be filled unless they are determined to be hibernacula for state- or federally-listed threatened or endangered bats. If bats are determined to be using any of the mine features as hibernacula, mitigation measures will be developed that will either preserve the feature(s) while addressing the contaminated mine discharges using other means[3] or adopt mitigation measures for the bats to address the loss of the feature(s) as hibernacula. Prior to any

[3] If the federally threatened Northern Long-Eared Bat is found to be using any of the features as hibernacula EPA, in consultation with the United States Fish and Wildlife Service, has already determined that the feature(s) would not be filled.

excavation or fill activities associated with the adits, a PDI will be performed to better understand the conditions within the adits, including the extent to which the adits may be full of water and possibly under pressure. The investigations will also assess whether the water in the adits could discharge in an uncontrolled manner when the entrance to the adits are exposed or filled. The design will consider engineering measures to prevent an uncontrolled release from the adits. The selected remedy also includes the use of low impact passive treatment to address the intermittent discharge from the Main Adit. A limestone drain or passive treatment system will be installed to increase the pH and precipitate and/or filter the metals within the discharge from the Main Adit.

The selected remedy includes a TI Waiver of chemical-specific legal standards under the Vermont Groundwater Quality Standards, which otherwise would be a chemical-specific ARAR that would apply to the groundwater in the Underground Workings. The selected remedy also includes a finding that it would be technically impracticable to clean up the groundwater in the Underground Workings to achieve federal risk-based groundwater standards. Because the groundwater within the Underground Workings cannot be restored to drinking water standards, the selected remedy includes the development of a groundwater use restriction area and the implementation of land use restrictions to prevent future consumption of the contaminated groundwater. The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The restrictions will include both the area over the Underground Workings and additional area sufficient to prevent the installation of wells that would have the potential to draw contaminated groundwater from the Underground Workings. The selected remedy will be designed to avoid any adverse impacts to the federally threatened Northern Long-Eared Bat, as well as State threatened and endangered bat species.

The selected remedy will consist of the following key components:

- Groundwater pre-design investigation (PDI) to delineate a groundwater use restriction zone;
- PDI program for adits and shafts;
- Deep Adit, Burleigh Shaft, Pollard Adit, and Shaft 4 filling and closure (potentially modified if bat hibernacula are identified);
- Passive chemical treatment system of the discharge from the Main Adit (and for any additional mine features where bat hibernacula need to be protected);
- Institutional Controls;
- Long-term monitoring and Site Inspections;
- Operation and Maintenance of the Passive Treatment System and other remedial features; and
- Five-year reviews.

Each component will be described further below:

Groundwater Pre-Design Investigation:

A groundwater PDI will be conducted to further develop the conceptual site model for Underground Workings and to delineate the extent of the groundwater use restriction area. The PDI will include work to assess the area with a primary photolineament crossing above the Main Shaft and associated with a drainage feature identified as ORT-1. The types of activities that may be performed include: additional bedrock outcrop evaluations; surface geophysical investigation; installation of additional bedrock monitoring wells; groundwater sampling; and 3-D Digital Model and Groundwater Modeling.

Adit Pre-Design Investigation:

An Adit PDI will be performed which will include the following:

- Bat Survey and Habitat Assessments: Studies and evaluations will be performed to identify measures to minimize the potential for the selected remedy to impact bats or bat habitat in the remedy area, including potential bat summer roost habitat within the remedy area. This program could include: field investigations to examine threatened or endangered bat populations and habitat within the potential remedy impact area (e.g. bat roost studies); an evaluation of any potential changes of the air flow in underground features used by bats; and an evaluation to determine if remedy related heavy equipment and/or drilling activities in the vicinity of the Underground Workings activities could result in vibrations that could cause damage to bat habitat or directly disturb threatened or endangered bat populations;
- UWA Bedrock Surface Fracture Survey: A study will be performed to identify whether there are surface expressions of fractures that may contribute surface water recharge to the Deep Adit. This survey may include a field geologic survey (i.e. manual compass measurements) of the bedrock surface to identify, measure, and characterize large, water-bearing near surface fractures;
- Passive Chemical System Treatability Studies: Bench and field-scale treatability studies may be conducted to evaluate passive biochemical treatment technologies for the Main Adit surface water discharge; and
- Adit Hazard Analysis: The Deep Adit, Burleigh Shaft, Pollard Adit, and Shaft 4 are all believed to be isolated features that are not connected to the Main Shaft Mine Pool. The entrance to the Deep Adit and Pollard Adit are inaccessible due to collapse and fill material. The Burleigh Shaft and Shaft 4 are open. The Main Adit is reportedly passable to the Main Shaft and Main Shaft Mine Pool. As part of the pre-design investigation and prior to any activities that could release fluids from the Underground Workings, an investigation will be performed to assess whether pressurized water or other conditions exist that could lead to a release of water as a result of the implementation of the selected remedy. All Underground Working features will be assessed with particular emphasis on

the Deep Adit and Main Adit. The PDI will include investigations to confirm the Deep Adit geometry, configuration, and conditions. The investigations may include surface geophysics, bedrock drilling to intercept the Underground Workings, cross borehole tomography, and groundwater sampling of bedrock boreholes to determine the source (in-adit) geochemistry. Water samples will also be used to evaluate filler material reactivity/stability to determine ultimate composition. Surface geophysics may be conducted if available techniques could help target the boring locations. Boreholes may extend to a depth of 140 feet deep, given that the historical cross-section of the Ely Mine indicates that the Deep Adit is essentially horizontal and continues into Dwight Hill to the extent indicated in Figure 8. Drill rigs will use access roads constructed as part of the OU1 RA to the extent possible, but additional access roads may be required to reach locations outside of the OU1 RA, such as the area north and northeast of the Deep Adit entrance. The boreholes intercepting the Deep Adit and associated submerged Underground Workings may be incorporated into a cross-borehole tomography study to determine the complete extent of the Underground Workings and the extent of collapse. Water samples will also be collected from the boreholes to evaluate contaminant concentrations throughout the Deep Adit and associated Underground Workings and to support a treatability study to evaluate filler material, quantities, and delivery mechanism (use of berms, areas of complete versus partial filling, etc.). Figure 10 depicts the potential boring locations.

Deep Adit Closure:

Figure 10 depicts a general layout for the Deep Adit component of the selected remedy. The Deep Adit is currently collapsed; water exits through rubble at the presumed entrance. No attempt will be made to excavate the entrance or disturb the entrance until the pre-design investigation, including the evaluation of hydraulic pressure, water volume, and structural condition of the adit and entrance are complete. A failure mode and effects analysis or similar evaluation will be performed for any intrusive activities associated with the Underground Working features as part of the OU2 and OU3 design. Once the internal condition has been assessed and, if necessary, stabilized, the excavation of the collapse and entrance of the adit will proceed. Measures to relieve any internal pressure or to prevent the buildup of pressure during the filling of the adit will be implemented if determined necessary as part of the design. If the Deep Adit contains water that is under pressure or that could become pressurized during the filling of the adit, preventative measures, which could include pumping the water from the Deep Adit, will be implemented. The water removed will be treated, if necessary, before be discharged into Ely Brook or one of the tributaries to Ely Brook. Once the pressure is relieved and the Deep Adit is filled, the potential for it to contain water under pressure will be eliminated.

Excavation is likely to destroy historic mine features associated with the adit entrance, but the material excavated will be documented and the impact on former mine features will be minimized to the extent possible. If an open tunnel is encountered and is not structurally stable, the roof and/or sides will be stabilized as needed. A flow-through bulkhead will be installed to stabilize any discharge from the Deep Adit. Bulkhead design will be determined by the stability and dimensions of the excavated entrance, but the bulkhead is assumed to consist of concrete, with one nonreactive (PVC or stainless steel) pipe to allow flow and prevent water pressure build-up above designed levels and a lower pipe to allow for occasional flushing of accumulated sediment. The Deep Adit will not be entered because of structural safety concerns. Instead, borings will be installed to access the void spaces.

Given the structural instability of the Deep Adit, addition of all filler materials will most likely be via injection from above (borehole injection). The configuration of injection points will be determined by the treatability study. Figure 10 shows the potential locations of injection points and injected fill dams that may be used to facilitate complete filling of the adit. The fill to be utilized could be one or a combination of inert fill material (either flowable fill or foam) or partially reactive material (e.g. fine limestone aggregate) to reduce any residual acidity that might remain after the remedy. The selection of the specific material will be made based on the PDIs as well as value engineering that will be performed during RD. Injection of the adit fill material will displace standing water within the Underground Workings. The PDIs described above will attempt to determine the amount of standing water. For cost estimation purposes, half of the adit volume is assumed to be water-filled. Temporary water storage tanks will be staged on-site to collect the displaced water and release it (or treat it, as needed) in a controlled manner during or after injection. In the event that some residual discharge continues from the Deep Adit, or new seeps appear that have AMD characteristics, a small passive biological treatment system could be constructed to provide polishing treatment as necessary. The Pollard Adit is believe to only be 20 feet long and will be filled with clear material once exposed after the removal of the Upper Waste Area as part of the OU1 cleanup. The Burleigh Shaft and Shaft 4 are relative small shafts that will be filled to minimize AMD generation. A bat habitat assessment for the Burleigh Shaft will be performed as part of the PDI.

Main Adit Passive Chemical Treatment:

Figure 11 depicts a general layout for the Main Adit passive chemical treatment system. The Main Adit entrance appears to discharge minimal surface water flow to the environment under most conditions. The average observed flow rate was 3.3 gpm from July 2014 to July 2015, and from October 2014 to March 2015, no flow was observed during monthly readings.

The preliminary concept of the passive treatment system is an open limestone channel installed at a grade that will introduce oxygen and increase the pH of the water before it reaches a discharge/settling pond or basin. A large diameter perforated pipe (a scour pipe) may be installed along the base of the open limestone channel to allow for periodic flushing of accumulated solids. The open limestone/aeration channel will use a sufficiently high gradient to minimize precipitation/clogging of the material. However, periodic cleaning and media replacement will be required during operation and maintenance. The pH-adjusted water will flow to a settling basin. The settling basin is estimated to be at least 20 feet by 20 feet based, but the final dimension will be determined during design, and will have a sloping bottom to a drain pipe which could be used to remove built-up sediment. Given the relatively low discharge rates and concentrations, an additional polishing step is not expected to be needed.

Institutional Controls:

Because the groundwater within the Underground Workings Main Shaft Mine Pool cannot be restored to drinking water standards, ICs will be implemented to prevent consumption of contaminated groundwater within the Underground Workings Main Shaft Mine Pool. ICs will include a groundwater use restriction zone and/or land use restrictions to prevent future consumption of the contaminated groundwater and to prevent the installation of wells that could draw contaminated water away from the Underground Workings Main Shaft Mine Pool. ICs will also include protections for components of the remedy (i.e., monitoring wells, passive treatment system). The land use restrictions could be environmental restrictive covenants on individual properties or local ordinances or some combination. The estimated extent of the land use restrictions is shown on Figure 12.

Long-term Monitoring and Site Inspections:

A long-term monitoring plan will be developed as part of the design. The long-term monitoring program is likely to include structural monitoring of the closure structures for the Deep Adit, Pollard Adit, Burleigh Shaft, and Shaft 4, any bat grates and Underground Workings entrances, as well as monitoring for surface water flow, and lab analysis for geochemistry and metals in surface water and groundwater to evaluate the effectiveness of the implemented remedy. An IC monitoring plan will also be prepared as part of the OU2/OU3 long-term monitoring program. The monitoring plan will include yearly monitoring to confirm that any deed restrictions incorporated/referenced within the title for the property(ies) or municipal restrictions that are created remain in place and are enforced. The long-term monitoring plan will also include a checklist of elements to be assessed during, at a minimum, yearly on-site inspections. The inspections will also document that restrictions remain in place to prevent disturbance of the components of the remedy.

Operations and Maintenance:

The selected remedy will require long-term O&M for installed structures, including periodic inspection and repairs to surface water diversion structures, and the Deep Adit flow-through bulkhead. No O&M is anticipated for the grouted bedrock fractures. The passive treatment system for Main Adit discharge will need periodic maintenance to flush out accumulated precipitate within the treatment system. The settlement basin will likewise require flushing or dredging to remove and properly dispose of accumulated solids every one to two years. Reactive media replacement will occur every 2 to 5 years, however, the timeframe for replacement will be based on the degree of reactive material armoring and a comparison of pre- and post-discharge concentrations.

Five Year Reviews:

Under §121(c) of CERCLA,42 U.S.C. § 9621(c), any RA that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. Five-year reviews will be performed to determine whether the implemented OU2 and OU3 remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate.

3. Summary of Estimated Remedy Costs

The total costs for the selected remedy are presented in Table 15 below. Detailed cost estimates for capital and long-term costs are presented in Table 4-4 and Appendices C and D of the OU2 and OU3 Feasibility Study Report.

Table 15
Estimated Cost of the Selected OU2 and OU3 Remedy

ITEM	COST
Temporary Facilities	$50,000
Upgrade of Existing Access Roads	$50,000
Erosion and Sediment Control	$20,000
Portal grates and stabilization	$45,000
Deep Adit Closure	$476,000
Main Adit – Passive Treatment System	$61,000
Groundwater Monitoring Wells	$100,000
Site restoration	$13,000
NHPA/historic preservation compliance activities	$50,000
Endangered species compliance activities	$100,000
Institutional Control implementation	$35,000
Remedial Action Report	$50,000
Direct Cost Subtotal	$1.050,000
Contingency Cost (@30 Percent)	$315,000
Direct and Contingency Cost Subtotal	$1,365,000
Indirect Capital Costs (Engineering, Const. Mgmt., Proj. Mgmt., etc.-22%)	$300,000
Pre-Design Investigations	$952,000
TOTAL CAPITAL COSTS	**$2,617,000**
Site Inspections, Sampling, and Reporting (average over 30 years)	$23,000
Routine Site Maintenance, Repairs, etc. (average over 30 years)	$12,000
Contingency (10%) and Project Management (5%)	$5,250
Annual O&M Subtotal	$40,250
PRESENT VALUE COSTS FOR OPERATION,MAINTENCE, AND MONITORING, 30-YEARS, 7% (See Note 1)	**$671,000**
PRESENT VALUE COSTS FOR FIVE YEAR REVIEWS, 30-YEARS, 7%	**$87,000**
TOTAL COST FOR SELECTED REMEDY INCLUDING PV OF O&M AND FYR	**$3,375,000**

The information in Table 15 is based on the best available information regarding the anticipated scope of the remedial alternative. A 7% discount rate was used to estimate present worth for the selected remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Changes may be documented in the form of a memorandum in the Administrative Record file, an

Explanation of Significant Difference (ESD), or a ROD amendment, depending on the scope and scale of the remedy change. Based on EPA guidance, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study -- OSWER No. 9355.0-75 -- July 2000, this is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

4. Expected Outcomes of the Selected Remedy

Implementation of the selected remedy will prevent consumption and further expansion of the contaminated groundwater within the Underground Workings. The implementation of the selected remedy will also contribute to the cleanup of Ely Brook, the tributaries of Ely Brook, and Ponds 4 and 5 to promote the ecological recovery of these surface water bodies. Once the remedy is completed any revised risk or ARAR standards will be evaluated through the Five-Year Review process and may require the issuance of additional CERCLA decisions documents to modify the remedy established under this ROD.

a. Surface Water Cleanup Levels

The cleanup level for surface water will be the federal Clean Water Act National Recommended Water Quality Criteria, 33 U.S.C. § 1314(a) and 40 C.F.R. §§122.44 and 131.11, and Vermont Water Quality Standards, VT Env. Prot. R. Ch. 29 (A), Ch. 1, 2, and 3 and Appendix C and D, for a Class B surface water. These standards contain both numerical and biological criteria that should be met when the cleanup is complete. The numerical remediation goals are listed below in Table 16. The remediation goals that are based on hardness adjusted values (cadmium, copper, lead, nickel, and zinc) will be re-calculated based on the hardness of each receiving waterbody at the time when EPA seeks to confirm that the remediation goals have been met.

Table 16
Surface Water Cleanup Levels

Contaminant of Concern	Remediation Goal (ug/l)	Basis
Aluminum	87	National Recommended Water Quality Criteria
Cadmium	1.13*	Vermont Water Quality Standards
Copper	8.6*	Vermont Water Quality Standards
Iron	1,000	Vermont Water Quality Standards
Lead	3.18*	Vermont Water Quality Standards
Nickel	52*	Vermont Water Quality Standards
Selenium	5	Vermont Water Quality Standards
Zinc	106*	Vermont Water Quality Standards

* Denotes COC whose cleanup level is based on the hardness of the receiving water. The cleanup levels are based on a hardness of 100 mg/l. If the hardness of the receiving water is greater than, or less than, 100 mg/l, the cleanup level will be adjusted accordingly, as allowed by

the regulation. Vermont Water Quality Standards, Appendix C (Nat. Res. Brd, Water Res. P. 12-004-052).

M. STATUTORY DETERMINATIONS

The remedial action for OU2 and OU3 selected for implementation at the Ely Copper Mine Superfund Site is consistent with CERCLA and, to the extent practicable, the NCP. The selected remedy is protective of human health and the environment, will comply with ARARs, except for when waived, and is cost-effective. In addition, the selected remedy utilizes permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable. The selected remedy is not able to achieve the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment) due to Site conditions (the absence of any principal threat waste) and the balancing of all of the CERCLA criteria for selecting remedial alternatives. Some limited treatment of materials will occur as a result of the use of a limestone or other measures to treat the discharge from de-watering activities, as well as potential treatment of leachate generated from the containment cells.

1. The Selected Remedy is Protective of Human Health and the Environment

The selected remedy for OU2 and OU3 at this Site will adequately protect human health and the environment by eliminating, reducing or controlling exposures to human and environmental receptors through treatment, engineering controls, monitoring, and institutional controls (i.e., land use restrictions).

The selected remedy will protect human health by using ICs to prevent the installation of wells that could result in consumption of the contaminated groundwater in the Underground Workings or its migration beyond the compliance boundary for the TI Zone. The restoration of the groundwater in the Underground Workings, including addressing exceedances of risk-based standards for iron, cobalt, and manganese, was determined to be technically impracticable from an engineering perspective. As a result, a Remedial Action Objective to restore groundwater in the Underground Workings was not developed, but the RAO that requires the prevention of migration of the contaminated groundwater that exceeds ARARs and risk-based standards beyond the compliance boundary and to prevent exposure to contaminated groundwater within the TI Zone will be achieved through ICs and long-term monitoring.

The selected remedy will protect the environment by taking source control actions to minimize the discharge of contaminated surface water from the Deep Adit and passive treatment of the contaminated discharge from the Main Adit. The filling of the Deep Adit is a source control action that will permanently eliminate the source of the contamination. Filling the Deep Adit and adjacent or connected lower Underground Workings will reduce the surface area available for contact with water and generation of AMD. The flow-through bulkhead at the Deep Adit will reduce flow out of the Deep Adit. The residual flow, if any, following the filling of the Deep Adit (and the implementation of the OU1 cleanup for the UWA) is not expected to represent a threat to ecological receptors at the downgradient point of compliance. If the residual flow exceeds cleanup levels at the point of compliance, a small passive treatment system will be installed to treat the water.

Passive treatment of discharge from the Main Adit will minimize metals and moderate pH of the water entering the Ely Brook watershed. The passive treatment of the Main Adit is expected to reduce metal concentrations to a level that will not represent a threat to ecological receptors at the downgradient point of compliance. Installation of surface water drainage structures and grouting of surface fractures will reduce the volume of water entering the Deep Adit and Main Adit from the surface in the immediate vicinity of the Underground Workings entrances.

Environmental protection standards will also be met through protecting of federal- and State-listed threatened and endangered bats and their habitats within OU2 and OU3, while implementing the selected remedy.

2. The Selected Remedy Complies With ARARs

The selected remedy will comply with all Federal and any more stringent State ARARs that pertain to the remedial actions (see Tables 17 – 19 in Appendix A), except for State Groundwater Regulatory standards that have been waived within the TI Zone. In making this determination, EPA has made the following specific findings:

a. Location-specific ARARs and TBCs (presented in Table 17).

In accordance with federal Floodplain Management and Protection regulations, 44 C.F.R. § 9, EPA has determined that the selected remedy can be implemented in a manner that will protect downstream floodplain and wetland resources. The standards will be achieved through the use of best management practices to address Site contaminant remediation, stream alterations, stormwater controls, and long-term O&M of the remedial components adjacent to the Site’s waterways.

Design and implementation of the selected remedy will also address measures that may be required to protect habitat for State and federally-listed endangered bat species in compliance with State and federal Endangered Species Acts, 10 V.S.A. Chapter 123 and 16 U.S.C. 1531 *et seq.*, respectively.

The National Historic Preservation Act, 16 U.S.C. 470 *et seq*. and the Vermont Historic Preservation Act, 22 VSA § 743(4), 761, 763, and 767, requires EPA to take into account the effects of all actions on historic properties, including archaeological sites that have been determined to be eligible for the National Register of Historic Places. EPA has determined that the Site is eligible for listing in the National Register of Historic Places. EPA has also determined that the construction activities required to implement this OU2 and OU3 RA may have unavoidable direct and indirect impacts on historic features, including archaeological sites, at the Site, but that these impacts are necessary to protect human health and the environment. The preliminary Area of Potential Effect (APE), as defined under the NHPA for direct effects is shown in Figure 16. The APE will be further defined to address indirect effects, cumulative effects and other effects as part of the design. EPA will work with the Vermont SHPO and other consulting parties to address minimize and mitigate any adverse effects to historic resources and archaeological sites.

State land use control and development standards under the Vermont State Land Use and Development Plans Act (Act 250), 10 V.S.A. Chapter 151, will be met in the design and implementation of the selected remedy regarding regulated activities, including water and air pollution, protection of headwaters, waste disposal, floodways, streams, wetlands (including Vermont Class 3 wetlands not regulated under the Vermont Wetland Rules), soil erosion, historic sites, endangered species, and extraction of earth resources, energy conservation, and protecting public investments..

To the extent that remedial activities affect other protected resource areas, the location-specific ARARs in Table 17 will apply.

b. Chemical-specific ARARs and TBCs (presented in Table 18).

The chemical specific ARARs pertaining to the cleanup of surface waters are the Vermont Water Pollution Control Act, 10 VSA Chapter 47; Vermont Water Quality Standards, Ch. 1, 2, and 3 and Appendix C and D and Section 304(a) of the Federal Clean Water Act, National Recommended Water Quality Criteria (NRWQC), 33 U.S.C. § 1314(a); 40 C.F.R. §§122.44 and 131.11. The ARARs define the numerical criteria that will be used to evaluate whether the cleanup has been successful. The remedial goals based on these criteria are listed in Table 16. The selected remedy will attain chemical-specific ARARs and TBCs relating to the discharge of water from the Main Adit and Deep Adit at the designated compliance point, downstream of the adits where the drainage stream becomes perennial. There are no chemical-specific ARARs or TBC for groundwater in the Underground Workings due to the Technical Impracticability Waiver.

c. Action-specific ARARs and TBCs (presented in Table 19).

It is expected that all activities can be designed and implemented to comply with action-specific ARARs, regarding the containment of OU2 and OU3 contaminants, stormwater controls, water treatment/discharge standards, leachate collection and on-site treatment/discharge, Site monitoring, and institutional controls.

Any leachate generated after the containment areas are completed will be collected and treated to meet standards for on-site treatment and discharge to surface waters. Long-term monitoring of the waste management areas will include federal and state drinking/groundwater standards for monitoring groundwater, as well as federal and State surface water quality standards for monitoring Site waterways. ICs will meet standards for preventing exposure to contaminated media left in place. Remediation throughout OU2 and OU3 will meet State erosion control TBC guidance standards.

3. The Selected Remedy is Cost-Effective

In EPA's judgment, the selected remedy for OU2 and OU3 is cost-effective because the remedy's costs are proportional to its overall effectiveness (see 40 C.F.R. § 300.430(f)(1)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all Federal and any more stringent State ARARs, or as appropriate, waive specific ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria – long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness – in combination. The overall effectiveness of each alternative then was compared to the alternative's costs to determine cost-effectiveness. The relationship of the overall effectiveness of the remedial alternative selected in this ROD was determined to be proportional to its costs, thereby representing a reasonable value for the money to be spent. The selected remedy for OU2 and OU3 is the least cost alternative among the alternatives considered that met the primary criteria.

4. The Selected Remedy Utilizes Permanent Solutions and Alternative Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

Once the Agency identified those alternatives that attain or, as appropriate, waive ARARs, and that are protective of human health and the environment, EPA identified which alternative utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. This determination was made by deciding which one of the identified alternatives provides the best balance of trade-offs among alternatives in terms of: (1) long-term effectiveness and permanence; (2) reduction of toxicity, mobility or volume through treatment; (3) short-term effectiveness; (4) implementability; and (5) cost. The balancing test emphasizes long-term effectiveness and permanence and the reduction of toxicity, mobility and volume through treatment, and considers the preference for treatment as a principal element, the bias against off-site land disposal of untreated waste, and community and State acceptance. The selected remedy for OU2 and OU3 provides the best balance of trade-offs among the alternatives.

The selected remedy for OU2 and OU3 provides the best balance of the five balancing criteria and other factors taken into consideration. It is the least expensive alternative that achieves protection of public health and the environment and complies with ARARs (unless waived). None of the alternatives considered used treatment as a primary element to achieve any reduction of toxicity, mobility, or volume, although some limited treatment will occur through the use of treatment to address the discharge from the Main Adit and the potential use of alkaline material to fill the Deep Adit. Containment of the waste was determined to be the most cost-effective approach to achieve long-term effectiveness and permanence for the Deep Adit, and treatment was not practical for the groundwater within the OU2 and OU3 Underground Workings. Potential short-term impacts associated with historic resources and endangered species, as well as community input regarding truck traffic, were taken into consideration. The long-term monitoring and five-year reviews will document that the protectiveness standards are being met. Maintenance of the remedial components along with monitoring and institutional controls will provide the long-term effectiveness.

5. The Selected Remedy Does Not Satisfy the Preference for Treatment Which Permanently and Significantly Reduces the Toxicity, Mobility or Volume of the Hazardous Substances as a Principal Element

The major components of the remedy are source control measures for the major source of surface water impacts (Deep Adit), which is consistent with EPA guidance. Some treatment may occur if alkaline materials are used to fill the Deep Adit. Treatment will be used to address the discharge from the Main Adit. Based on the finding of Technical Impracticability, treatment is not a principle element of the selected remedy for the groundwater in the underground workings. No principal threat wastes were identified at the Site.

6. Five-Year Reviews of the Selected Remedy are Required

Because this remedy and the previously selected OU1 remedy will result in hazardous substances remaining on-site above levels that will not allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of the OU1 remedial action and every five years thereafter, to ensure that the remedy continues to provide adequate protection of human health and the environment. The OU2 and OU3 Remedy will be the second remedial action initiated at the Site.

N. DOCUMENTATION OF NO SIGNIFICANT CHANGES

EPA reviewed all written and verbal comments submitted during the public comment period, which was open from September 8 to October 8, 2015 and determined, after reviewing the comments received, that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary (See Appendix C). While no information has been received that would change the selected remedy, two additional items of information are worth noting with respect to the remedy. The USFWS has finalized a rule under section 4(d) of the Endangered Species Act identifying measures that are necessary and advisable to provide for the conservation of the Northern Long-Eared Bat, 40 C.F.R. Part 17(o). The rule went into effect on February 16, 2016 and has specific provisions for activities with ¼ mile of a hibernaculum. Since the remedy will involve activities within a ¼ mile of a hibernaculum, the requirements of this rule would apply to the selected remedy. EPA has consulted with the USFWS and has obtained their concurrence that the mitigation measures proposed would meet the intent of the new rule. Their concurrence is also based on EPA conducting additional assessments, as part of remedial design, to determine whether Shaft 4 or the Burleigh Shaft serve as bat hibernacula.

Since the Proposed Plan was issued, EPA also performed a preliminary failure mode and effect analysis (FMEA) for the activities that are proposed in the selected remedy. The FMEA identified the conditions that could result in the sudden and uncontrolled release of water pooled within the Deep Adit and the Main Adit. The approach outlined in this ROD for the selected remedy represents the best practice for implementing an action to prevent such a release for the Deep Adit. The approach includes a comprehensive pre-design program to identify whether there is water pooled within the adit and to support design objectives to remove sufficient pooled water prior the opening of the adit to allow for the remaining water to be controlled using the designed water management practices. The selected remedy does not include measures to address a future uncontrolled release from the Main Adit. The Main Adit would need to become blocked to allow the conditions that would create the potential for a release to occur. The Main Adit is not currently blocked, so long-term monitoring of the condition of the opening of the Main Adit is an appropriate response given the significance of the Main Adit for federal- and State-listed threatened and endangered bat species.

O. STATE ROLE

The State of Vermont Department of Environmental Conservation has reviewed the various alternatives and has indicated its support for the selected remedy. The State has also reviewed the OU2 and OU3 Remedial Investigation, Risk Assessment and Feasibility Study with respect to the Site to determine whether the selected remedy is in compliance with applicable or relevant and appropriate State environmental and facility siting laws and regulations. The State of Vermont concurs with the selected remedy for OU2 and OU3 for the Ely Copper Mine Superfund Site. A copy of the declaration of concurrence is attached as Appendix B.

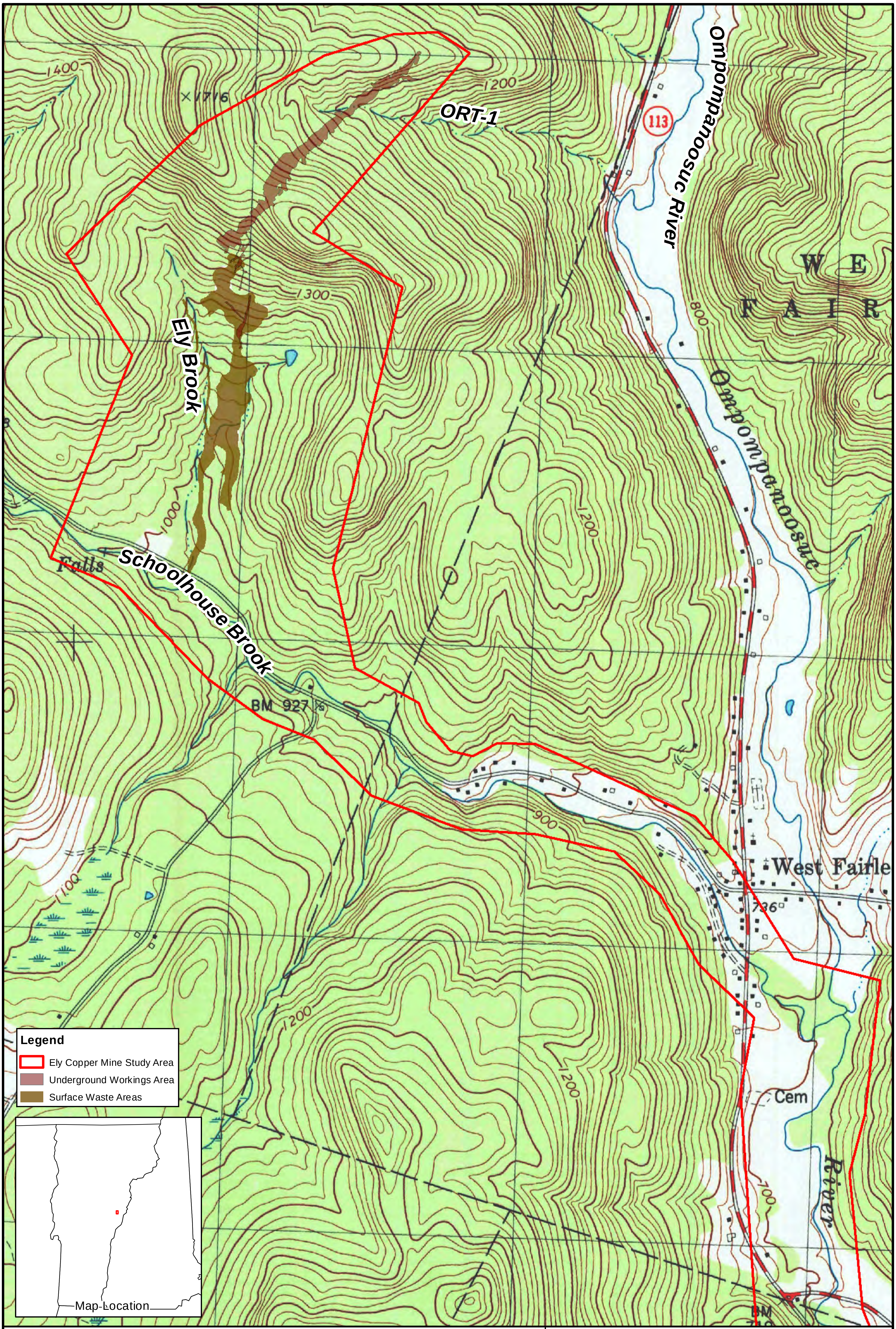
APPENDIX A

TABLE 1, FIGURES,
AND
ARAR TABLES

Table 1-2
Summary of Site Investigations
Ely Copper Mine Superfund Site
OU2/OU3 Underground Workings
Vershire, Vermont

Year of Investigation	Principal Investigator	Investigation Description	Sampling Summary
2001	Slack and others	Geology and geochemistry of ore and rocks of VT Copper Belt	
2002	USGS and USACE	Geochemical diversity of water sources in the Ely Brook Watershed	surface water sampling from seeps from mine waste areas, Ely Brook and tributaries, Schoolhouse Brook, and the Ompompanoosuc River
2005 to 2008	URS and USACE	Habitat characterization	terrestrial habitats, potential wetland areas, potential terrestrial receptors
			test pits and borings in waste areas
			monitoring well installation
			surface water samples
			sediment samples
			surface and subsurface soil samples
			groundwater samples
			residential samples
2007	VTDEC	Aquatic Life Use Attainment Assessment	evaluation of fish and macroinvertebrate data
2008	Techlaw	Aquatic Baseline Ecological Risk Assessment	surface water samples
			sediment samples
			porewater samples
2009	Nobis	Remedial Investigation - OU1	terrestrial habitats, potential wetland areas, potential terrestrial receptors
			test pits and borings in waste areas
			monitoring well installation
			surface water samples
			sediment samples
			surface and subsurface soil samples
			groundwater samples
			residential samples
2012-2015	Nobis	Remedial Investigation - OU2/OU3	*surface water samples and discharge measurements*
			borings installed to intercept mine pool
			monitoring well completion
			bedrock characterization - photolineament, outcrop, and borehole surveys
			packer testing/sampling
			monitoring well installation
			monitoring well groundwater sampling
			continuous groundwater level monitoring
2013-2015	Nobis	Remedial Design Investigation - OU1	surface water monitoring
			monthly groundwater level monitoring
			test pits and borings in waste areas
			groundwater sampling
			rock coring
			installation of overburden and shallow bedrock monitoring wells

Notes:
USGS = United States Geological Survey
USACE = United States Army Corp of Engineers
VTDEC = Vermont Department of Environmental Conservation
Summary items in *italics* indicate samples included in OU2/OU3 evaluations



Notes:

1. Source: USGS 7.5 Minute Series Topographic map: Vershire VT. Revised 1983 .

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 500 1,000 2,000
Feet
1 inch = 1,000 feet

N

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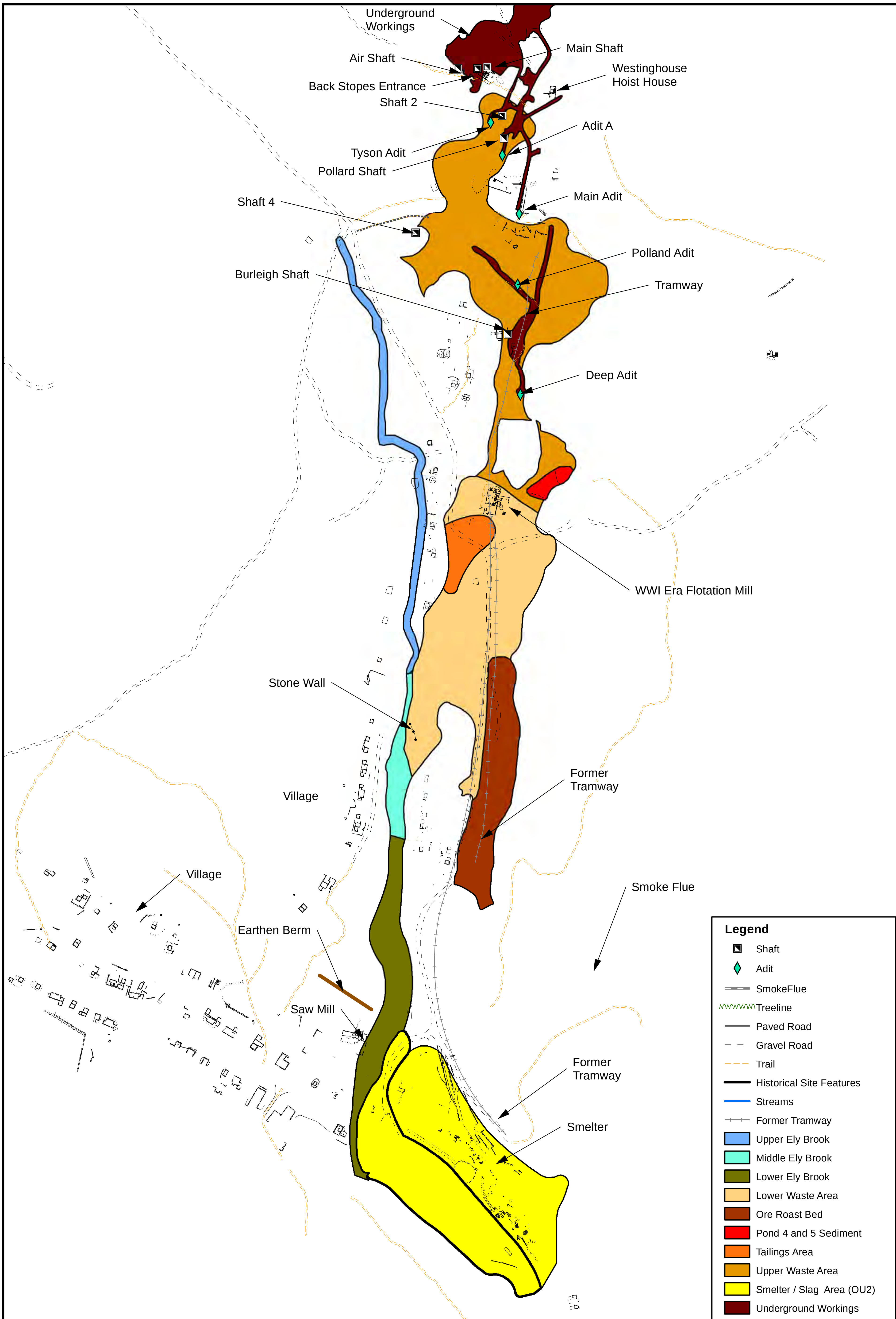
FIGURE 1 - SITE LOCATION



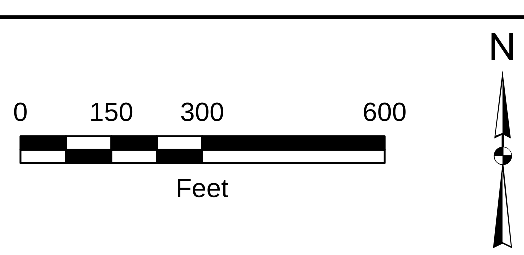


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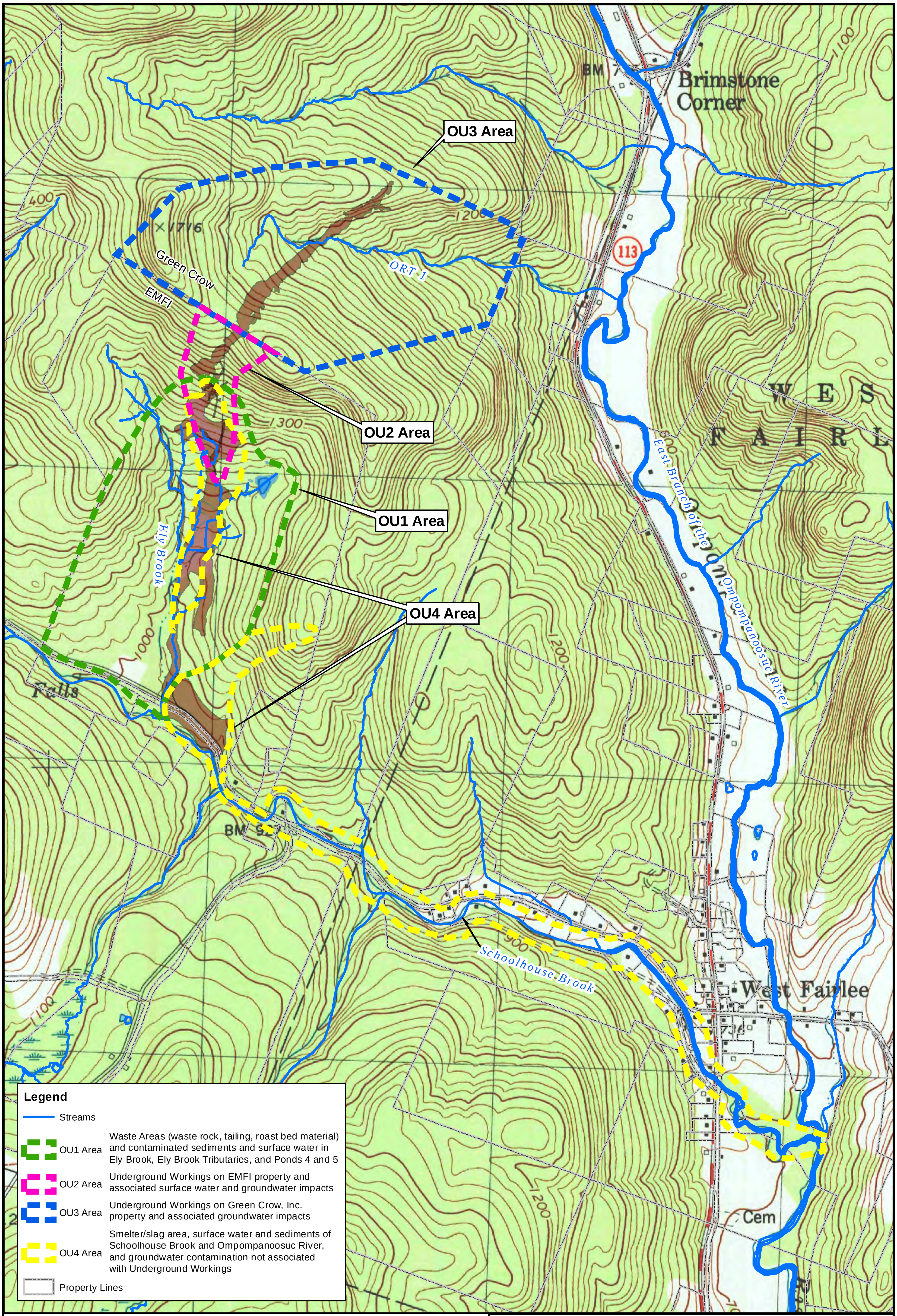
FIGURE 2 - HISTORIC FEATURES



Notes

1. EMFI = Ely Mine Forest, Inc.

2. Property Lines are from Vermont Center for Geographic Information (VCGI). Topographic map from USGS Vershire, VT quadrangle, revised 1983.

3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 500 1,000 2,000

Feet

N

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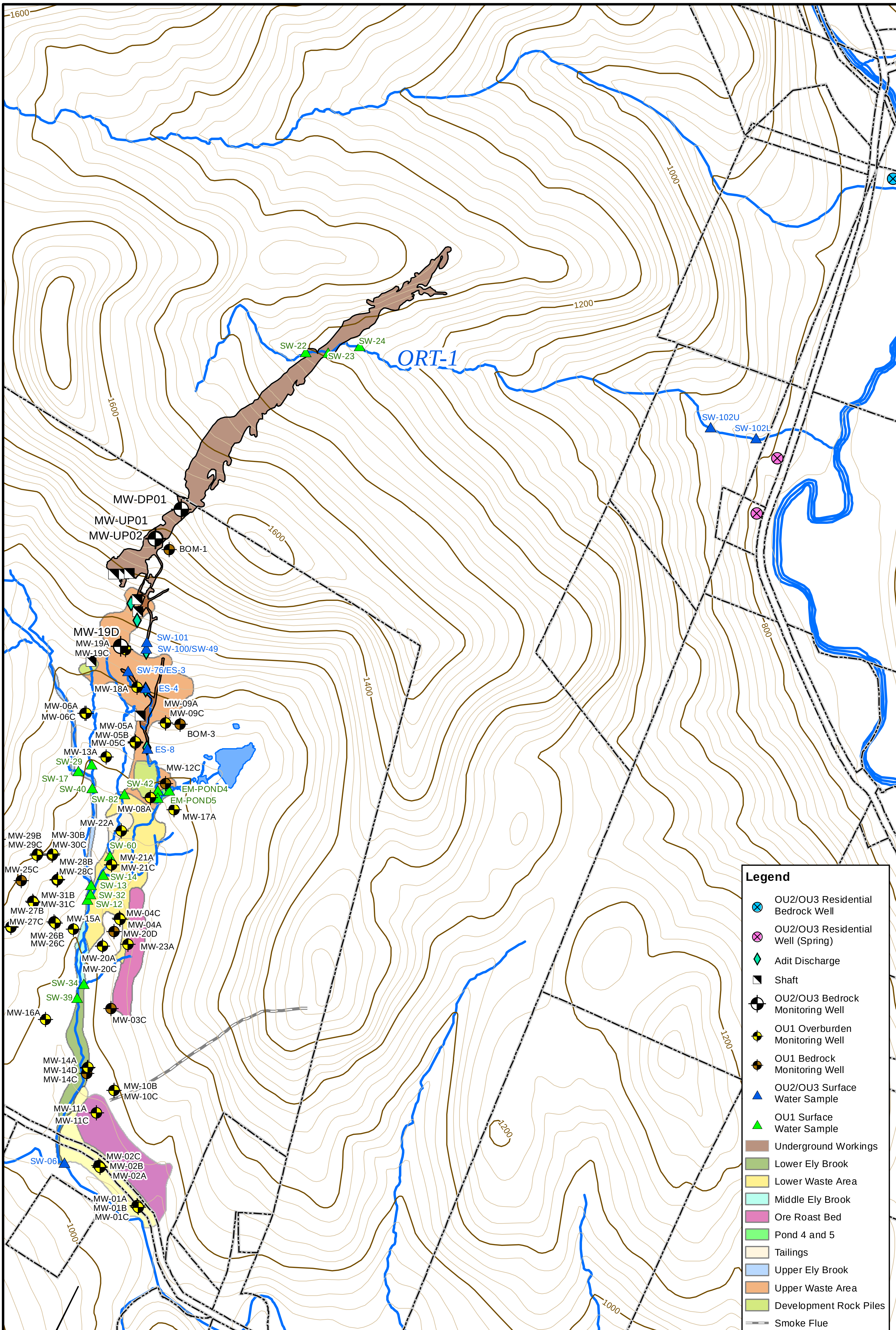
FIGURE 3 - OPERABLE UNITS



Notes:

1. Transducers were installed in the bedrock monitoring wells sampled for OU2/OU3.

2. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 300 600 1,200

Feet

1 inch = 600 feet

N

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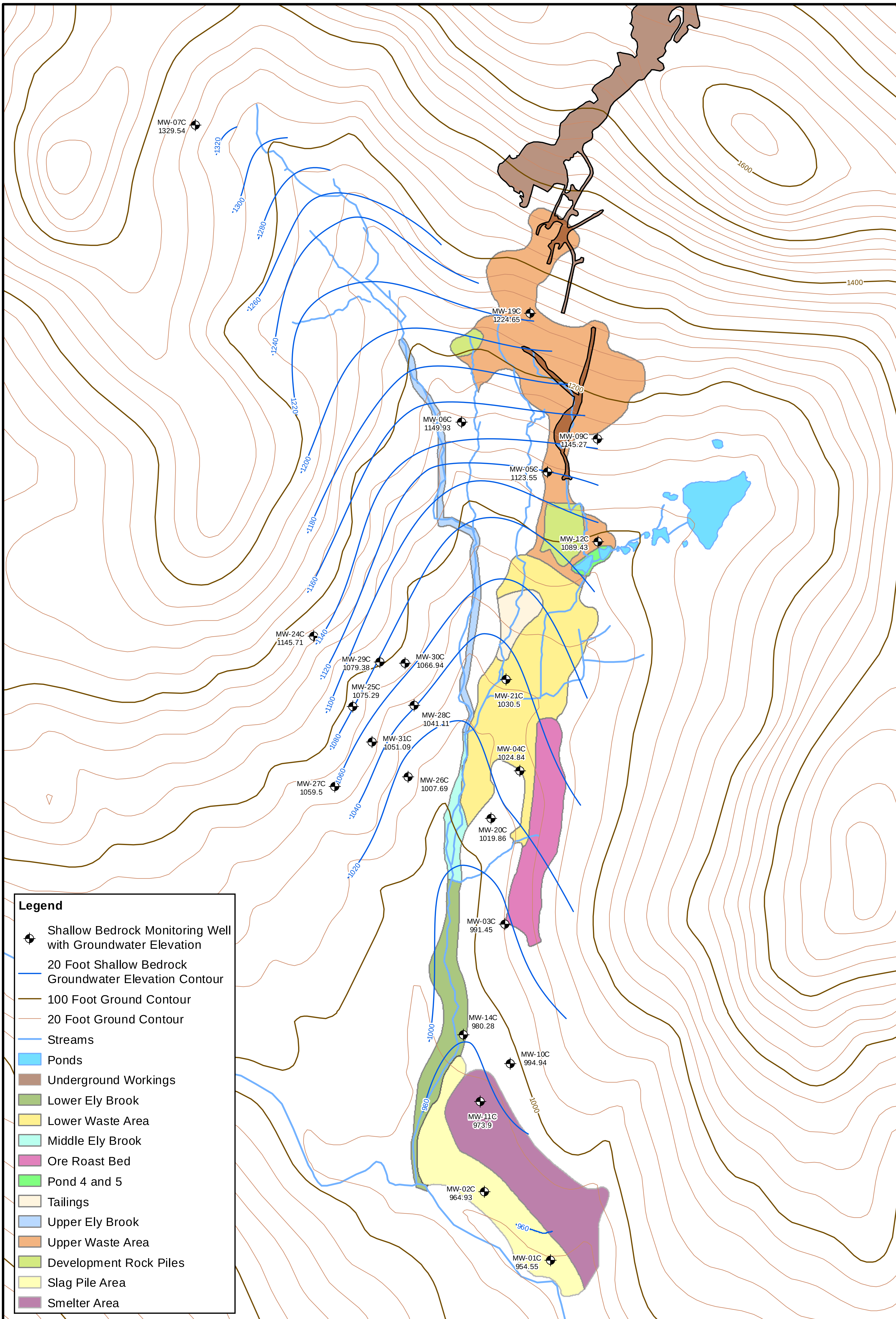
FIGURE 4 - SITE INVESTIGATION LOCATIONS

Path: R:\80000 Task Orders\80070 Ely Copper Mine OU 2 RI-FS\Technical Data\GIS\Maps\ROD 2015\Figure 4 Ely ROD Investigation Locations.mxd Date Printed: 2/22/2016



Notes

1. Groundwater elevations based on November 10, 2014 water level round.

2. Groundwater contours were generated by ESRI Spatial Analyst version 10.2.1 using the natural neighbor method. Other interpretations are possible.

3. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 175 350 700

Feet

1 inch = 350 feet

N

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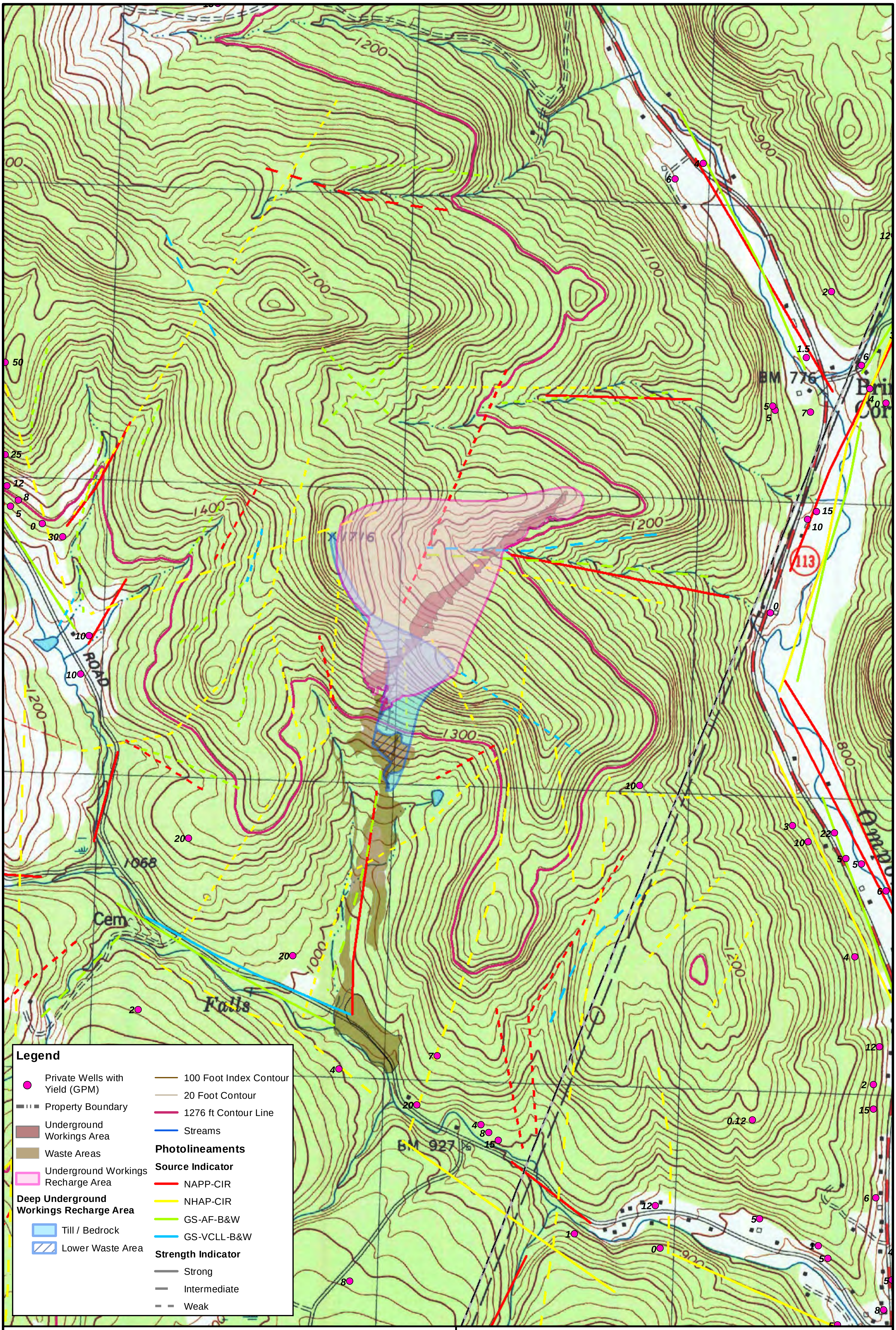
FIGURE 5 - SHALLOW BEDROCK GROUNDWATER ELEVATIONS AND CONCEPTUAL FLOW DIRECTION



Notes:

1. Residential Sample Locations from figure 3-8 of 2011 RI. Private Wells obtained from Vermont Agency of Natural Resources GIS, November 2014.

2. For discussion of recharge area, please see Appendix L in RI report (Nobis, 2015).

3. Topographic map is from USGS Vershire, VT quadrangle, revised 1983.

4. Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 500 1,000 2,000

Feet

1 inch = 1,000 feet

N

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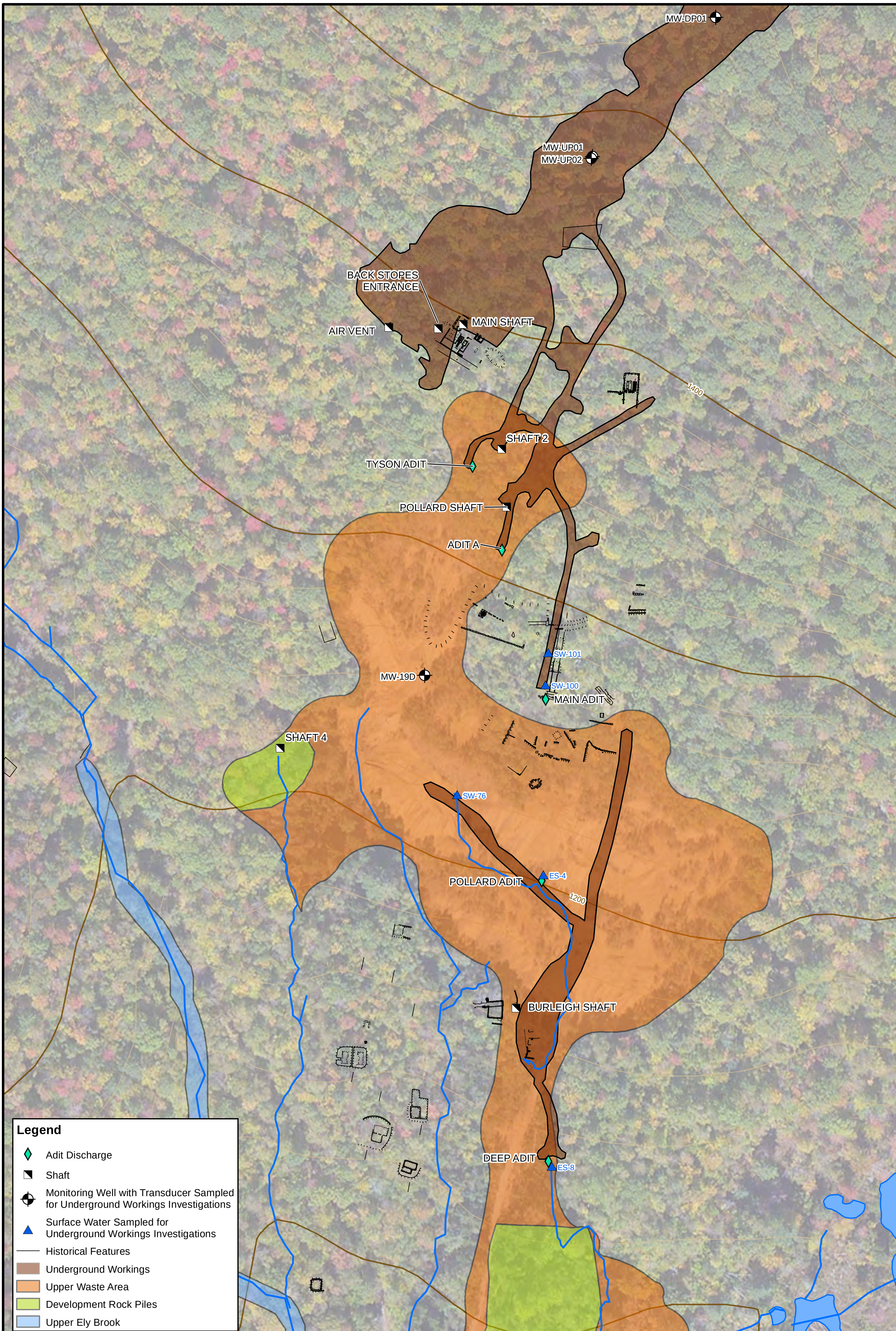
FIGURE 6 - POSSIBLE FRACTURE ZONES



Note

Locations of site features depicted hereon are approximate and given for illustrative purposes only.

0 125 250

Feet

1 inch = 125 feet

N

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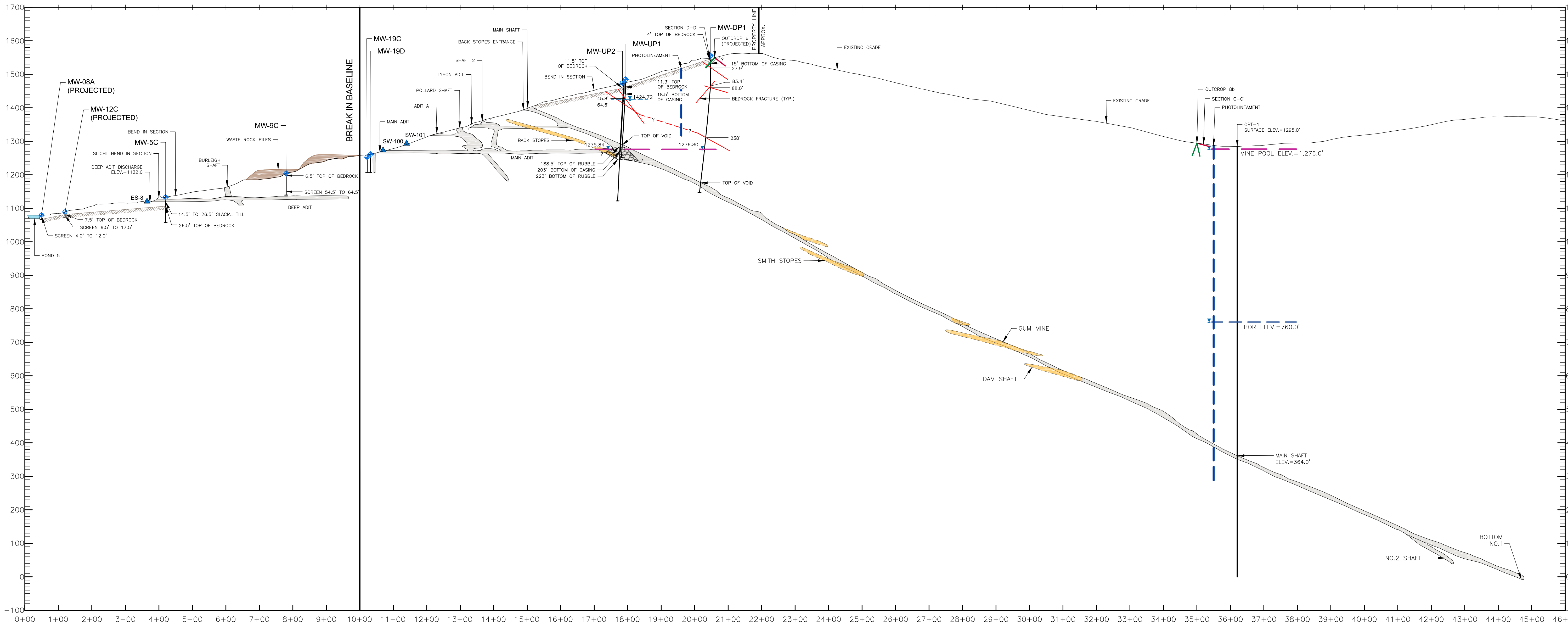
FIGURE 7 - SURFACE FEATURES ASSOCIATED WITH UNDERGROUND WORKINGS



NOTES:

1. PHOTOLINEAMENTS FROM NOBIS ENGINEERING, 2013. DRAFT TECHNICAL MEMORANDUM - UNDERGROUND WORKINGS HYDROGEOLOGY CHARACTERIZATION, ELY COPPER MINE SUPERFUND SITE, VERSHIRE, VERMONT. FEBRUARY 15, 2013.
2. PHOTOLINEAMENTS ASSUMED TO REPRESENT VERTICAL STRUCTURES IN BEDROCK, ARBITRARILY DRAWN TO DEPTH OF 200 FEET. LINEAMENTS COINCIDING WITH ORT-1 ARBITRARILY DRAWN TO DEPTH OF 1,000 FEET, OR BOTTOM OF FIGURE.
3. FRACTURES MEASURED IN OUTCROP OR IN BOREHOLE BY ACOUSTIC TELEVIEWER. FRACTURE ORIENTATIONS (RELATIVE TO TRUE NORTH) CONVERTED TO APPARENT DIP IN THE TREND OF EACH CROSS SECTION.
4. TWO TYPES OF FRACTURES RECOGNIZED IN OUTCROPS - FRACTURES THAT COINCIDE WITH METAMORPHIC FOLIATION, AND FRACTURES THAT CROSS CUT FOLIATION. MOST OUTCROP FRACTURES SHOWN ARE THE AVERAGE OF TWO OR MORE FRACTURES MEASURED IN OUTCROPS.
5. FRACTURE LENGTHS SHOWN ARE AVERAGES OF MEASURED FRACTURE LENGTHS IN DWIGHT HILL OUTCROPS.
6. DETAILED GEOMETRY WHERE MW-UP1 AND MW-UP2 INTERSECT THE MAIN SHAFT IS MORE COMPLEX THAN SHOWING, WITH VOID, RUBBLE AND MORE COMPACT ROCK PRESENT. VARIATIONS BETWEEN THE TWO BOREHOLES ARE PRESENT.
7. SUBSURFACE INFORMATION IS BASED ON A 1944 UNITED STATES DEPARTMENT OF INTERIOR GEOLOGICAL SURFACE, "STRATEGIC MINERALS INVESTIGATIONS PRELIMINARY MAP PLATE 4".
8. MW-UP1, MW-UP2, AND MW-DP1 ARE DEVIATED TO THE SOUTHWEST FROM VERTICAL. ILLUSTRATIONS ARE APPROXIMATE.

LEGEND:

- EXISTING GROUND SURFACE
- PHOTOLINEAMENT
- FOLIATION FRACTURE
- X-CUT FRACTURE
- MINE POOL POTENTIOMETRIC SURFACE

LEGEND:

- MONITORING WELL
- 1287.29 GROUNDWATER ELEVATION
- TOP OF BEDROCK
- SW-100 SURFACE WATER SAMPLED FOR MINE WORKINGS INVESTIGATION

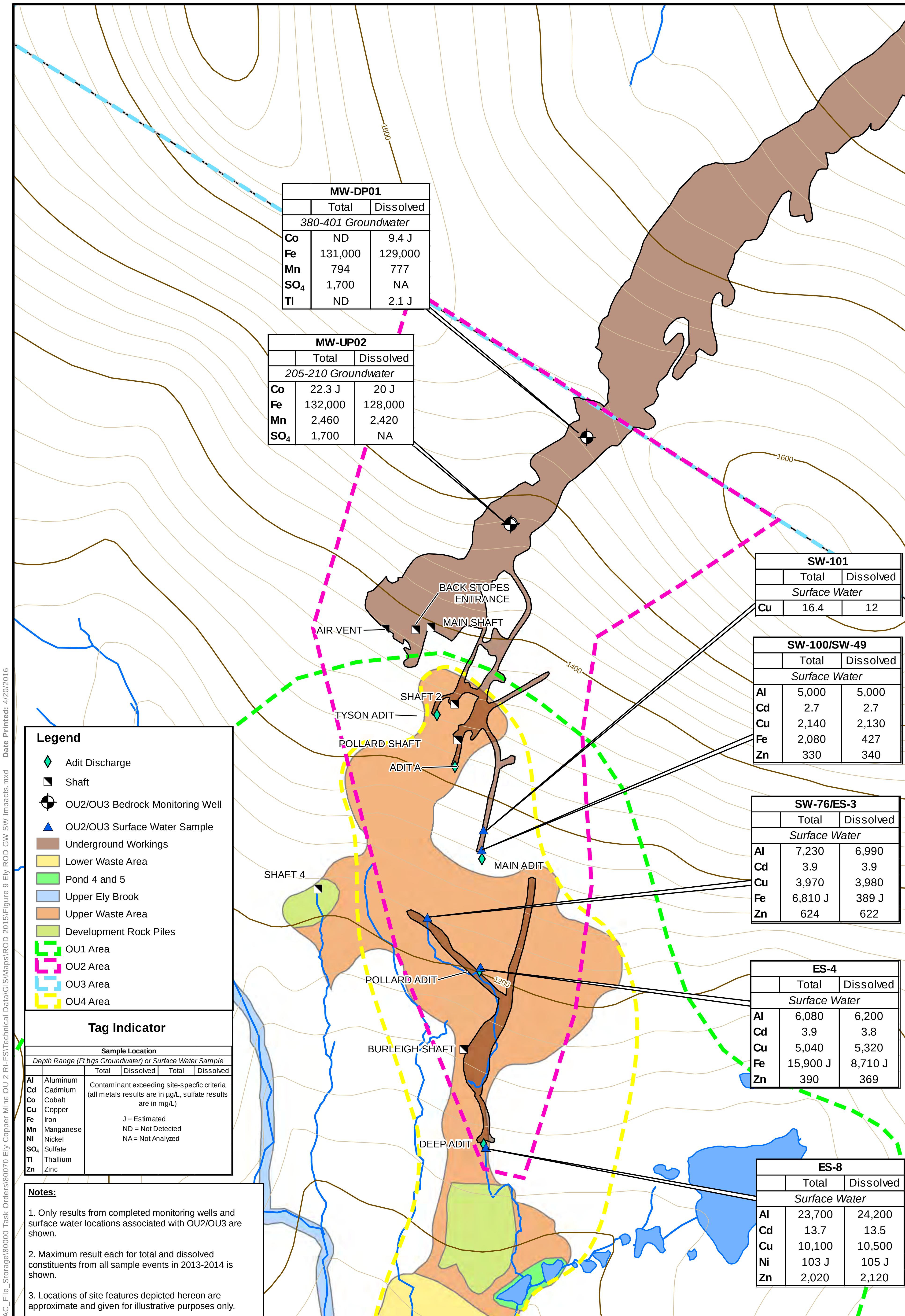
HORIZONTAL SCALE IN FEET 0 150' 300'

VERTICAL SCALE IN FEET 0 150' 300'

ELY COPPER MINE OU2 and OU3 ROD

FIGURE 8 - CROSS SECTION UNDERGROUND WORKINGS

J:\80070 Ely OU2 GIS\CAD\dwg\80070-XSECTION-UGW.dwg 4/19/2016 1:25 PM



0 100 200 400
Feet
1 inch = 200 feet
N

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FIGURE 9 - GROUNDWATER AND SURFACE WATER IMPACTS ASSOCIATED WITH UNDERGROUND WORKINGS

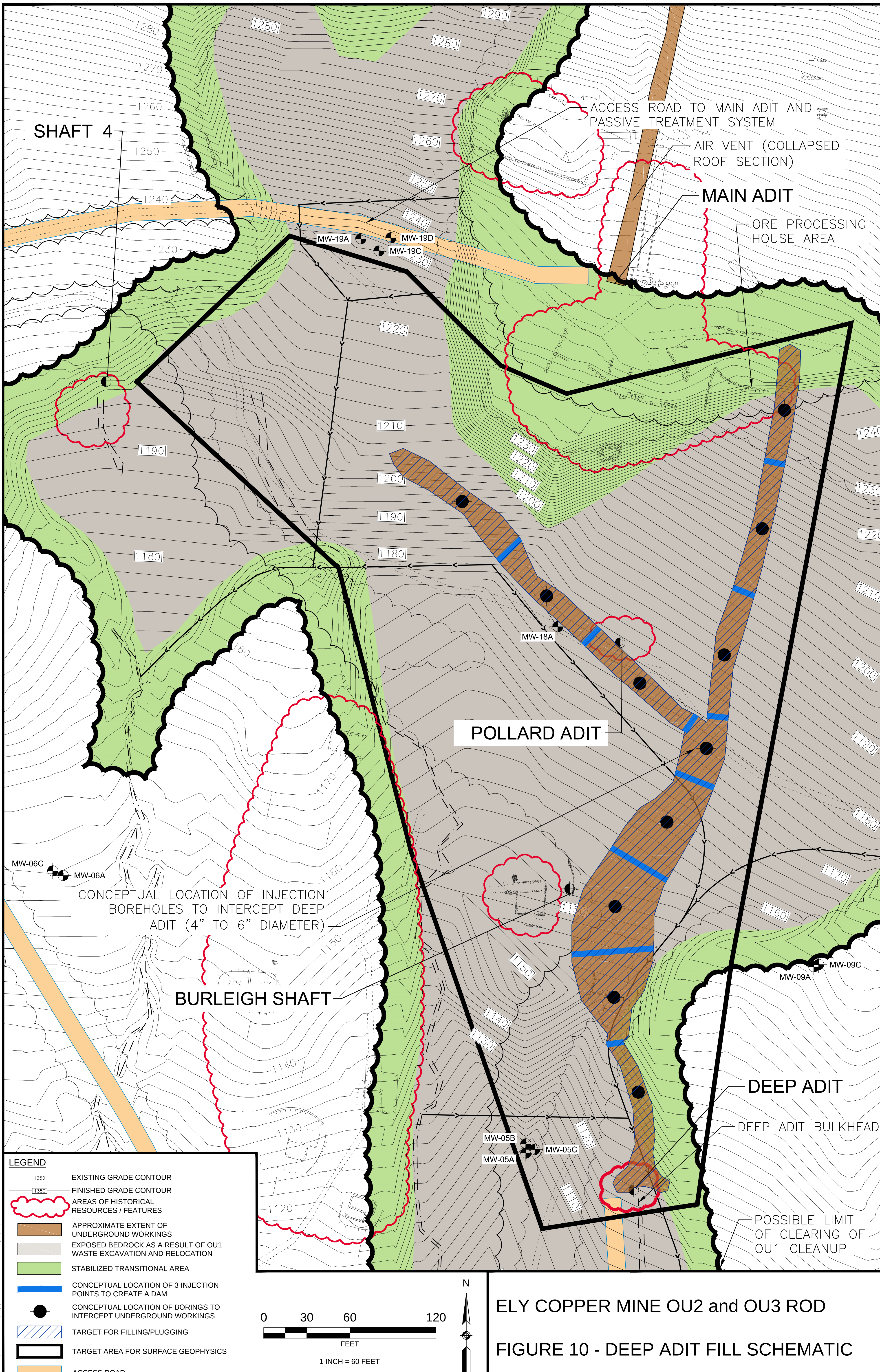

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FIGURE 10 - DEEP ADIT FILL SCHEMATIC

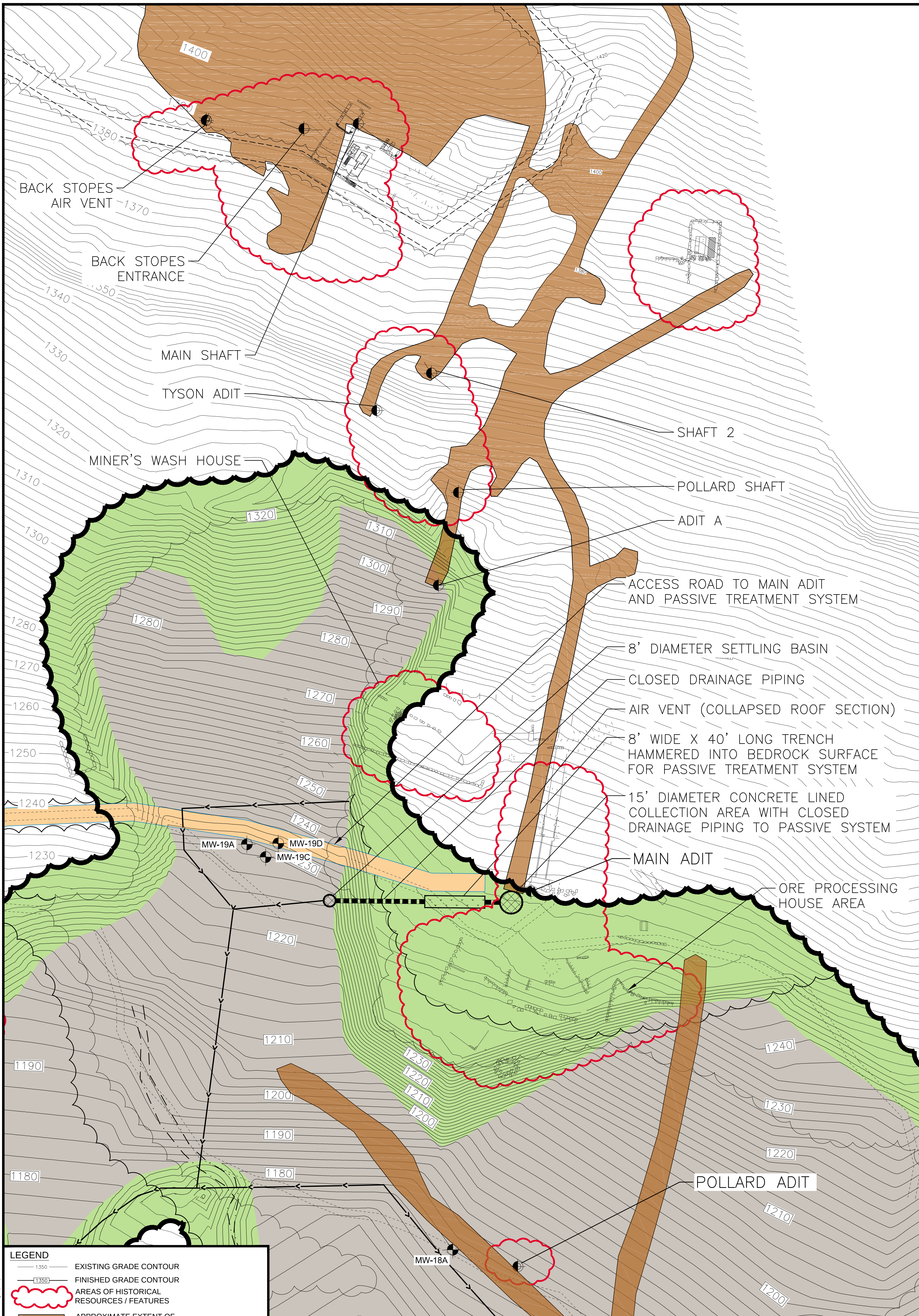

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FIGURE 11 - MAIN ADIT PASSIVE TREATMENT SYSTEM SCHEMATIC

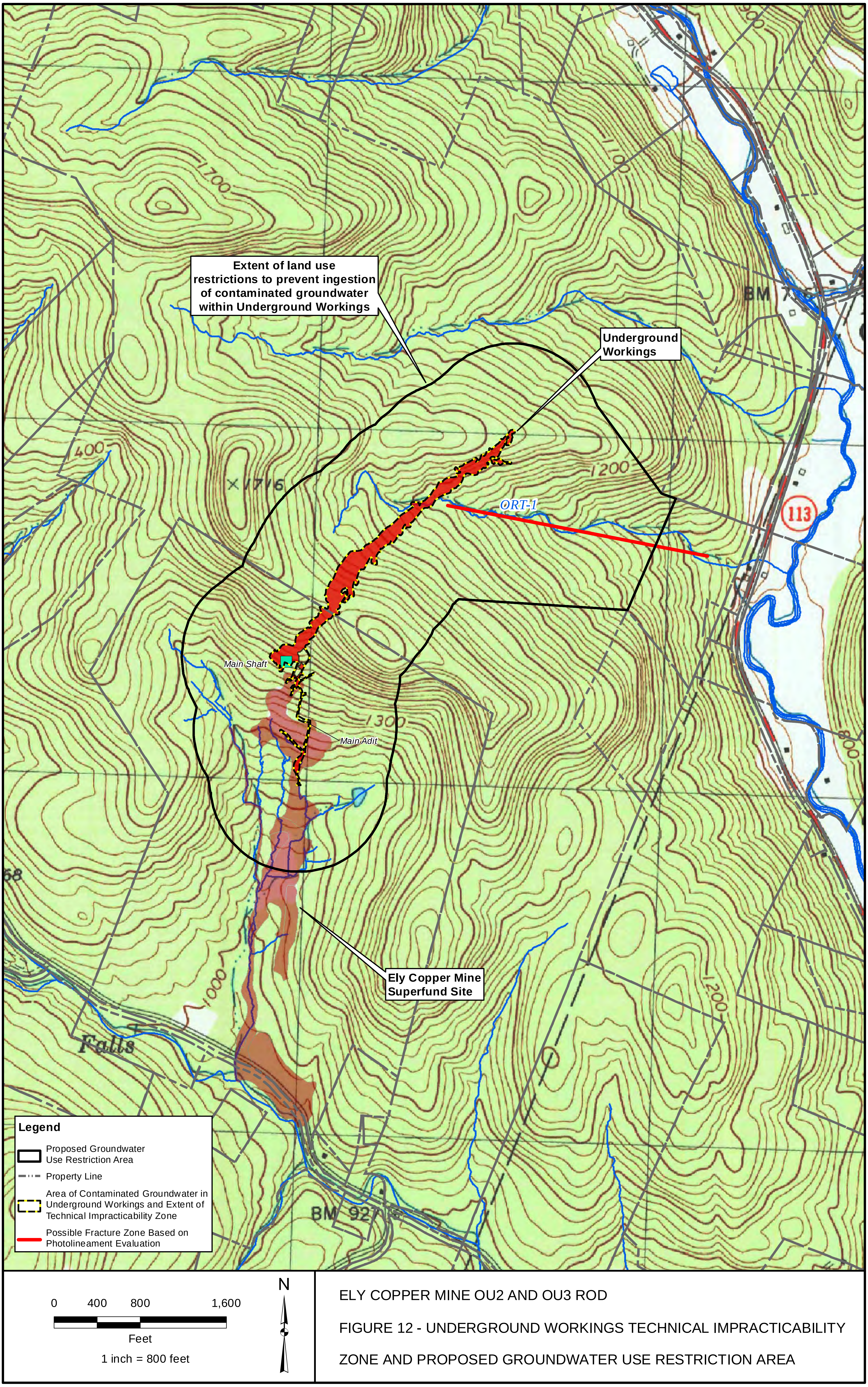

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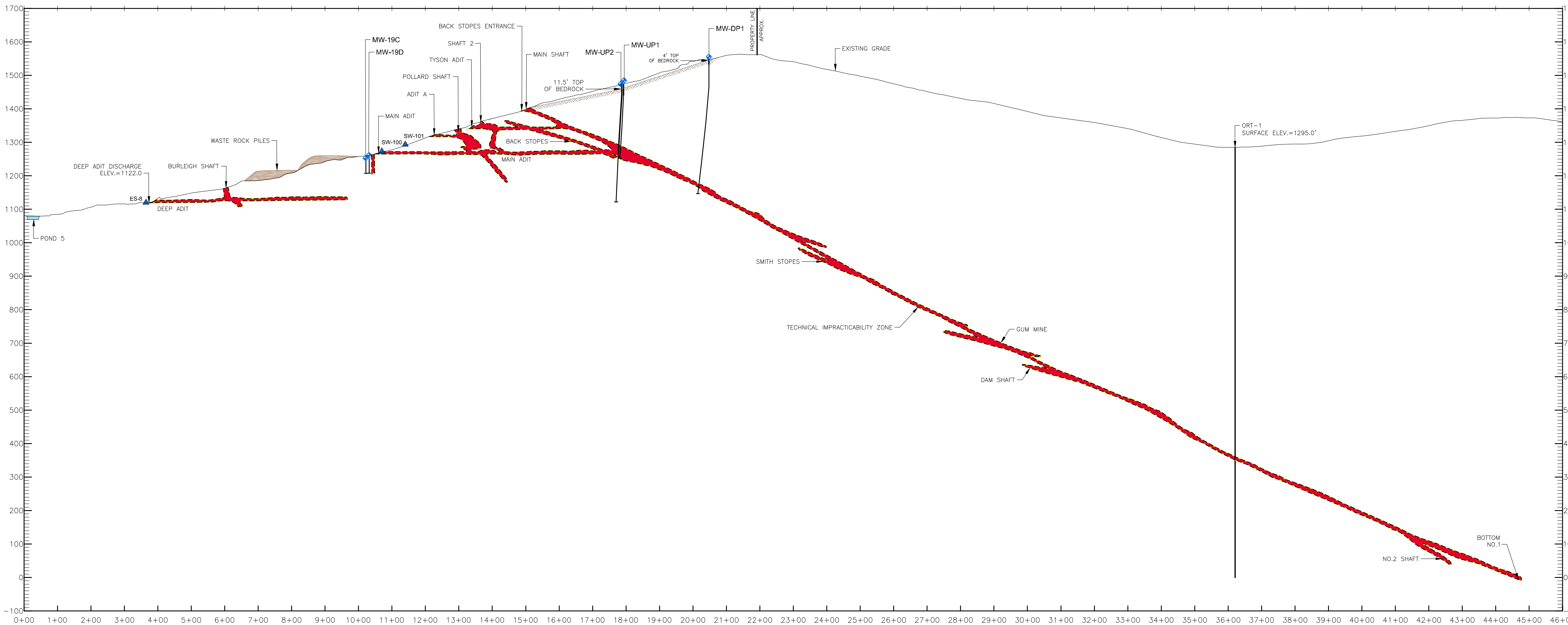
FIGURE 12 - UNDERGROUND WORKINGS TECHNICAL IMPRACTICABILITY ZONE AND PROPOSED GROUNDWATER USE RESTRICTION AREA



NOTES:

1. THE TECHNICAL IMPRACTICABILITY ZONE SHOWN HEREON IS THE SAME RED-SHADED AREA AS THE UNDERGROUND WORKINGS.

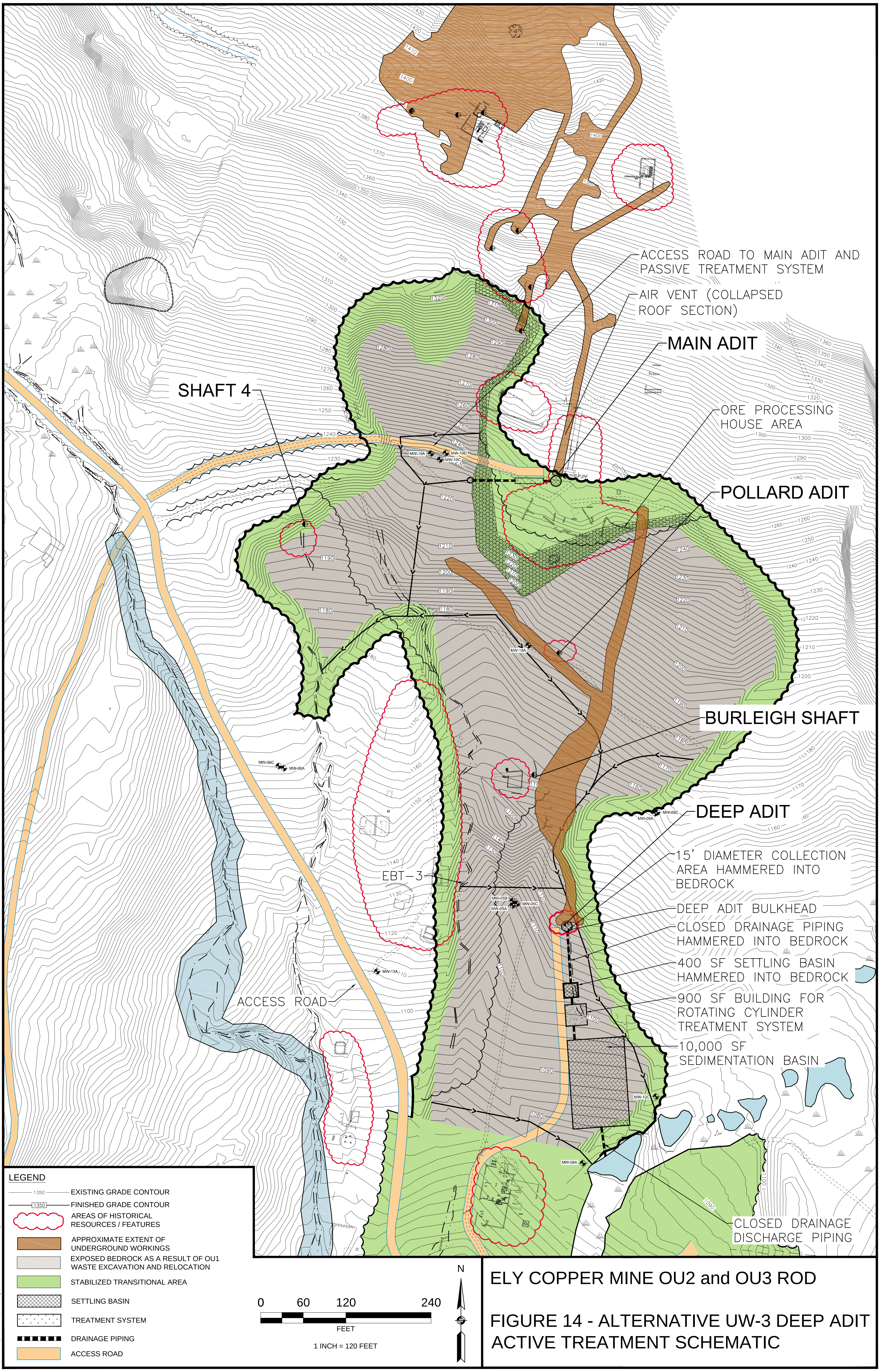
LEGEND:

- MONITORING WELL
- SIGNIFICANT FRACTURE
- GROUNDWATER SURFACE
- TOP OF BEDROCK
- SW-101 SURFACE WATER SAMPLED FOR MINE WORKINGS INVESTIGATION
- TECHNICAL IMPRACTICABILITY ZONE (SAME AREA AS UNDERGROUND WORKINGS)

HORIZONTAL SCALE IN FEET 0 150' 300'
VERTICAL SCALE IN FEET 0 150' 300'

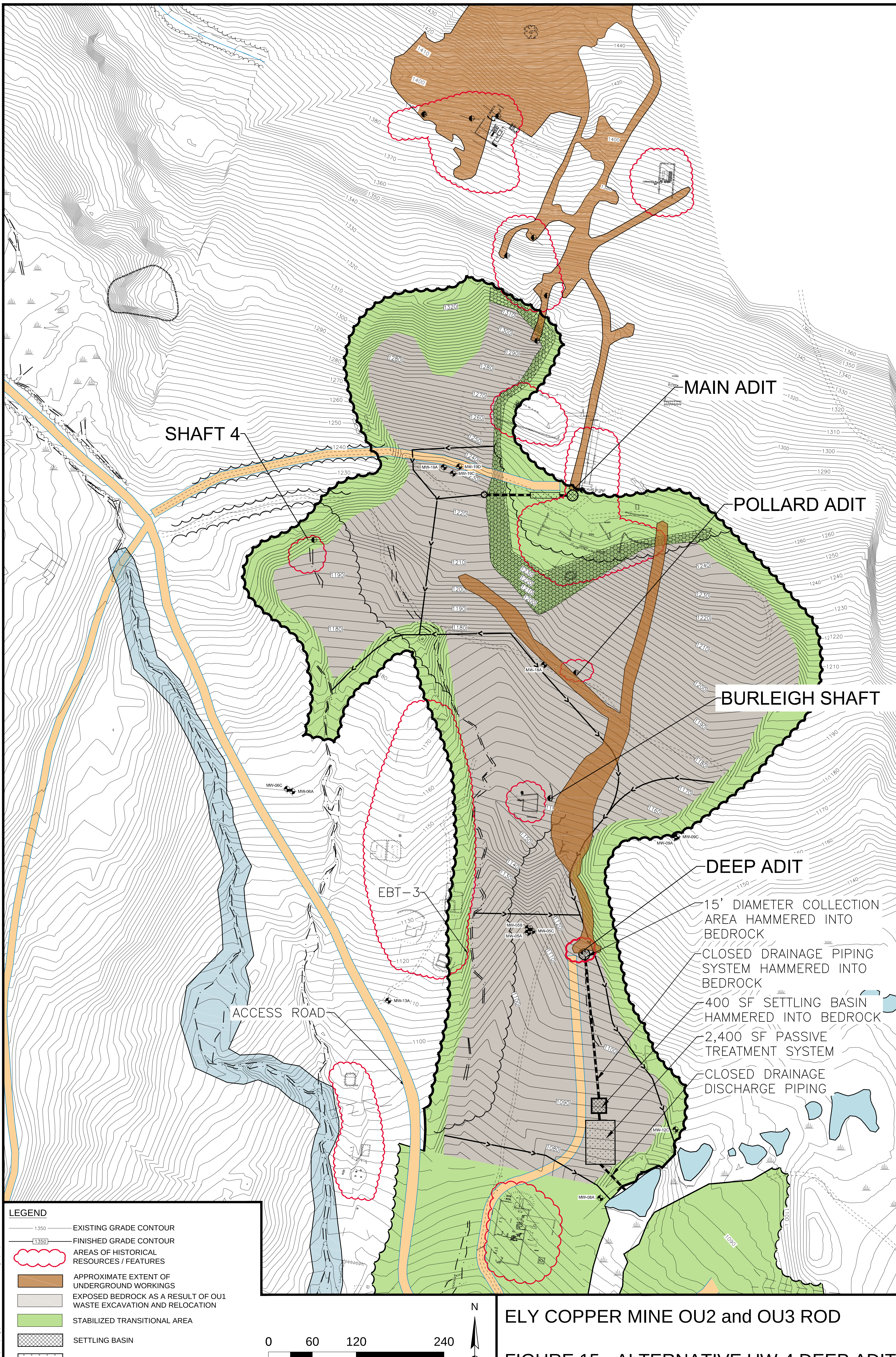
ELY COPPER MINE OU2 and OU3 ROD

FIGURE 13 - TECHNICAL IMPRACTICABILITY ZONE CROSS-SECTION



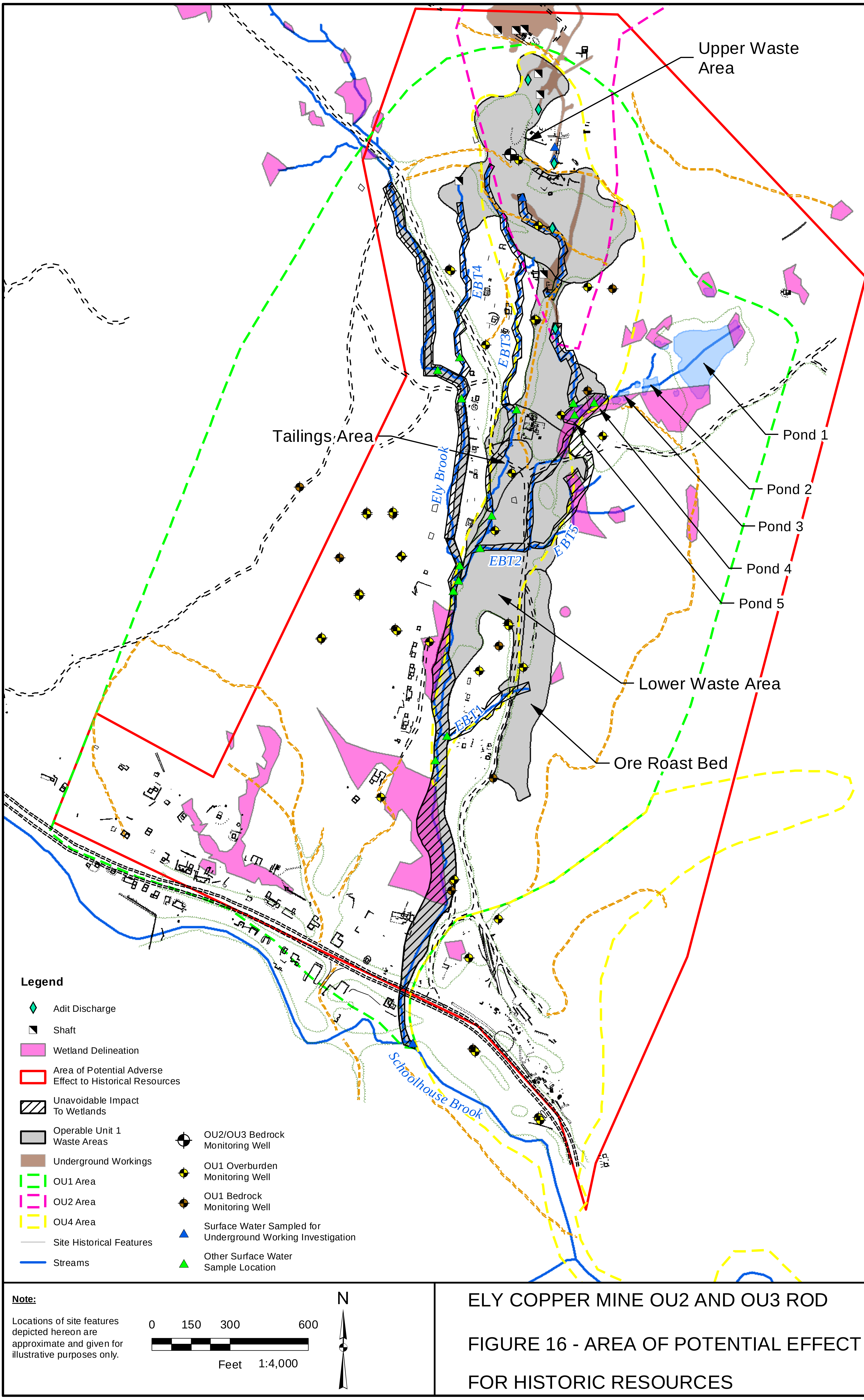
ELY COPPER MINE OU2 and OU3 ROD

FIGURE 14 - ALTERNATIVE UW-3 DEEP ADIT ACTIVE TREATMENT SCHEMATIC



ELY COPPER MINE OU2 and OU3 ROD

FIGURE 15 - ALTERNATIVE UW-4 DEEP ADIT PASSIVE TREATMENT SCHEMATIC



Note:

Locations of site features depicted hereon are approximate and given for illustrative purposes only.

ELY COPPER MINE OU2 AND OU3 ROD

FIGURE 16 - AREA OF POTENTIAL EFFECT FOR HISTORIC RESOURCES

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TAKEN TO COMPLY WITH ARARs
STATE ARARs			
Vermont State Land Use and Development Plans Law (Act 250), 10 V.S.A. Chapter 151; Natural Resource Board Act 250 Rules	Applicable	Issues to be addressed in assessing compliance with Act 250 include substantive environmental and facility siting requirements necessary to demonstrate that the activity: • will not result in undue water and air pollution, including construction-related dust (criterion 1); • will protect headwaters (criterion 1(A)); • will meet all standards for disposal of wastes (criterion 1(B)); • will protect floodways (criterion 1(D)); • will, whenever feasible, maintain the natural condition of streams (criterion 1(E)); • will not violate the rules relating to wetlands (Class Three) (criterion 1(G)); • will not cause unreasonable soil erosion (criterion 4); • will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites, rare and irreplaceable natural areas (criterion 8); • will not destroy or significantly imperil necessary wildlife habitat or any endangered species (criterion 8(A)); • extraction of earth resources will not have an unduly harmful impact upon the environment or surrounding land uses and development and upon completion of the extracting or processing operation the site will be left in a condition suited for an approved alternative use or development (criterion 9 (E)); • will be designed and operated to conserve energy, to the extent practicable (criterion 9(F)); and • will protect public investments (roads) (criterion 9(K)).	Alternative UW-2 will be designed to minimize impacts on protected resources under the Act's criteria, including preventing impacts to downgradient wetlands, streams, and floodways, as appropriate. UW-2 will be designed to minimize energy consumption and impacts on public investments (roads) by using local and industrial waste materials to the extent possible. Site work will be managed to minimize impacts to potential endangered species habitat.
Regulation of Stream Flow Act, 10 V.S.A. Chapter 41; Stream Alteration Rule, Env. Prot. R. Ch. 27, § 27-101 through 27-706	Applicable	Regulates and permits activities that interrupt the natural flow of water in watercourses to protect against damage to aquatic life, prevent creation of flood hazards, and protect from damaging the rights of riparian owners.	Water displaced during the filling of the Deep Adit and associated Underground Workings will be contained and released in a controlled manner to minimize impacts on Ely Brook and tributaries.
Vermont Historic Preservation Act, 22 VSA § 743(4), 761, 763, and 767.	Relevant and Appropriate	Places controls on actions conducted by the state that may impact historic, scientific, or archaeological sites and data.	The filling of the Deep Adit and associated Underground Workings represents a permanent impact to a historic resource. The installation of bat grates will impact historic resources. EPA will consult with the SHPO and community regarding the loss of historic resources and institute mitigation measures, if necessary.
Vermont Protection of Endangered Species Act, 10 V.S.A. Chapter 123	Applicable	This statute outlines the definition of endangered and threatened and the species listed as endangered or threatened. The statute prohibits the taking, possession or transport of wildlife or plants that are members of an endangered or threatened species without complying with the Act. Bat species that have been documented as occurring or may occur on the Site that are listed as threatened or endangered species in Vermont: the Eastern Small-Footed Bat, Tri-colored Bat, Little Brown Bat, Indiana Bat and the Northern Long-eared Bat.	Underground Workings construction and filling activities will be limited to non-hibernation season. An assessment of the Burleigh Shaft, Shaft 4, the Pollard Adit and other mine features will be conducted to determine if previously unidentified hibernacula are present at the Site. Bat grate and structural improvements to Underground Workings entrances will be designed based on the impacts to bats determined in the PDI. Activities around year-round bat habitats will be planned to minimize impacts to the extent possible. Institutional Controls will provide long-term protection to bats and their habitats within the Site.
Vermont ANR Guidance on Riparian Buffers (December 9, 2005)	To Be Considered	This guidance provides technical information on the functions and values of riparian buffers, as well as describing acceptable activities within buffer zones. It recommends the establishment of 100 foot buffer zones to streams under circumstances where there is an increased risk of erosion and/or potential for overland flow of pollutants.	Access roads and other activities will be planned to minimize impacts on riparian buffer zones. Water displaced during the filling of the Deep Adit and associated underground workings will be contained and released in a controlled manner to minimize impacts on Ely Brook and tributaries.

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TAKEN TO COMPLY WITH ARARs
FEDERAL ARARS AND TBCs			
Floodplain Management and Protection of Wetlands, 44 C.F.R. 9	Relevant and Appropriate	Remedial alternatives that may cause alteration within a 500-year floodplain/cause negative impacts to downstream floodplain or that will cause alteration of federal jurisdictional wetlands/aquatic habitats will be implemented in compliance with these relevant and appropriate FEMA standards (which promulgrate requirements under Executive Order 11988 (Floodplain Management) and Executive Order 11990 (Protection of Wetlands)). Prohibits activities that adversely affect a federally-regulated wetland unless there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands that may result from such use.	Water displaced during the filling of the Deep Adit and associated Underground Workings will be contained and released in a controlled manner to minimize downstream flooding and wetland impacts. Measures to prevent acid mine drainage from reaching downstream wetlands/waterways will protective of downstream receptors.
Federal Endangered Species Act of 1973 (ESA), 16 U.S.C. 1531 *et seq*.; 33 C.F.R. Part 320 50 CFR Part 17(o) Endangered and Threatened Wildlife and Plants; 4(d) Rule for the Northern Long-Eared Bat	Applicable	The purpose of the ESA is to "conserve the ecosystems upon with threatened and endangered species depend" and to conserve and recover listed species. Federal agencies must consult with the U.S. Fish and Wildlife Service to ensure that the actions they authorize, fund, or carry out will not jeopardize listed species. The law provides for critical habitat designations for listed species. Critical habitat designations affect Federal agency actions and federally funded or permitted activities. The Northern long-eared bat (*Myotis septentrionalis*) is listed as federally threatened and the Indiana bat (*Myotis sodalis*) is listed as federally endangered. The Northern long-eared bat has been documented at the Site and the Indiana bat may occur. The U.S. Fish and Wildlife Service (Service), finalized a rule under authority of section 4(d) of the Endangered Species Act of 1973 (Act), as amended, that provides measures that are necessary and advisable to provide for the conservation of the Northern long-eared bat. These rules became effective February 16, 2016.	Underground Workings construction and filling activities will be limited to non-hibernation season. An assessment of the Burleigh Shaft, Shaft 4, the Pollard Adit and other mine features will be conducted to determine if previously unidentified hibernacula are present at the Site. Bat grate and structural improvements to Underground Workings entrances will be designed based on the impacts to bats determined in the PDI. The U.S. Fish and Wildlife Service will be consulted in the PDI planning process and throughout the remedial action so that investigations and RAs do not adversely impact bat populations or habitats that may be present throughout the year. The cleanup activities will follow the recommended bat conservation measures including the dates when tree cutting can be performed and avoidance of activities that may impact the hibernaculum. Institutional Controls will provide long-term protection to bats and their habitats within the Site.
National Historic Preservation Act (NHPA), 16 U.S.C. 470 et seq., 36 C.F.R. Part 800	Applicable	Section 106 of the NHPA requires EPA to take into account the effect of all of its actions on historic properties in consultation with the State Historic Preservation Officer (SHPO). A determination has been made that the Ely Mine Site is eligible for the National Register of Historic Places. The consultation is to identify potential adverse effects on historic properties and seek ways to avoid, minimize or mitigate any such effects on historic properties.	Unavoidable adverse impacts will occur to historic Site resources. Filling of the Deep Adit and associated Underground Workings will impact these features, and actions to shore up Underground Workings entrances and install bat grates may cause impacts to those features as well. EPA with consult with the SHPO in developing mitigation measures, as required.
Archeological and Historic Preservation Act, 16 U.S.C. 469 *et seq*., 36 C.F.R. Part 65	Applicable	This standard requires that, whenever any federal agency finds or is made aware that its activity in connection with any construction project or federally licensed project, activity, or program may cause irreparable loss or destruction of significant scientific, pre-historical, historical, or archeological data such agency shall undertake the recovery, protection, and preservation of such data or notify the Secretary of the Interior. The undertaking could include a preliminary survey (or other investigation as needed) and analysis and publication of the reports resulting from such investigation.	Any access roads or other construction to complete UW-2 will be located to avoid known significant scientific, pre-historic, historical, or archaeological assets. Most of the UW-2 activities will be within the footprint of the OU1 RA or on properties with no known connection to Ely Mine. Access roads and monitoring wells within the OU3 area will be sited to avoid any potential protected resource areas, or mitigation will be carried out for unavoidable impacts, if required.

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TAKEN TO COMPLY WITH ARARs
STATE ARARs			
Groundwater Protection, 10 V.S.A. Ch 48, Groundwater Rule and Strategy, VT Env. Prot. R. Ch. 12, Appendix One, Table 1 Primary Groundwater Protection Standards	**WAIVED**	State groundwater protection standards.	Primary groundwater protection standards for manganese are waived for the area within the TI Zone.
Vermont Water Quality Standards, VT Env. Prot. R. Chapter 29(a), Ch. 1, 2, and 3 and Appendix C and D	Relevant and Appropriate	Standards establish human and ecological health-based criteria for surface water, including solids, alkalinity, pH, and toxic substances.	Alternative UW-2 will be designed to minimize contaminated surface water discharges by filling the Deep Adit and associated Underground Workings and installing a passive treatment system to address discharges from the Main Adit or potentially from other mine features where bat hibernacula have been located, as necessary. Surface water treatment standards for Class B waters will be achieved at the downgradient compliance point.
FEDERAL ARARS AND TBCs			
Clean Water Act, Section 304(a), 33 U.S.C. § 1314(a); National Recommended Water Quality Criteria, 40 C.F.R. §§ 122.44 and 131.11	Relevant and Appropriate	These standards were used to develop numerical standards for the protection of aquatic biota quality for surface water and sediment at and downstream of the compliance points.	Alternative UW-2 will be designed to minimize contaminated surface water discharges by filling the Deep Adit and associated Underground Workings and installing a passive treatment system to address discharges from the Main Adit or potentially from other mine features where bat hibernacula have been located, as necessary. Surface water treatment standards for Class B waters will be achieved at the downgradient compliance point.
EPA National Recommend Water Quality Criteria (guidance) - EPA 822-R-02-047 (EPA 2002)	To Be Considered	This guidance regarding the NRWQC is based on data and scientific judgments about the relationship between pollutant concentrations and environmental effects. The guidance was considered in the establishment of site-specific cleanup levels and delineation criteria for surface water when Vermont Water Quality Standards were not available.	UW-2 will address ecological exposure risks from surface water developed using this guidance, by meeting treatment standards at the downstream compliance point through source minimization and discharge treatment.
Preliminary Remediation Goals for Ecological Endpoints , Efroymson et al., August 1997	To Be Considered	This technical memorandum presents recommended preliminary remediation goals (PRGs) for ecological endpoints for risk assessments and decision making at CERCLA sites.	UW-2 will address ecological exposure risks from surface water developed using this guidance, by meeting treatment standards at the downstream compliance point through source minimization and discharge treatment.

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TAKEN TO COMPLY WITH ARARs
STATE ARARs			
Vermont Water Quality Standards, VT Env. Prot. R. Ch. 29(A), Ch. 1, 2, and 3 and Appendix C and D (October 2014)	Applicable	Establishes water quality standards for surface waters and applies to alternatives that call for monitoring surface water bodies on and off of the Site.	UW-2 includes reduction of source volume and treatment of discharge to achieve these standards. These standards will be used to monitor UW discharge and confirm acceptable outlet concentrations.
Vermont Pollution Control Act, 10 V.S.A. Ch. 47; Water Pollution Control Permit Regulations, VT Env. Prot. R. Ch. 13	Applicable	The regulations stipulate requirements for discharges to surface waters, compliance with NPDES standards, and meeting stormwater management requirements.	UW-2 includes reduction of source volume and treatment of discharge to achieve these standards. Water displaced from Underground Workings during adit filling will be contained and tested to determine the need for treatment based on these regulations. Site disturbance will be subject to best management practices in order to be comply with stormwater management standards. Water displaced from UW during remedial activities (such as filling) may require treatment prior to discharge to surface waters.
Groundwater Protection, 10 V.S.A. Ch 48, Groundwater Rule and Strategy, VT Env. Prot. R. Ch. 12, Appendix One, Table 1, Primary Groundwater Protection Standards	Applicable	Establishes monitoring standards for groundwater at the TI Zone compliance boundary. Also the basis for ICs to prevent groundwater use within the TI Zone and to restrict well installation in the well-restriction zone.	Alternative UW-2 institutional controls will restrict exposure to contaminated groundwater within the TI Zone and prevent the installation of wells within the well restriction area that might cause the migration of contaminated groundwater from the TI Zone. Establishes monitoring standards for the TI Zone to ensure contaminant migration is not occurring and the remedy remains protective.
Vermont Stormwater Management Act, 10 V.S.A. § 1263 and §1264; Vermont Stormwater Management Rule, VT Env. Prot. R. Ch. 18	Applicable if over 1 acre of impervious surface created; Relevant and Appropriate if less than 1 acre of impervious surface created	Activities that create more than one acre of impervious surfaces, including roads and expansions to existing impervious surfaces that result in a total of one acre of impervious surfaces or more, must implement measures to address the storm-water from the impervious surfaces.	Alternative UW-2 would include measures to comply with these requirements through the design of measures to mitigate the release of stormwater from disturbed areas of the Site.
Vermont Waste Management Act, 10 V.S.A. Chapter 159; Hazardous Waste Management Regulations, VT Env. Prot. R. Ch. 7	Applicable	Establishes requirements for the identification and management of hazardous waste. These regulations apply to solutions having pH less than 2 or contaminated media that exceeds toxicity standards under these regulations. Treatment media or any other wastes that are disposed of off-site will be tested to determine if it exceeds the standards to be managed and disposed of as hazardous waste. Incorporates requirements of the federal Resource Conservation and Recovery Act regulations, 40 C.F.R. 264.	Wastes generated by UW-2 for off-site disposal (such as settled solids associated with the passive treatment system) or discharged downstream (pH of liquids) will be tested for hazardous waste characteristics. If the wastes exceed these standards, they will be handled under the requirements of these regulations.
Vermont Air Pollution Control Act, 10 V.S.A. Ch. 23; Air Pollution Control Regulations, VT Env. Prot. R. Ch. 5	Applicable	Establishes standards for air pollution prevention, abatement and control. List prohibited activities and establishes primary and secondary ambient air quality standards for specific pollutants. Includes dust control standards.	Dust suppression will be used during construction/site alteration actions to comply with these standards, as applicable.
Underground Injection Control Regulations, VT Env. Prot. R. Ch. 11	Relevant and Appropriate	These standards regulate disposal systems or any bored, drilled, or driven shaft, dug hole, or any other opening in the ground that is used to discharge waste (where "waste" is defined as "any substance or material that flows or moves whether in a semi-solid, liquid or other state), either under pressure or gravity, to the soil or groundwater.	Substances injected into the Underground Workings will not negatively impair groundwater quality. Standards to protect groundwater are relevant and appropriate to alternative components that involve injecting grout or other substances into the Underground Workings.
Vermont Handbook for Erosion Prevention and Sediment Control (VTDEC, 2006)	To Be Considered	A compilation of information from various sources released by the Vermont Department of Environmental Conservation for use in developing the erosion prevention and sediment control plans required for construction-related stormwater discharge permitting.	The manual will be used to guide development of measures to prevent erosion and sedimentation from remedial activities.

REQUIREMENT	STATUS	REQUIREMENT SYNOPSIS	ACTION TAKEN TO COMPLY WITH ARARs
FEDERAL ARARS AND TBCs			
Federal Safe Drinking Water Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs), National Primary Drinking Water Regulations, 40 C.F.R. Parts 141.11 – 141.16 and 141.50 – 141.53	Relevant and Appropriate for MCLs and non-zero MCLGs only	These standards may be used as monitoring standards for groundwater at the TI Zone compliance boundary.	UW-2 will include these groundwater standards as monitoring standards for the TI Zone.
Resource Conservation and Recovery Act, 42 U.S.C. § 6901 *et seq.* ; 40 C.F.R. Part 264	Applicable	Vermont is delegated to implement these standards through its Hazardous Waste Management Regulations (see reference Vermont Waste Management Act, 10 V.S.A. Chapter 159; Hazardous Waste Management Regulations, VT Env. Prot. R. Ch. 7 above).	Wastes generated by UW-2 for off-site disposal (such as settled solids associated with the passive treatment system) or discharged downstream (pH of liquids) will be tested for hazardous waste characteristics. If the wastes exceed these standards, they will be handled under the requirements of these regulations
Federal Clean Water Act, Section 304(a), 33 U.S.C. § 1314(a); National Recommended Water Quality Criteria (NRWQC), 40 C.F.R. §§122.44 and 131.11	Relevant and Appropriate	These standards are used to develop numerical and biological water quality standards for monitoring surface water quality.	These standards will be used to monitor UW surface water discharge and confirm acceptable outlet concentrations. Monitoring will ensure that source control remedies at the Site are preventing metals and acid mine drainage from migrating to surface waters and exceeding the waterways' water quality standards.
Federal Clean Water Act, Section 402, 33 U.S.C. § 1342; National Pollution Discharge Elimination System (NPDES) 40 CFR 122-135, 131	Applicable	These regulations contain discharge limitations, monitoring requirements, and best management practices (BMPs) for discharges into navigable waters, i.e., surface waters. These regulations would be applicable to remedial strategies involving discharge to surface waters.	Water displaced during the filling of the UW will be treated to meet discharge standards prior to being discharged to Site waterways. Site disturbance will comply with stormwater management standards.
Federal Clean Water Act, § 1342; Stormwater Requirements for Construction Sites; 40 C.F.R. 122.26	Applicable if over 1 acre of impervious surface created; Relevant and Appropriate if less than 1 acre of impervious surface created	Regulates stormwater discharge from construction activity including clearing, grading and excavation for operations that result in the disturbance of over one acre of total land area. The standards are relevant and appropriate for alternatives that will disturb less than an acre of land.	Alternative UW-2 would include measures to comply with these requirements through the design of measures to mitigate the release of stormwater from disturbed areas of the Site.
Groundwater Injection Standards, 40 C.F.R. §§ 144, 146, 147	Relevant and Appropriate	These standards regulate disposal systems or any bored, drilled, or driven shaft, dug hole, or any other opening in the ground that is used to discharge waste (where "waste" is defined as "any substance or material that flows or moves whether in a semi-solid, liquid or other state), either under pressure or gravity, to the soil or groundwater.	Substances injected into the Underground Workings will not negatively impair groundwater quality. Standards to protect groundwater are relevant and appropriate to alternative components that involve injecting grout or other substances into the Underground Workings.
EPA Carcinogenicity Slope Factor	To Be Considered	Slope factors are developed by EPA from Health Effects Assessments and present the most up-to-date information on cancer risk potency. Slope factors are developed by EPA from Health Effects Assessments by the Carcinogenic Assessment Group.	Alternative UW-2 addresses carcinogenic groundwater exposure risks calculated using this guidance through ICs to prevent exposure to contaminated groundwater in the TI Zone and using the risk-based standards developed using this guidance as TI Zone monitoring standards.
EPA Risk Reference Doses (RfDs)	To Be Considered	RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Alternative UW-2 addresses groundwater exposure risks calculated using this guidance through ICs to prevent exposure to contaminated groundwater in the TI Zone and using the risk-based standards developed using this guidance as TI Zone monitoring standards.
Health Advisories (EPA Office of Drinking Water)	To Be Considered	Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only. To be considered for monitoring contaminants in groundwater where the standard is more conservative than either federal or state statutory or regulatory standards. These standards are used for monitoring standards for groundwater.	Alternative UW-2 addresses groundwater exposure risks calculated using this guidance through ICs to prevent exposure to contaminated groundwater in the TI Zone and using the risk-based standards, particularly for manganese, developed using this guidance as TI Zone monitoring standards.
Guidelines for Carcinogen Risk Assessment EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk. Used to establish risk-based standards for managing groundwater at the Site.	Alternative UW-2 addresses carcinogenic groundwater exposure risks calculated using this guidance through ICs to prevent exposure to contaminated groundwater in the TI Zone and using the risk-based standards developed using this guidance as TI Zone monitoring standards.
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance for assessing cancer risks to children. Used to establish risk-based standards for managing groundwater at the Site.	Alternative UW-2 addresses carcinogenic groundwater exposure risks to children calculated using this guidance through ICs to prevent exposure to contaminated groundwater in the TI Zone and using the risk-based standards developed using this guidance as TI Zone monitoring standards.

APPENDIX B

STATE OF VERMONT DEC
LETTER OF CONCURRENCE

VERMONT

Vermont Department of Environmental Conservation
Commissioner's Office
One National Life Drive, Main 2 [phone] 802-828-1556
Montpelier, VT 05620-3520 [fax] 802-828-1541

Agency of Natural Resources

June 15, 2016

Bryan Olson, Director
Office of Site Remediation and Restoration
USEPA Region 1
5 Post Office Square
Suite 100 (OSRR07-4)
Boston, MA 02109

Dear Mr. Olson

The State of Vermont, Department of Environmental Conservation (VTDEC) has reviewed the US EPA May 2016 Record of Decision for Operable Unit 2 and 3, to remediate the Ely Copper Mine Superfund Site. The VT DEC concurs with the preferred response actions outlined in the ROD, which consists of the following key components:

- Groundwater Pre-Design Investigation (PDI) to delineate a groundwater use restriction zone;
- PDI program for adits and shafts;
- Deep Adit, Burleigh Shaft, Pollard Adit, and Shaft 4 Filling and Closure;
- Passive chemical treatment system of the discharge from the Main Adit;
- Institutional Controls;
- Long -Term monitoring and Site inspections;
- Five-year reviews

This concurrence is predicated on obtaining the necessary funds from the Legislature. The VT DEC is committed to work with the Legislature to establish the required level and system of funding to meet the financial obligation at this site. The VT DEC intends to fulfill its obligations under CERCLA to the best of its abilities, given the funding constraints that may exist over the life of the project.

The VT DEC looks forward to its continued partnership with EPA and the successful implementation of this project.

Sincerely,

George Desch, Deputy Commissioner
Department of Environmental Conservation

APPENDIX C

RESPONSIVENESS SUMMARY

ATTACHMENT C
ELY COPPER MINE SUPERFUND SITE
OU2 AND OU3 RECORD OF DECISION
RESPONSIVENESS SUMMARY

PREFACE

The purpose of this Responsiveness Summary is to document EPA's responses to the questions and comments raised during the public comment period. EPA considered all of the comments submitted to EPA during the public comment period for the Ely Copper Mine Superfund Site OU2 and OU3 Proposed Cleanup Plan and associated Administrative Record selecting a final remedial alternative to address contamination at the Site. Attachment A to the Responsiveness Summary contains a copy of the transcript from the public hearing held on Tuesday, September 22, 2015 at the Vershire Town Center Building in Vershire, Vermont. One written comment was submitted during the comment period and it is included in the Administrative Record.

This Responsiveness Summary addresses comments pertaining to the OU2 and OU3 Proposed Plan, the OU2 and OU3 Feasibility Study Report, the EPA finding regarding the Least Environmentally Damaging Practicable Alternative for the wetlands at the Site, the finding regarding unavoidable adverse effects on historic resources, and the Administrative Record for the Ely Copper Mine Superfund Site that were received by EPA during the comment period from September 8, 2015 to October 8, 2015. The State of Vermont Department of Environmental Conservation, the current landowner for OU3, and several members of the community submitted comments to EPA either in writing or at the public hearing.

SUMMARY OF COMMENTS FROM FEDERAL, STATE AND LOCAL AGENCIES AND OFFICIALS, AND FROM INDIVIDUALS

<u>Comments from State or Local Government or other Federal Agencies:</u>

Comment: The Vermont Department of Environmental Conservation (VT DEC) commented that they had reviewed the Proposed Plan and supporting documents for the OU2 and OU3 cleanup. Based on this information the VT DEC concurs with the EPA's cleanup proposal. The VT DEC recognizes that the State will be financially responsible for 10 percent (or approximately $0.337 million) of the capital costs for the remedy and for operational and maintenance costs in perpetuity. At this time, the State's contribution for the proposed cleanup has not been approved by the Vermont legislature. However, the legislature is aware that there are financial commitments associated with the cleanup actions at the Ely Copper Mine, and the VT DEC is committed to working diligently with the legislature to establish the required level and system of funding to meet the State's financial obligation at the Site.

Response: EPA and the State of Vermont have worked as partners at the Ely Copper Mine. The continued support of Vermont DEC is appreciated and noted for the record. EPA understands that future expenditures must be addressed through the state budgetary processes.

Comments from Individuals:

Comment: One individual expressed support for the cleanup of the Ely Copper Mine along with a concern that the current landowners be required to provide a public benefit as a result of the public money to be spent on the cleanup. Specifically, the comment suggest that the landowners be required to provide public access to the areas that have been deemed safe for hiking, maybe even access to ridgelines if in the future somebody in town determines that it would be a good site for solar or wind energy,

Response: EPA agrees that the cleanup should be implemented and appreciates the support. While EPA agrees with the concept of beneficial use of all cleanup sites, EPA cannot require the landowner to provide general public access or perform other activities beyond what is necessary to implement the response actions. EPA would encourage the community to engage the landowners in a dialogue regarding the future use of the property.

Comment: One individual, representing the Vershire Historical Society, requested that EPA coordinate with the Vershire Historical Society to allow for recovery and conservation of any artifacts or historic materials that may be impacted by the cleanup actions.

Response: EPA appreciates the cooperation and support that the Vershire Historical Society has provided to date. EPA will work with the landowners, State Historic Preservation Officer, Vermont Division for Historic Preservation, the Vershire Historical Society, and other key stakeholders to ensure the proper documentation, recovery, and curation of any artifacts that may be impacted or recovered as a result of the OU2 and OU3 cleanup activities.

Comments from Current Landowner of OU3:

Terracon Consultants, Inc. (Terracon) on behalf of the current landowner of property overlying the Underground Mine Workings at OU3, Green Crow Corporation, commented that the area proposed for groundwater use restriction as part of the OU3 proposed cleanup plan should be reduced. Terracon provided specific comments as the basis for their opinion regarding the EPA's proposed groundwater use restriction area and their suggested revision. Specific comments are listed below along with the EPA response.

Comment: Terracon asserts that the EPA proposed AUL Area is overly expansive and appears to be counter to known hydrogeological information for the hydrogeological regime in the vicinity of the Green Crow property.

Response: EPA does not agree that the proposed groundwater use restriction area, referred to in the comments as the Activity and Use Limitation (AUL) Area, is overly expansive nor does EPA agree that the AUL is counter to known hydrogeological information for the hydrogeological regime in the vicinity of the Green Crow property. The OU2 and OU3 RI, along with the other information in the Administrative Record, was used to develop the proposed groundwater use restriction area. Given the very limited data available for the OU3 area, the proposed groundwater use restriction area relied upon assumptions that were based on creating a restriction area where there would be high confidence that groundwater at or beyond the edge *of the restriction area would not be impacted by the Underground Workings, even if a pumping stress at the edge of the groundwater restriction area were to exist. EPA does agree that the information available suggests that the current extent of contamination is likely limited to the Underground Workings. Data collected during the OU1 and OU2/OU3 RI does provide some insight that contaminated groundwater in the Underground Workings is not actively contributing to ORT-1 or the bedrock aquifer associated with the residential water supplies at the outer edge of the potential fracture zone. Four residential wells in the area east and north of the Underground Workings along with surface water samples along the upper and lower elevation portion of ORT-1 were collected during the OU1 RI and OU2/OU3RI. The residential well results and surface water samples suggest that site contamination is not discharging to ORT-1 or impacting existing water supplies. The assessment of the current geochemical conditions of the mine pool (i.e. circumneutral pH with elevated ferrous iron, calcium, bicarbonate, and sulfate), also indicate that the mine pool is relatively stagnant (i.e. the volume of inflow and outflow is significantly less than the total volume of the mine pool). That is why EPA identified the extent of the Technical Impracticability Zone as the extent of the Underground Workings. The purpose of the groundwater use restriction area is to prevent a future groundwater pumping stress from causing migration of contamination from the Underground Workings into the surrounding bedrock aquifer.*

In support of the above assertion, Terracon comments as follows:

Comment: In the 2015 Tech Memo that updated the RI (the "2015 Tech Memo"), a significant amount of recharge to bedrock was assumed: 25% of the average precipitation was assumed to infiltrate the ground and recharge groundwater in bedrock, based on research by Harte and Johnson, 1995 noting an estimated recharge of 10 inches for surface geologic deposits of glacial till or bedrock in the Contoocook River Basin, and also based on Vermont Agency of Agriculture website data indicating a recharge estimate of 10 inches per year for somewhat poorly drained soils. Conversely, runoff rates as high as 95% (corresponding to 5% infiltration) are indicated by application of standard storm-water design procedures and use of stormwater design studies of mountainous watersheds. Published USDA- published information for the soils on Green Crow property indicates shallow unweathered rock, which supports high runoff. Findings in the Remedial Investigation (RI) included glacial till was observed up to 6 ft. thick in the Upper Waste Area (UWA), and exposed bedrock at many locations in the upper elevations of Dwight Hill.

Response: Storm water design procedures are intended to address low-frequency water flow (e.g. 100 year storm design), which are expected to cause a much higher percentage of runoff because of the inability of the subsurface to absorb that rate of precipitation. Storm water design infiltration rates are not appropriate for the estimating the average recharge rate over the long term, which is why the estimate of 10 inches of water per year was selected.
It is noted that the "2015 Tech Memo" was submitted prior to the OU2/OU3 RI and, therefore, was not an update of that RI. All previous technical memoranda associated with OU2/OU3 have been superseded by the Final OU2/OU3 RI. The Tech Memo, OU2/OU3 RI and all other documents supporting the selection of the OU2/OU3 remedy are found in the Administrative Record for OU2/OU3.

Comment: For the purposes of AUL boundary delineation, Nobis assumes that all of the 25% recharge enters the deep bedrock via fractures. In the RI report, however, Nobis discusses the very fractured nature of observed shallow bedrock seen overlying intact (massive) bedrock below depths of, typically, 30 feet and, when discussing contaminant transport, Nobis concludes that " ...the limited yield and relatively low number of water-bearing deep bedrock fractures encountered during recent exploration efforts indicates that with the exception of these mine openings, contaminated groundwater is not likely to be transported significant distances via the deep bedrock." (RI p.153)

Response: The recharge analysis was used in Tech Memo 2 to estimate a general water budget for the Underground Workings and surrounding area. These recharge estimates are meant to present an approximate assessment of average annual inputs for groundwater recharge that might be expected based on published values. This previous exercise was conducted as part of the conceptual site model and was not part of the AUL delineation documented in the July 2015 RI report. The quote in Terracon's comment is from the 2011 RI Report, not the 2015 RI Report.

Comment: Also, "Of the 20 bedrock wells analyzed as part of the RI, only 4 wells (BOM-3, MW-12C, MW-19C, and MW-21C) consistently indicated impacts from ARD. Impacted wells or bedrock zones are generally located in the shallow bedrock within or immediately downgradient of waste source areas and areas where overburden groundwater is also impacted." (RI p.70)

Response: UP1, UP2, and DP1 are the only wells that were specifically installed to assess the Underground Workings. UP2 and DP1 intersect the Underground Workings and have a well screen within the Underground Workings to allow the collection of groundwater samples to assess the water quality within the Underground Workings. Based on UP1, UP2, and DP1, the OU2/OU3 RI concluded that the source of the Main Shaft mine pool groundwater contamination is the wall rock and residual waste rock within the Main Shaft and associated shafts, tunnels, and adits, not the surface waste rock and tailings pile sources. The wells referenced in the comment (BOM-3, MW-12C, MW-19C, and MW-21C) were used to assess groundwater conditions outside of the Underground Workings. The ARD impacts in these wells did confirm that the waste source areas are the likely source of the groundwater contamination within the OU1 area in the vicinity of the waste areas. The nature and extent of the surface-source related contamination and associated groundwater plumes are described in detail in the OU1 RI (Nobis, 2011). The conclusions provided in the OU1 RI and OU2/OU3 RI indicate that the contaminant sources and transport pathways of OU1 versus OU2/OU3 are distinctly different. Therefore, the near-surface OU1 results should not be directly extrapolated to the deep bedrock setting of OU2/OU3.

Comment: When discussing the chemical quality of the mine pool water, Nobis noted in the RI differences in groundwater chemical quality between the adits and the deep mine pools, observing that the chemical quality of discharge from the main adit is significantly affected by groundwater percolating into the adit from above, rather than the water comprising the deep mine pool. In Tech Memo 4, Nobis also noted differences in water quality in the shallower and deeper levels of the mine pool. These observations indicate very limited impacts to surrounding groundwater in areas of discharge into the Ely Brook Valley from groundwater in the deep pool.

Response: The proposed cleanup plan acknowledges that there are likely very limited current impacts to the bedrock groundwater from the Underground Workings. That is why the Technical Impracticability Zone is limited to the extent of the Underground Workings. That is different from the purpose of the groundwater use restriction area which seeks to prevent the installation of wells that could create pumping stresses that could cause the migration of the contamination of the Underground Workings into the surrounding groundwater.

The OU2/OU3 RI concludes that the difference in groundwater chemistry between the mine pool (represented by MW-UP2 and MW-DP1) and the Main Adit surface water can be explained by a combination of percolation and geochemical reactions that occur in the presence of oxygen within the mine pool discharge zone (i.e. the Main Adit). The presence of oxygen in this zone causes dissolved metals in the discharging anoxic mine pool groundwater to oxidize. This oxidation process precipitates metals out of solution, resulting in distinct geochemical differences as this precipitant mass is removed from the aqueous system. It is also possible that seepage from surface waste near the Main Adit or Deep Adit are contributing to the chemistry of the surface water discharge from these mine features.

The OU2/OU3 groundwater impact zone, and the resulting AUL delineation, is based on the potential for groundwater to be impacted directly by the Main Shaft mine pool, not by the impact of the Main Adit discharge or by surface waste located in the Ely Brook Valley downgradient of the Main Shaft. The conclusions provided in the OU1 RI and OU2/OU3 RI clearly demonstrate that the contaminant sources and transport pathways of OU1 versus OU2/OU3 are distinctly different. Therefore, the near-surface OU1 results should not be directly extrapolated to the deep bedrock setting of OU2/OU3, particularly in the AUL area.

Comment: The RI contains several other data indications of limited connections between deep bedrock groundwater and shallow. One example from an area of direct mine waste disposal states the following: "Two shallow bedrock wells located approximately 190 ft. downgradient of the UWA waste piles (MW-SC and MW-9C) do not contain COC exceedances. However, these wells are screened 40 ft. to 50 ft. into bedrock and, therefore, impacts within the upper 15-20 ft. of bedrock cannot be ruled out in these areas." (RI p.82)

Response: The OU2/OU3 RI provides the basis for a bedrock groundwater impact zone that is associated with the Main Shaft mine pool, not with groundwater plumes related to OU1 surface sources (i.e. waste rock and tailings piles). Therefore, the near-surface OU1 results should not be directly extrapolated to the deep bedrock setting of OU2/OU3.

Comment: Deep bedrock copper concentrations are typically lower even directly below the waste in areas where discharge could be expected: in the LWA (RI Section 6., copper concentration in deep bedrock 0.8 MB1versus 142 MB shallow bedrock, Ore Roast Bed (0.5 MB versus 14.9 MB); and Lower Ely Brook deep bedrock MB of 0.8 versus shallow bedrock MB of 1.0). MB - (magnitude relative to background) is arrived at by dividing the study area COG concentrations by the maximum background COG concentration.

Response: The OU2/OU3 RI provides the basis for a bedrock groundwater impact zone that is associated with the Main Shaft mine pool, not with groundwater plumes related to OU1 surface *sources (i.e. waste rock and tailings piles). Therefore, the near-surface OU1 results should not be directly extrapolated to the deep bedrock setting of OU2/OU3.*

Comment: These discharge areas are topographically higher (bedrock elevation near Schoolhouse Brook is 930 feet, compared to the shallowest elevation of the mine pool near the ridge of 1,000 feet) than the depth of the underground pool on Green Crow property. Discharge to the ground surface or even deeper overburden groundwater is unlikely due to the depth of the pool relative to the ground surface above the pool.

Response: The Main Shaft is located approximately 930 feet below ground surface where it crosses the ORT-1 (and associated photolineaments) in plan-view and beneath the ridge to the north of ORT-1, the Main Shaft becomes progressively deeper along its down-dip extent. However, if the ORT-1 photolineament represents a major, steeply-dipping fracture zone, a hydraulic connection between a future pumping well and the Main Shaft cannot be ruled out. Proceeding along the ORT-1 photolineament and potential fracture zone eastward and down elevation, the land surface is at a lower hydraulic head than the Main Shaft mine pool elevation. Therefore, under the current static hydrogeologic conditions, the observed head differential between the mine pool and the ORT-1 drainage results in vertically upward head gradients (from the mine pool to ORT-1) that could drive fracture flow from the mine pool to the ORT-1 drainage. If a future well in this area was pumped, the resulting drawdown cone would further increase these vertical gradients and in low yield fractured bedrock aquifers such as within the OU2/OU3 deep bedrock, these drawdown cones would be expected to be steep. Because the current static conditions are sufficient to result in fracture flow from the Main Shaft to the ORT-1 ground surface, it follows that future pumping conditions in this area would only serve to enhance the potential for transport from the mine pool to the pumping well. Furthermore, groundwater flow and plume transport can be significantly enhanced along substantial bedrock fracture zones should they be present. The ORT-1 photolineament zone represents a potential significant bedrock fracture and anisotropy.

Comment: In its 2015 Tech Memo, Nobis noted that: "…actual recharge areas are unknown because bedrock fractures (i.e., recharge pathways) could reach the surface outside of the mapped areas. Uncertainty surrounding the recharge area northeastward in the down-plunge direction was also noted to potentially either increase or decrease the potential area of influence of groundwater quality: it could increase because the area of land surface that may be intersected by a dipping fracture that is connected to the underground workings could be expected to widen as the workings deepen; or to decrease due to the likely decrease in permeable, connected bedrock fractures with the depth of the workings."

Based on Figure 5-1 of Tech Memo 4 (which shows the Underground Workings Cross-Section and is included as an inset in Exhibit 1), Terracon estimates the depth to the Workings under the Green Crow's property to range from approximately 470 feet near the ECMS property line to about 1,300 feet bgs (below ground surface) at the north end, the deepest area of the Workings.

Specifically, the use of surface topography (which dictates surface water flow) is inappropriate as a basis for groundwater flow paths located 500 to more than 1,000 feet deep in massive bedrock where hydraulic connection at depths greater than 30 feet was found in the nearby vicinity to be minor.

Response: Neither the OU2/OU3 Underground Workings Conceptual Site Model nor the OU2/OU3 RI relied upon surface topography as the basis of the deep groundwater flow paths. It should be noted that the OU2/OU3 RI should be relied upon as the most current understanding of the groundwater conceptual model for deep bedrock flow. The limited information available to characterize the deep bedrock in the OU3 area was clearly identified in these documents. As a result, the analysis focused upon a combination of the available bedrock information, the possible existence of a fracture zone as indicated by the photo-lineament analysis, and the geochemical evaluation of potential contaminant transport. In addition, given the objective of protecting current and future individuals from exposure to the contaminants in the Underground Workings, the buffer zone was developed from a perspective that the goal is to avoid making the proposed extent of groundwater use restrictions too small – potentially putting individuals at risk in the future. The actual data that was obtained from the groundwater discharge to the ORT-1 drainage and the samples from the residential wells near the potential fracture zone provide some level of assurance that the contamination does not extend to those locations which are just outside the proposed extent of the groundwater use restriction area. The OU2/OU3 RI identified that the extent of the groundwater use restriction would be re-evaluated during the Remedial Design if additional information is available to suggest revising the extent.

Comment: The use of surface topography to define contribution areas is also uncertain: The direct influence of surface water on groundwater typically decreases markedly with depth below surface water, particularly in bedrock environments due to typically decreased fracture apertures.

Response: EPA does not disagree with this general statement. Surface topography as it relates to defining a contributing area was only used as an order-of-magnitude assessment to support the development of a water budget that is itself a supporting element of the Conceptual Site Model (CSM). Surface topography was related, indirectly, to delineating the AUL, in that surface topography demonstrates areas where any well, no matter how shallow, would be below the hydraulic head in the mine pool.

Comment: Decreasing groundwater yield was observed during testing at the deepest- yielding fracture nearest the Green Crow property. This fracture was about 100 feet shallower than the shallowest occurrence of the Underground Workings under Green Crow property nearest the ECMS property line.

Response: EPA does not disagree with this general statement. The only two locations penetrating the Main Shaft are UP1 and DP1 (note that MW-UP1 and MW-UP2 are generally equivalent locations with respect to the deep bedrock observations and data sets generated within these boreholes). The observations and conclusions based only on fractures observed in these two boreholes under static conditions cannot be used to draw conclusions about a future well under pumping conditions that may be located at a significant distance from the current data set.

Comment: The hydrogeological studies at the site do not show fractures that yield high amounts of groundwater. Water yielding fractures encountered generally decreases with depth.

Response: EPA does not disagree with this general statement. Once again, the CSM for the Underground Workings assumes limited groundwater influx into and out of the Underground Workings under current groundwater conditions. That is the basis for limiting the Technical Impracticability Zone to the extent of the Underground Workings. However, future bedrock wells in the ORT-1 area would not need to be installed at significant depth to result in a vertical head differential that would drive fracture transport from the Main Shaft to the pumping well. In fact, because the current static conditions are sufficient to result in fracture flow from the Main Shaft to the ORT-1 ground surface, it follows that future pumping conditions in this area would only serve to enhancing the potential for transport from the mine pool to even a shallow pumping well.

Comment: Details provided in Tech Memo 4 supported observations in the RI, indicating limited connectivity between surface water and the Underground Workings, and limited yield where such connections exist. As Nobis notes in Tech Memo 3, hydrogeologically, the influence of surface water on groundwater at the depths of the Workings is very uncertain.

Response: The risk being addressed by the proposed OU2/OU3 AUL is not related to the influence of surface water on the mine pool groundwater. Rather, the AUL addresses the risk of deep bedrock mine pool contamination expanding and/or impacting future drinking water receptors.

Comment: Conversely, the likelihood of contamination of surface water by the water in the Underground Workings on Green Crow property is not indicated by site studies due to the depth to groundwater, the even greater depth of the workings and the lack of upward gradients from deep bedrock.

Response: Along ORT-1 and the associated photolineaments, the hydraulic head of the mine pool in the Underground Workings is higher than the land surface. This head differential results specifically in vertically upward gradients from the mine pool to the ground surface.

Comment: Because the Underground Workings are likely 200 to over 1000 feet below the groundwater table on the Green Crow property, and water-bearing fractures were encountered in site studies above the water table, private water supply wells, if they were ever to be installed, would be highly unlikely to be drilled to the depths of the Workings on the Green Crow property. Therefore, Tech Memo 4 supports Terracon's earlier conclusions that water movement from the Underground Workings to surrounding groundwater is low and therefore unlikely to pose a threat to the quality of area-wide groundwater or surface water.

Response: The OU2/OU3 RI identified that a future pumping well within the proposed AUL would not need to be installed to the actual depth of the Main Shaft to penetrate a zone of hydraulic influence, within which sufficient head differential currently exists (or would be created under future pumping conditions) to drive fracture flow from the mine pool to the pumping well. In fact, the current static conditions are sufficient to result in fracture flow from the Main Shaft to the ground surface in the downgradient zones of ORT-1. Therefore, it follows that future pumping conditions in this area would only serve to enhance the potential for transport from the mine pool to even a shallow pumping well. It is also noted that some local water supply wells have been drilled to depths of as much as 620 feet below ground. The *information regarding regional water supplies is discussed in Section 5.4 of the OU2/OU3 RI Report with the supporting information provided in Appendix J of the RI Report. The information regarding the residential wells was obtained from the on-line Well Completion Report Searchable Database maintained by the Vermont Department of Environmental Conservation Drinking Water and Groundwater Protection Division.*

Comment: In addition, the remoteness of the Green Crow property and presence of steep slopes makes this property undesirable for residential development.

Response: EPA's remedy must be designed and implemented to address potential future threats of release of contaminants, not just present conditions of development. A part of instituting the TI Waiver Zone over the Underground Workings is that the buffer zone, which is the groundwater use restriction area, is required to ensure no future development will created a threat of release of the contaminated water within the Underground Workings. Because the TI Zone results in contamination being left in place above levels that would allow for human exposure, the Superfund law requires that administrative measures be put in place to prevent exposure to the contamination.

Comment: Terracon staff spoke with a driller in the area, who indicated that most residential water supply wells were drilled to depths shallower than 400 feet, and more typically were around 250 feet in depth.

Response: Some local water supply wells have been drilled to depths of as much as 620 feet below ground surface. Also, as stated in previous comments, the well does not need to be installed to the same depth as the deeper Underground Workings if the overall mine pool water level is at the decant elevation of 1275 above mean sea level (msl). The information regarding regional water supplies is discussed in Section 5.4 of the RI Report with the supporting information provided in Appendix J of the OU2/OU3 RI Report. The information regarding the residential wells was obtained from the on-line Well Completion Report Searchable Database maintained by the Vermont Department of Environmental Conservation Drinking Water and Groundwater Protection Division.

Comment: Groundwater samples collected from drinking water sources in the vicinity of the Site during the RI did not detect metals or geochemical parameter concentrations indicative of a potential impact from the Site.

Response: The sampling confirmed there is no present release of Site contaminants into local drinking water wells, but the remedy is designed to address potential future threats of release. The findings from the OU1 RI were confirmed with water supply well sampling during the OU2/OU3 RI.

Comment: "For all the above reasons, Terracon asserts that the proposed EPA AUL Area can be reduced in extent on the Green Crow Property, while still being protective of human health and the environment and sufficiently conservative to reflect subsurface uncertainties. Exhibit 1, attached to this Memorandum, shows an Alternative AUL Area (blue lines) which approximately follow the watershed ridges for ease of field location, while still encompassing the projected Underground Workings. This Alternative AUL Area is proposed based on the following rationale: the area of influence of groundwater quality in the Underground Workings appears very limited; …"

Response: EPA agrees that the current extent of contamination is likely to be limited to the Underground Workings, which is the basis for the delineation of the Technical Impracticability Zone. That does not address whether contamination could migrate from the Underground Workings under future pumping scenarios. In addition, there remains a high degree of uncertainty regarding the extent of the contamination associated with the Underground Workings since only two OU2/OU3 deep bedrock locations have been installed and tested or sampled. Both of these wells are located within the Main Shaft mine pool itself (i.e. within the OU2/OU3 contaminant source zone), and neither of these locations is near the potentially significant ORT-1 photolineament zone. The results of the OU2/OU3 RI clearly demonstrate groundwater within the Underground Workings would pose an unacceptable risk for human consumption. It's unclear how these water quality results were used by Terracon to estimate a boundary where these impacts are limited to the extent they no longer pose an unacceptable risk for human consumption.

Comment: "…contaminated water in the deep Underground Workings is not impacting surface water and no studies suggest upward hydraulic heads that exist to bring contaminated water vertically upwards 1000 or more feet from the Workings; …"

Response: The hydraulic head of the Main Shaft mine pool creates the potential vertically upward gradients at any location with a ground elevation lower than 1,276 feet. When the possibility of pumping wells drawing down the water level in the well is considered, the area in which upward gradients from the Underground Workings are possible is even larger than just the area that is topographically below 1,276 feet in elevation. The OU2/OU3 RI did confirm that the surface water within ORT-1 is not impacted by the Underground Workings under current conditions.

Comment: "…hydrogeologically it is shown in site studies that shallow fractures are more productive than deep and drinking water wells in the general vicinity tend to be less than 500' in depth; …"

Response: EPA does not disagree with this general statement. However, state drilling records indicate that some local water supply wells have been drilled to depths of as much as 620 feet below ground surface. Also, as stated in previous comments, the well does not need to be installed to the same depth as the deeper Underground Workings if the overall mine pool water level is at the decant elevation of 1275 above msl.

Comment: "…steep slopes and property remoteness makes the Green Crow property undesirable for property development; and…"

Response: EPA's remedy must be designed and implemented to address potential future threats of release of contaminants, not just present conditions of development. A part of instituting the TI Waiver Zone over the workings is that the buffer zone, which is the groundwater use restriction area, is required to ensure no future development will created a threat of release of the contaminated water within the Underground Workings.

Comment: "…other permanent land use easements are in place that prohibit property use for residential development."

Response: EPA is not aware of any permanent land use restrictions in place for the OU2 or OU3 property at this time. The proposed cleanup plan specifically includes such restrictions to accomplish, among other things, the objective of preventing the installation of wells in the future. Any land use restrictions to address Site risks need to be incorporated into the remedial action to make them enforceable under CERCLA.

THE SELECTED REMEDY'S CHANGES TO THE PROPOSED PLAN MADE BASED UPON PUBLIC COMMENTS

There have been no significant changes to the selected remedy from the OU2/OU3 Proposed Plan as a result of public comments. None of the comments received opposed the OU2/OU3 cleanup. The OU3 landowner requested that the extent of groundwater use restriction on their property be reduced. EPA has fully considered the comments provided and responded to the comments. The comments did not identify any facts/issues that would result in EPA modifying its proposed remedy.

APPENDIX D

ADMINISTRATIVE RECORD INDEX

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Vershire, Vermont

Administrative Record Index
Record of Decision (ROD)
for
Operable Unit (OU)
[OU2 Adit Discharge (Combined with OU3]

INDEX

ROD Signed:
Released:

Prepared by
EPA New England
Office of Site Remediation and Restoration

Introduction to the Collection

This is the administrative record Index for the Ely Copper Mine Superfund Site, Vershire, Vermont, Operable Unit (OU) OU2 and OU3 for the Record of Decision (ROD) released on June 2016. The file contains site-specific documents and a list of guidance documents used by EPA staff in selecting a response action at the site.

This Administrative Record includes, by reference, the Administrative Record for the Record of Decision (ROD), Operable Unit One 1 (OU1) dated September 28, 2011.

The administrative record file is available for review online:

http://semspub.epa.gov/src/collection/01/AR63915

For general information on the site visit:

www.epa.gov/superfund/

For assistance with access or for questions, contact:

EPA New England Office of
Site Remediation & Restoration
1 Congress Street, Suite 1100 (HSC)
Boston, MA 02114
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617-918-1440 (phone)
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www.epa.gov/region01/superfund/resource/records.htm

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(802) 685-2227 (phone)
admin@vershirevt.org

Town of West Fairlee
870 Route 113
Fairlee, VT 05045
(802) 333- 9696
www.westfairleevt.com

An administrative record file is required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

Questions about the decision documented in this Administrative Record file should be directed to the EPA New England remedial project manager, Ed Hathaway, Hathaway.Edward@epa.gov.

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Record of Decision (ROD) for Operable Unit (OU) 2-3

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File Break:

587365 **PUBLIC COMMENT FROM SITE LANDOWNER REGARDING OU2 AND OU3 PROPOSED PLAN**

# of Pages: 10
Doc Date: 10/07/2015
Resource Type: CORR
Access Control: UCTL

Author: SHELLEY FROST, TERRACON CONSULTANTS INC
MURIEL ROBINETTE, TERRACON CONSULTANTS INC

Addressee: EDWARD HATHAWAY, US EPA REGION 1

File Break:

587366 **GREEN CROW CORP COMMENTS ON PROPOSED PLAN**

# of Pages: 1
Doc Date: 10/07/2015
Resource Type: CORR
Access Control: UCTL

Author: PETER D VAN OOT, DOWNS RACHLIN & MARTIN PLLC

Addressee: EDWARD HATHAWAY, US EPA REGION 1

File Break: **03.04**

577660 **QUALITY ASSURANCE PROJECT PLAN (QAPP) FOR REMEDIAL INVESTIGATION/FEASIBILITY STUDY (RI/FS), REVISION 3 (11/13/2012 TRANSMITTAL LETTER ATTACHED)**

# of Pages: 453
Doc Date: 11/01/2012
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC

Addressee: , US EPA REGION 1

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AR Collection: 63915
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File Break: 03.06

577670 **REMEDIAL INVESTIGATION (RI) REPORT**

# of Pages: 541
Doc Date: 07/01/2015
Resource Type: RPT
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 03.07

577661 **TECHNICAL MEMORANDUM 1: DRAFT UNDERGROUND WORKINGS FIELD INVESTIGATION PLAN 1**

# of Pages: 24
Doc Date: 09/01/2012
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 03.07

577662 **TECHNICAL MEMORANDUM 2: UNDERGROUND WORKINGS BEDROCK HYDROGEOLOGY CHARACTERIZATION**

# of Pages: 20
Doc Date: 02/15/2013
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

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577663 **TECHNICAL MEMORANDUM 3: FINAL UNDERGROUND WORKINGS BEDROCK DRILLING LOCATIONS AND ACCESS ROAD PLAN**

# of Pages: 12
Doc Date: 06/24/2013
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 03.07

577664 **TECHNICAL MEMORANDUM 4: PHASE I DEEP BEDROCK INVESTIGATION**

# of Pages: 161
Doc Date: 01/17/2014
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 03.07

577665 **TECHNICAL MEMORANDUM 5: UNDERGROUND WORKINGS INVESTIGATION PLAN 2**

# of Pages: 31
Doc Date: 07/11/2014
Resource Type: WP
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

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AR Collection: 63915
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File Break: 03.07

577672 **TECHNICAL MEMORANDUM REGARDING MILESTONE HERITAGE CONSULTING (11/24/1899 MEMO ATTACHED)**

# of Pages: 12
Doc Date: 07/04/2015
Resource Type: MEMO
Access Control: UCTL

Author: , UNIVERSITY OF VERMONT ARCHIVAL RESEACH
Addressee: , NOBIS ENGINEERING INC

File Break: 03.10

577671 **HUMAN HEALTH RISK ASSESSMENT (HHRA)**

# of Pages: 171
Doc Date: 07/01/2015
Resource Type: RPT
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 04.06

581834 **FEASIBILITY STUDY (FS) REPORT**

# of Pages: 384
Doc Date: 08/01/2015
Resource Type: RPT
Access Control: UCTL

Author: , NOBIS ENGINEERING INC
Addressee: , US EPA REGION 1

File Break: 04.09

581868 **PROPOSED PLAN FOR OPERABLE UNIT (OU) OU2 AND OU3 UNDERGROUND WORKINGS GROUNDWATER CLEANUP**

# of Pages: 26
Doc Date: 08/19/2015
Resource Type: PUB
Access Control: UCTL

Author: , US EPA REGION 1
Addressee:

File Break: 05.01

587362 **STATE CONCURRENCE LETTER REGARDING RECORD OF DECISION (ROD) FOR OPERABLE UNIT (OU) OU2 AND OU3**

# of Pages: 1
Doc Date: 06/15/2016
Resource Type: LTR
Access Control: UCTL

Author: GEORGE DESCH, VT DEPT OF ENVIRONMENTAL CONSERVATION
Addressee: BRYAN OLSON, US EPA REGION 1

File Break: 05.01

587373 **FAILURE MODES AND EFFECTS ANALYSIS (FMEA) FOR ELY COPPER MINE OU1, OU2, AND OU3**

# of Pages: 120
Doc Date: 06/01/2016
Resource Type: RPT
Access Control: UCTL

Author: , SLR GLOBAL ENVIRONMENTAL SOLUTIONS
Addressee:

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AR Collection: 63915
Record of Decision (ROD) for Operable Unit (OU) 2-3
AR Collection Index Report
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File Break: **13.03**

581879 **PUBLIC NOTICE: ELY COPPER MINE PUBLIC INFORMATION MEETING FOLLOWED BY PUBLIC HEARING ON 09/22/2015**

# of Pages: 1
Doc Date: 08/30/2015
Resource Type: PUB
Access Control: UCTL

Author: , VALLEY NEWS
Addressee:

File Break: **16.01**

581876 **EPA'S NOTIFICATION LETTER SEEKING COMMENTS ON PROPOSED PLAN FOR CLEANUP OF OPERABLE UNIT (OU) OU2 AND OU3 TO DEPT OF INTERIOR (DOI) IN ITS ROLE AS NATURAL TRUSTEE**

# of Pages: 1
Doc Date: 08/28/2015
Resource Type: LTR
Access Control: UCTL

Author: EDWARD HATHAWAY, US EPA REGION 1
Addressee: ANDREW RADDANT, US DEPT OF INTERIOR

File Break: **16.01**

581877 **EPA'S NOTIFICATION LETTER SEEKING COMMENTS ON PROPOSED PLAN FOR CLEANUP OF OPERABLE UNIT (OU) OU2 AND OU3 TO US NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) IN ITS ROLE AS NATURAL TRUSTEE**

# of Pages: 1
Doc Date: 08/28/2015
Resource Type: LTR
Access Control: UCTL

Author: EDWARD HATHAWAY, US EPA REGION 1
Addressee: KENNETH FINKELSTEIN, US NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

File Break: 16.01

581878 **LETTER REGARDING EPA'S CONSULTATION WITH US FISH AND WILDLIFE SERVICE (USFWS) IN ACCORDANCE WITH SECTION 7 OF ENDANGERED SPECIES ACT (ESA)**

# of Pages: 11
Doc Date: 08/28/2015
Resource Type: LTR
Access Control: UCTL

Author: EDWARD HATHAWAY, US EPA REGION 1
Addressee: SUSI VON OETTINGEN, US DEPT OF INTERIOR - FISH & WILDLIFE SERVICE

File Break: 16.01

587323 **DEPT OF INTERIOR'S RESPONSE TO 03/01/2016 LETTER REQUESTING REVIEW OF PROPOSED CLEAN-UP REMEDY FOR OPERABLE UNIT (OU) OU2 AND OU3**

# of Pages: 2
Doc Date: 03/23/2016
Resource Type: LTR
Access Control: UCTL

Author: , US DEPT OF INTERIOR
Addressee: EDWARD HATHAWAY, US EPA REGION 1

File Break: 17.07

583578 **FINAL ENVIRONMENTAL ASSESSMENT - FINAL 4 (D) RULE FOR NORTHERN LONG-EARED BAT**

# of Pages: 86
Doc Date: 12/01/2015
Resource Type: PUB
Access Control: UCTL

Author: , US FISH AND WILD LIFE SERVICE
Addressee:

File Break: 17.07

583579 **FEDERAL REGISTER VOL. 81, NO.9/RULES AND REGULATIONS**

# of Pages: 23
Doc Date: 01/14/2016
Resource Type: PUB
Access Control: UCTL

Author:
Addressee:

File Break: 17.07

583580 **FEDERAL REGISTER VOL. 80, NO.63/RULES AND REGULATIONS**

# of Pages: 61
Doc Date: 04/02/2015
Resource Type: PUB
Access Control: UCTL

Author: , US DEPT OF INTERIOR - FISH & WILDLIFE SERVICE
Addressee:

File Break: 17.07

583581 **PROGRAMMATIC BIOLOGICAL OPINION ON FINAL 4 (D) RULE FOR NORTHERN LONG-EARED BAT AND ACTIVITIES EXCEPTED FROM TAKE PROHIBITIONS**

# of Pages: 109
Doc Date: 01/05/2016
Resource Type: PUB
Access Control: UCTL

Author: , US DEPT OF INTERIOR - FISH & WILDLIFE SERVICE
Addressee:

ELY COPPER MINE
AR Collection: 63915
Record of Decision (ROD) for Operable Unit (OU) 2-3
AR Collection Index Report
*****For External Use*****

File Break: **17.07**

583582	**KEY TO NORTHERN LONG-EARED BAT 4 (D) RULE FOR FEDERAL ACTIONS THAT MAY AFFECT NORTHERN LONG-EARED BATS**	**# of Pages:** 8 **Doc Date:** 02/17/2016
Author:	, US DEPT OF INTERIOR - FISH & WILDLIFE SERVICE **Addressee:**	**Resource Type:** PUB **Access Control:** UCTL

Number of Documents in Administrative Record: 25

Selected Key Guidance Documents
EPA Guidance Documents may be reviewed at the OSRR Records and Information Center in Boston, MA

DOCNUMBER	DOCDATE	TITLE	OSWEREPAID
2002	October 1, 1988	INTERIM FINAL GUIDANCE FOR CONDUCTING REMEDIAL INVESTIGATIONS AND FEASIBILITY STUDIES UNDER CERCLA.	OSWER #9355.3-01
2018	November 1, 1989	FEASIBILITY STUDY - DEVELOPMENT AND SCREENING OF REMEDIAL ACTION ALTERNATIVES [QUICK REFERENCE FACT SHEET]	OSWER #9355.3-01FS3
2019	March 1, 1990	FEASIBILITY STUDY: DETAILED ANALYSIS OF REMEDIAL ACTION ALTERNATIVES [QUICK REFERENCE FACT SHEET]	OSWER #9355.3-01FS4
3006	May 1, 1989	ARARs Q'S & A'S [QUICK REFERENCE FACT SHEET]	OSWER #9234.2-01FS
3009	December 1, 1989	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL - CERCLA COMPLIANCE WITH STATE REQUIREMENTS [QUICK REFERENCE FACT SHEET]	OSWER #9234.2-05FS
3010	February 1, 1990	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL - CERCLA COMPLIANCE WITH THE CWA AND SDWA [QUICK REFERENCE FACT SHEET]	OSWER #9234.2-06FS
3011	December 1, 1989	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL - OVERVIEW OF ARARs - FOCUS ON ARAR WAIVERS [QUICK REFERENCE FACT SHEET]	OSWER #9234.2-03FS
3012	April 1, 1990	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL - SUMMARY OF PART II - CAA, TSCA, AND OTHER STATUTES [QUICK REFERENCE FACT SHEET]	OSWER #9234.2-07FS
3013	August 1, 1989	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL PART II: CLEAN AIR ACT AND OTHER ENVIRONMENTAL STATUTES AND STATE REQUIREMENTS	OSWER #9234.1-02
5003	September 24, 1986	GUIDELINES FOR CARCINOGEN RISK ASSESSMENT (FEDERAL REGISTER, SEPTEMBER 24, 1986, p. 33992)	
5004	September 24, 1986	GUIDELINES FOR EXPOSURE ASSESSMENT (FEDERAL REGISTER, SEPTEMBER 24, 1986, p. 34042)	
5005	September 24, 1986	GUIDELINES FOR HEALTH ASSESSMENT OF SUSPECT DEVELOPMENTAL TOXICANTS (FEDERAL REGISTER, SEPTEMBER 24, 1986, p. 34028)	
5006	September 24, 1986	GUIDELINES FOR MUTAGENICITY RISK ASSESSMENT (FEDERAL REGISTER, SEPTEMBER, 24, p. 34006)	
5013	April 1, 1988	SUPERFUND EXPOSURE ASSESSMENT MANUAL	OSWER #9285.5-1
5014	October 1, 1986	SUPERFUND PUBLIC HEALTH EVALUATION MANUAL	OSWER #9285.4-1
9002	April 1, 1990	GUIDE TO SELECTING SUPERFUND REMEDIAL ACTIONS	OSWER #9355.0-27FS
C025	August 1, 1985	ENDANGERMENT ASSESSMENT HANDBOOK.	OSWER 9850.1
C158	October 4, 1993	GUIDANCE FOR EVALUATING THE TECHNICAL IMPRACTICABILITY OF GROUND WATER RESTORATION.	OSWER 9234.2-25

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DOCNUMBER	DOCDATE	TITLE	OSWEREPAID
C174	December 1, 1989	RISK ASSESSMENT GUIDANCE FOR SUPERFUND. VOLUME I. HUMAN HEALTH EVALUATION MANUAL (PART A). INTERIM FINAL.	EPA 540/1-89/002
C180	July 1, 1989	RISK ASSESSMENT GUIDANCE FOR SUPERFUND. HUMAN HEALTH EVALUATION MANUAL PART A.	OSWER 9285.7-01A
C191	July 1, 1990	ARARs Q's & A's: STATE GROUND-WATER ANTIDEGRADATION ISSUES.	OSWER 9234.2-11FS
C192	June 1, 1990	ARARs Q's & A's: COMPLIANCE WITH FEDERAL WATER QUALITY CRITERIA.	OSWER 9234.2-09/FS
C213	January 19, 1995	CONSISTENT IMPLEMENTATION OF THE FY 1993 GUIDANCE ON TECHNICAL IMPRACTICABILITY OF GROUND-WATER RESTORATION AT SUPERFUND SITES.	OSWER 9200.4-14
C214	June 25, 1993	FINAL REVISIONS TO OMB CIRCULAR A-94 ON GUIDELINES AND DISCOUNT RATES FOR BENEFIT-COST ANALYSIS.	OSWER 9355.3-20
C276	April 22, 1991	ROLE OF THE BASELINE RISK ASSESSMENT IN SUPERFUND REMEDY SELECTION DECISIONS	OSWER 9355.0-30
C281	September 1, 1992	ARAR'S FACT SHEET: COMPLIANCE WITH CLEAN THE CLEAN AIR ACT AND ASSOCIATED AIR QUALITY REQUIREMENTS	
C288	August 1, 1994	RISK UPDATE ISSUE NO. 2	
C317	January 1, 1995	LAND USE IN THE CERCLA REMEDY SELECTION PROCESS	OSWER 9355.7-04
C356	August 1, 1997	EXPOSURE FACTORS HANDBOOK; GENERAL FACTORS, VOLUME I	EPA 600/P-95/002FA
C473	August 1, 1997	RULES OF THUMB FOR SUPERFUND REMEDY SELECTION (EPA 540-R-97-013)	OSWER 9355.0-69
C525	July 1, 1999	GUIDE TO PREPARING SUPERFUND PROPOSED PLANS RECORDS OF DECISION AND OTHER REMEDY SELECTION DECISION DOCUMENTS	OSWER 9200.1-23 P
C526	August 1, 2000	ABANDONED MINE SITE CHARACTERIAZTION & CLEANUP HANDBOOK (AVAILABLE ON CD-ROM)	PB2002-107421
C527	September 1, 1997	INTRODUCTION TO HARD ROCK MINING: A CD-ROM APPLICATION (AVAILABLE ON CD-ROM)	EPA 530-C-97-005
C531	September 1, 2000	INSTITUTIONAL CONTROLS: A SITE MANAGER'S GUIDE TO IDENTIFYING, EVALUATING AND SELECTING INSTITUTIONAL CONTROLS AT SUPERFUND AND RCRA CORRECTIVE ACTION CLEANUPS.	OSWER 9355.0-74 FS-P
C532	September 1, 1993	GUIDANCE FOR EVALUATING THE TECHNICAL IMPRACTICABILITY OF GROUND-WATER RESTORATION.	EPA 540-R-93-080
C563	October 7, 1999	ECOLOGICAL RISK ASSESSMENT AND RISK MANAGEMENT PRINCIPLES FOR SUPERFUND SITES	OSWER 9285.7-28 P
C564	August 12, 1994	ROLE OF THE ECOLOGICAL RISK ASSESSMENT IN THE BASELINE RISK ASSESSMENT	OSWER 9285.7-17

Selected Key Guidance Documents

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DOCNUMBER	DOCDATE	TITLE	OSWEREPAID
C575	September 1, 2004	STRATEGY TO ENSURE INSTITUTIONAL CONTROL IMPLEMENTATION AT SUPERFUND SITES	OSWER NO. 9355.0-106
C582	July 1, 2000	A GUIDE TO DEVELOPING AND DOCUMENTING COST ESTIMATES DURING THE FEASIBILITY STUDY	OSWER 9355.0-75
C593	December 1, 2001	RISK ASSESSMENT GUIDANCE FOR SUPERFUND VOLUME I: HUMAN HEALTH EVALUATION MANUAL. PART D. STANDARDIZED PLANNING, REPORTING, AND REVIEW OF SUPERFUND RISK ASSESSMENTS. FINAL	
C602	July 1, 2004	RISK ASSESSMENT GUIDANCE FOR SUPERFUND VOLUME I: HUMAN HEALTH EVALUATION MANUAL (PART E SUPPLEMENTAL GUIDANCE FOR DERMAL RISK ASSESSMENT) FINAL	
C604	September 1, 1994	HEALTH EFFECTS ASSESSMENT FOR IRON (AND COMPOUNDS)	
C622	November 1, 1991	A GUIDE TO PRINCIPLE THREAT AND LOW LEVEL THREAT WASTES	9380.3-06FS
C623	May 1, 2001	OPERATION AND MAINTENANCE IN THE SUPERFUND PROGRAM	OSWER 9200.1-37FS
C636	January 1, 2004	DRINKING WATER HEALTH ADVISORY FOR MANGANESE	EPA-822-R-04-003
C651	February 1, 2003	HEALTH EFFECTS SUPPORT DOCUMENT FOR MANGANESE	
C663	September 1, 1996	ROLE OF COST IN THE SUPERFUND REMEDY SELECTION PROCESS	EPA-540/F-96/018
C692	February 19, 1992	PERMITS AND PERMIT EQUIVALENCY PROCESSES FOR CERCLA ON-SITE RESPONSE ACTIONS	OSWER 9355.7-03
C693	July 1, 1991	ARARS Q'S & A'S: GENERAL POLICY, RCRA, CWA, SDWA, POST-ROD INFORMATION AND CONTINGENT WAIVERS	9234.2-01/FS-A
C721	April 26, 2002	ROLE OF BACKGROUND IN THE CERCLA CLEANUP PROGRAM	9285.6-07P
C751	July 1, 2011	GROUNDWATER ROAD MAP: RECOMMENDED PROCESS FOR RESTORING CONTAMINATED GROUNDWATER AT SUPERFUND SITES	OSWER 9288.1-34
C762	September 1, 1999	RISK UPDATES	
C848	March 1, 2001	EPA REQUIREMENTS FOR QUALITY ASSURANCE PROJECT PLANS (QA/R5)	EPA/240/B-01/003
C875	September 20, 2010	REVISED GUIDANCE ON COMPILING ADMINISTRATIVE RECORDS FOR CERCLA RESPONSE	
C880	February 11, 1994	EXECUTIVE ORDER 12898, FEDERAL ACTIONS TO ADDRESS ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW-INCOME POPULATIONS	
C884	May 1, 1994	CONSIDERING WETLANDS AT CERCLA SITES	

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DOCNUMBER	DOCDATE	TITLE	OSWEREPAID
C908	December 1, 2008	GREEN REMEDIATION: BEST MANAGEMENT PRACTICES FOR EXCAVATION AND SURFACE RESTORATION	EPA 542-F-08-012
C918	August 5, 2013	NATIONAL RECOMMENDED WATER QUALITY CRITERIA: CURRENT WATER QUALITY CRITERIA	
C920	April 1, 2012	2012 EDITION OF THE DRINKING WATER STANDARDS AND HEALTH ADVISORIES	EPA 822-S-12-001
C923	September 19, 2011	CLARIFICATION OF OSWER'S 1995 TECHNICAL IMPRACTICABILITY WAIVER POLICY	OSWER 9355.5-32
C925	April 1, 2005	SUPERFUND COMMUNITY INVOLVEMENT HANDBOOK	EPA/540/K‑05/003
C936	December 1, 2012	INSTITUTIONAL CONTROLS: A GUIDE TO PLANNING, IMPLEMENTING, MAINTAINING, AND ENFORCING INSTITUTIONAL CONTROLS AT CONTAMINATED SITES	OSWER 9355.0-89, EPA/540/R-09/001
C937	December 1, 2012	INSTITUTIONAL CONTROLS: A GUIDE TO PREPARING INSTITUTIONAL CONTROLS IMPLEMENTATION AND ASSURANCE PLANS AT CONTAMINATED SITES	OSWER 9200.0-77, EPA/540/R-09/02
C938	March 1, 2012	UNIFORM FEDERAL POLICY FOR QUALITY ASSURANCE PROJECT PLANS, PARTS 1-2	EPA/505/B-04/900A THROUGH 900C
C941	February 6, 2014	HUMAN HEALTH EVALUATION MANUAL: SUPPLEMENTAL GUIDANCE - UPDATE OF STANDARD EXPOSURE FACTORS	OSWER DIRECTIVE 9200.1-120
C1004	August 1, 2012	SUMMARY OF TECHNICAL IMPRACTICABILITY WAIVERS AT NATIONAL PRIORITIES LIST SITE (NPL), REPORT WITH GENERAL TECHNICAL IMPRACTIBILITY SITE INFORMATION SHEETS	OSWER 9230.2-24
C1005	June 1, 2015	REGIONAL SCREENING LEVELS (RSL) FOR CHEMICAL CONTAMINANTS AT SUPERFUND SITES	
C1006	June 1, 1995	REMEDIAL DESIGN/REMEDIAL ACTION HANDBOOK	OSWER 9355.0-04B, EPA 540/R-95/059
C1007	August 1, 1988	CERCLA COMPLIANCE WITH OTHER LAWS MANUAL. PART I. INTERIM FINAL	OSWER EPA/9234.1-01,
C1011	December 1, 2015	FINAL ENVIRONMENTAL ASSESSMENT - FINAL 4 (D) RULE FOR NORTHERN LONG-EARED BAT	
C1012	April 2, 2015	FEDERAL REGISTER VOL. 80, NO.63/RULES AND REGULATIONS	
C1013	January 5, 2016	PROGRAMMATIC BIOLOGICAL OPINION ON FINAL 4 (D) RULE FOR NORTHERN LONG-EARED BAT AND ACTIVITIES EXCEPTED FROM TAKE PROHIBITIONS	
C1014	January 14, 2016	FEDERAL REGISTER VOL. 81, NO.9/RULES AND REGULATIONS	
C1015	February 17, 2016	KEY TO NORTHERN LONG-EARED BAT 4 (D) RULE FOR FEDERAL ACTIONS THAT MAY AFFECT NORTHERN LONG-EARED BATS	