

ORE KNOB MINE

Water Quality Issues & Restoration Efforts



ORE KNOB MINE

MINE HISTORY

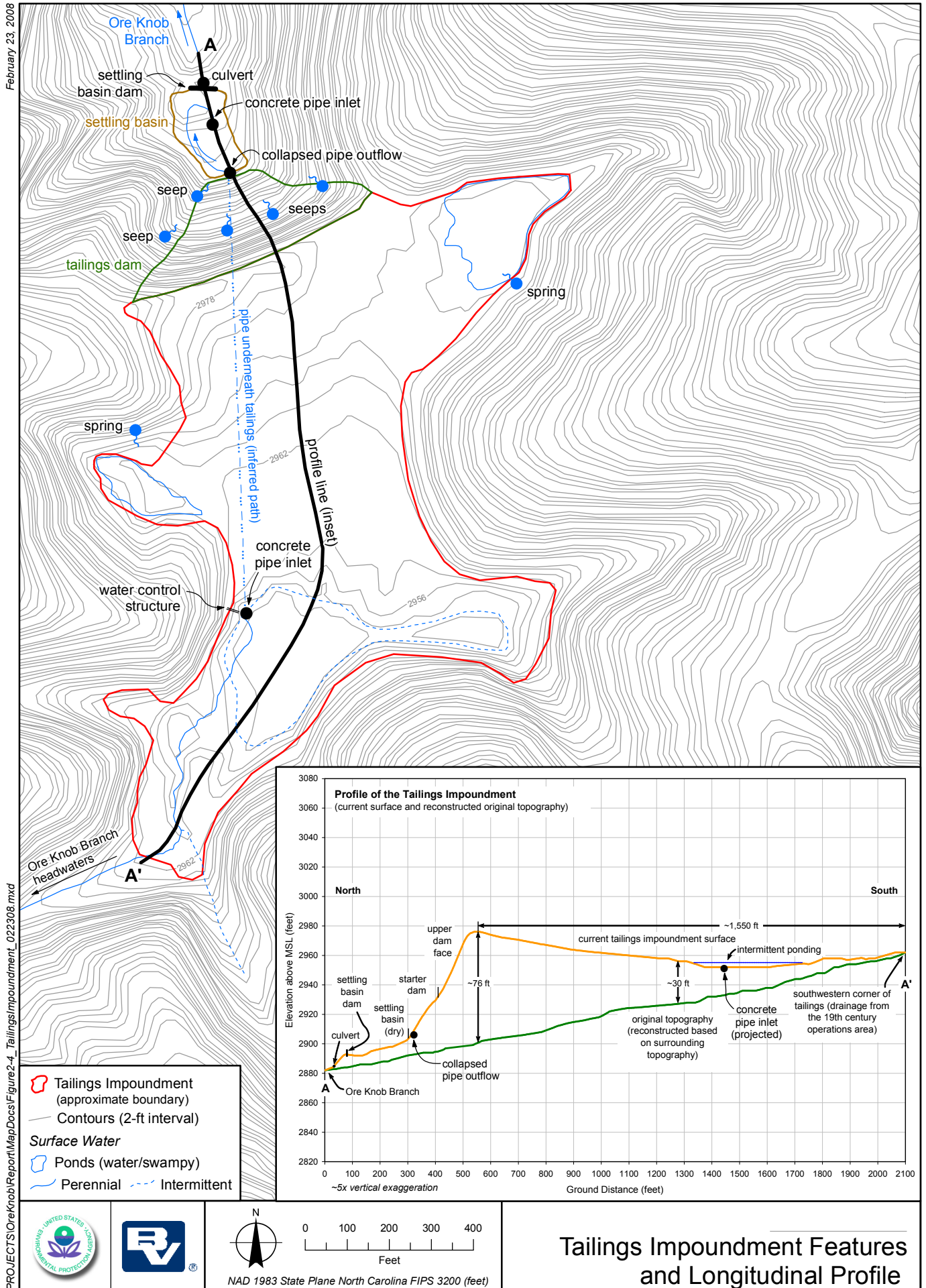
Ore Knob Mine is a former copper mine which was operated intensively from 1871 to 1883. Then limited mining activities took place until 1957 when it was operated by Appalachian Sulphides Inc. For the next five to six years, the mining company extracted the ore from 11 openings and one main shaft. Ore was then ground in a processing facility in the Little Peak Creek drainage area. Using a froth flotation and cyanide leaching process, Copper, gold and silver was extracted further.

The waste tailings from this process were mostly pumped into a large tailings impoundment located on Ore Knob Branch. A smaller portion of the tailings were dumped in a small hollow adjacent to the processing facility. The drainage from the processing facility and associated waste piles is an acidic toxic mix that has contaminated the surface and ground water in the drainage area.

FIGURE 4-1: PHOTOS TAKEN OF THE WASTE/TAILINGS PILES DURING A SITE VISIT IN DECEMBER 2006 BY DWQ. (TOP LEFT: TOP OF IMPOUNDMENT FACING THE SETTLING POND; TOP RIGHT: LOOKING NORTH EAST ACROSS THE IMPOUNDMENT; BOTTOM: ON IMPOUNDMENT LOOKING BACK ACROSS TAILINGS PILE.)



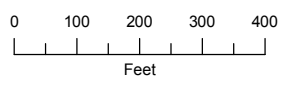
FIGURE 4-2: TAILINGS IMPOUNDMENT AND PONDS FEATURES AND LONGITUDINAL PROFILE (BLACK & VEATCH, 2008).



February 23, 2008

PROJECTS\OreKnob\Report\MapDocs\Figure2-4_TailingsImpoundment_022308.mxd

2011 NEW RIVER BASIN PLAN: ORE KNOB MINE (SOUTH FORK NEW RIVER WATERSHED)



Tailings Impoundment Features and Longitudinal Profile

DESCRIPTION OF CONTAMINATED AREA & IMPACTS

The main area of the Ore Knob Mine that is impacting surface and ground water is the tailings pile which is a little over 20 acres and holds most of the waste tailings from the mining operations. This is seen in Figure 4-2 as the area outlined in red. The tailings pile, estimated at 720,000 cubic yards, is held behind a 60 foot dam. Behind the large dam is a settling basin held back by a smaller 20 foot dam. This smaller dam has a culvert which drains directly to Ore Knob Branch.

Two small streams flow into the southern portion of the pile where it intermittently ponds (two blue lines at the bottom left corner of Figure 4-2). A concrete pipe inlet drains the intermittent pond, bypassing majority of the tailings pile and the larger dam, discharging into the settling basin. Two spring fed ponds, located on either side of the northern portion of the pile, filter through the tailings and seeps through the larger dam where it then collects in the settling basin.

The tailings piles as well as the mine shafts are causing acidic metal-laden runoff to contaminate surface and groundwater on the site which then flows into Little Peak Creek, Ore Knob Branch and Peak Creek [AU#: 10-1-35-(2)b]. Multiple studies have been conducted since the early 1990's to measure the impact on water quality and the environment. These studies have detailed results within their respective study reports which are discussed below.

RESTORATION ACTIVITY HISTORY (1990's TO 2005)

Restoration efforts to the abandoned mine and its receiving streams began in the early 1990's by the US Army Corps of Engineers (USACE) and DWQ. Under Section 206 of the Water Resources Development Act of 1996 (PL 104-303), USACE published the Ore Knob Aquatic Restoration Project: Draft Detailed Project Report and Environmental Assessment (March 2003). The goal of the project was defined "to return aquatic macrobiota and fish to Peak Creek and Little Peak Creek." Quantitatively, the project would restore up to 14.3 acres of aquatic habitat (6.9 stream miles).

In order to meet the goals and objectives of the Ore Knob project, restoration of the former processing area and reclamation of the tailings area, which include mine portals and shafts, would be necessary. This involves three distinct treatments: (1) diversion of surface water runoff away from and around tailings; (2) isolation of the tailings; and (3) passive treatment of acid discharge through the use of wetlands. Implementation of the project was expected to restore 6.9 miles of aquatic habitat and 24 acres or more of terrestrial (wetland and upland) habitat. Two million dollars was allocated for project study, design and construction, and operation and maintenance costs. Even though, due to federal budget constraints, funding for the full Ore Knob Aquatic Restoration Project was not provided, the 2003 document has been utilized in almost all Ore Knob restoration projects since.

RECENT ACTIVITY (2005 TO 2010)

319 Watershed Management Plan

In 2005, NCSU was awarded funding to develop a [Watershed Management Plan](#) for the Ore Knob Mine area. This study included surface water monitoring for pH, DO, temperature, acidity and numerous metal values. Averages for these values are summarized in Figure 4-4. These parameters were monitored at seven locations within the area during the study. Locations of five of those monitoring stations are listed in Table 4-1 and shown in Figure 4-3.

TABLE 4-1: MONITORING LOCATIONS FOR FIVE OF NINE SITES SAMPLED DURING 319 PROJECT

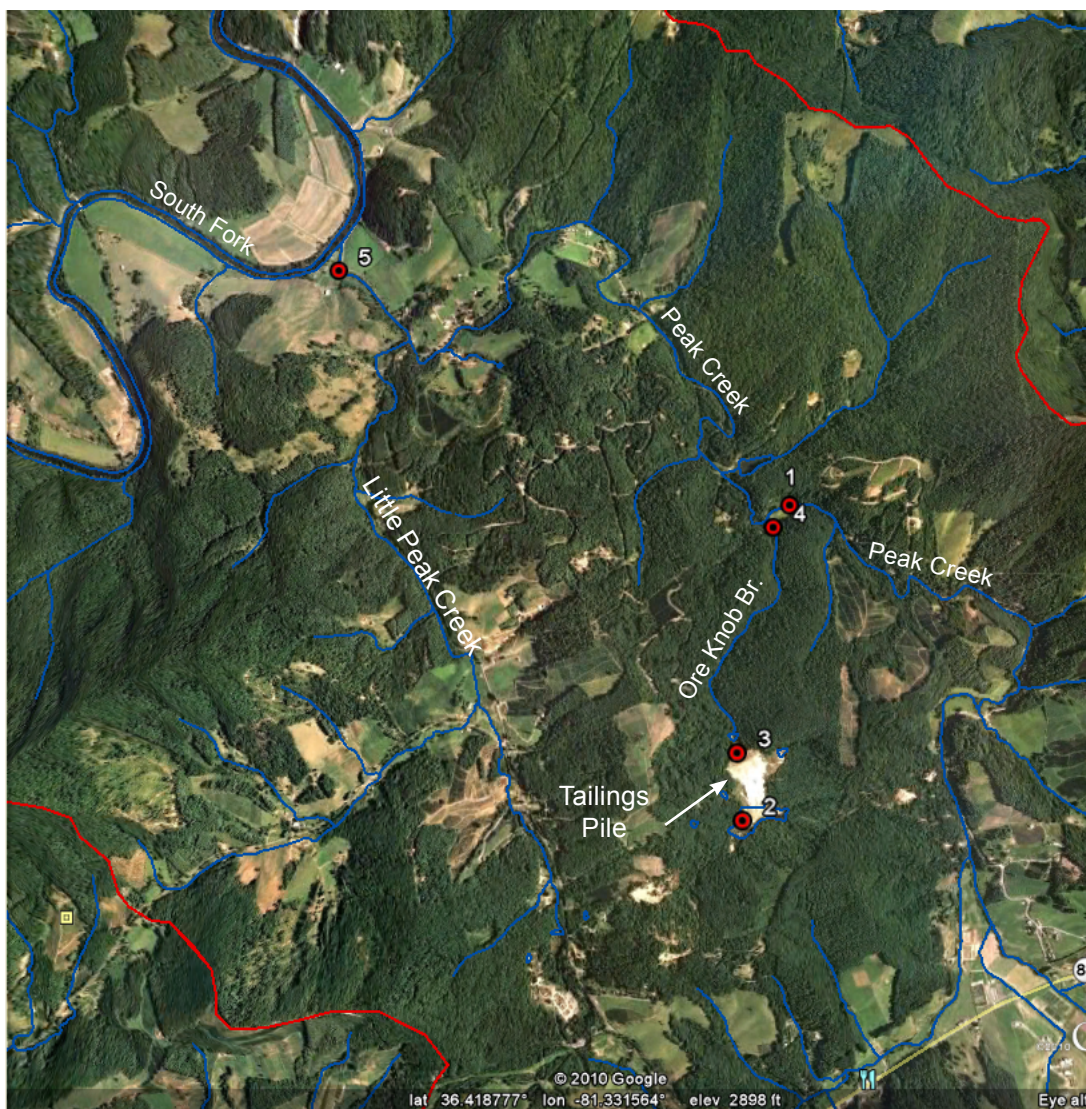
STATION #	LOCATION	STATION #	LOCATION	STATION #	LOCATION
1	Peak Creek	3	Discharge from tailings	5	Peak Creek just before South Fork New River
2	Southern intermittent pond	4	Ore Knob Branch		

Results of the sampling indicated pH levels at all stations except one were significantly lower than the states surface water quality standard of 6. The one station that was not below the standard was Site 1 which is the only site upstream of the mines impacted area. Acidity levels were highest were the concrete pipe discharges the tailings into the settling basin (Site 3). Copper was the only metal, sampled during this study, that showed higher levels at Site 2 (located at the intermittent pond) than Site 3. Site 2 represents runoff from the watershed area upstream (south) of the tailings pile as well as runoff that flows through the adits (a slightly sloped passage into the mine) before it enters the intermittent pond at the south end of the tailings pile. Higher copper levels at this site indicate signs of filtration of the metal as the water from the intermittent pond travels through the tailings pile. All other metals shown in Figure 4-4 had a much higher value once discharged from the tailings pile into the settling basin.

Site 4 (Figure 4-3), which is located on Ore Knob Branch just before its confluence with Peak Creek, results showed that much of the contaminates were reaching Peak Creek. And Site 5, on Peak Creek just before its confluence with the South Fork, results also showed evidence of the contaminates, but to a lesser degree.

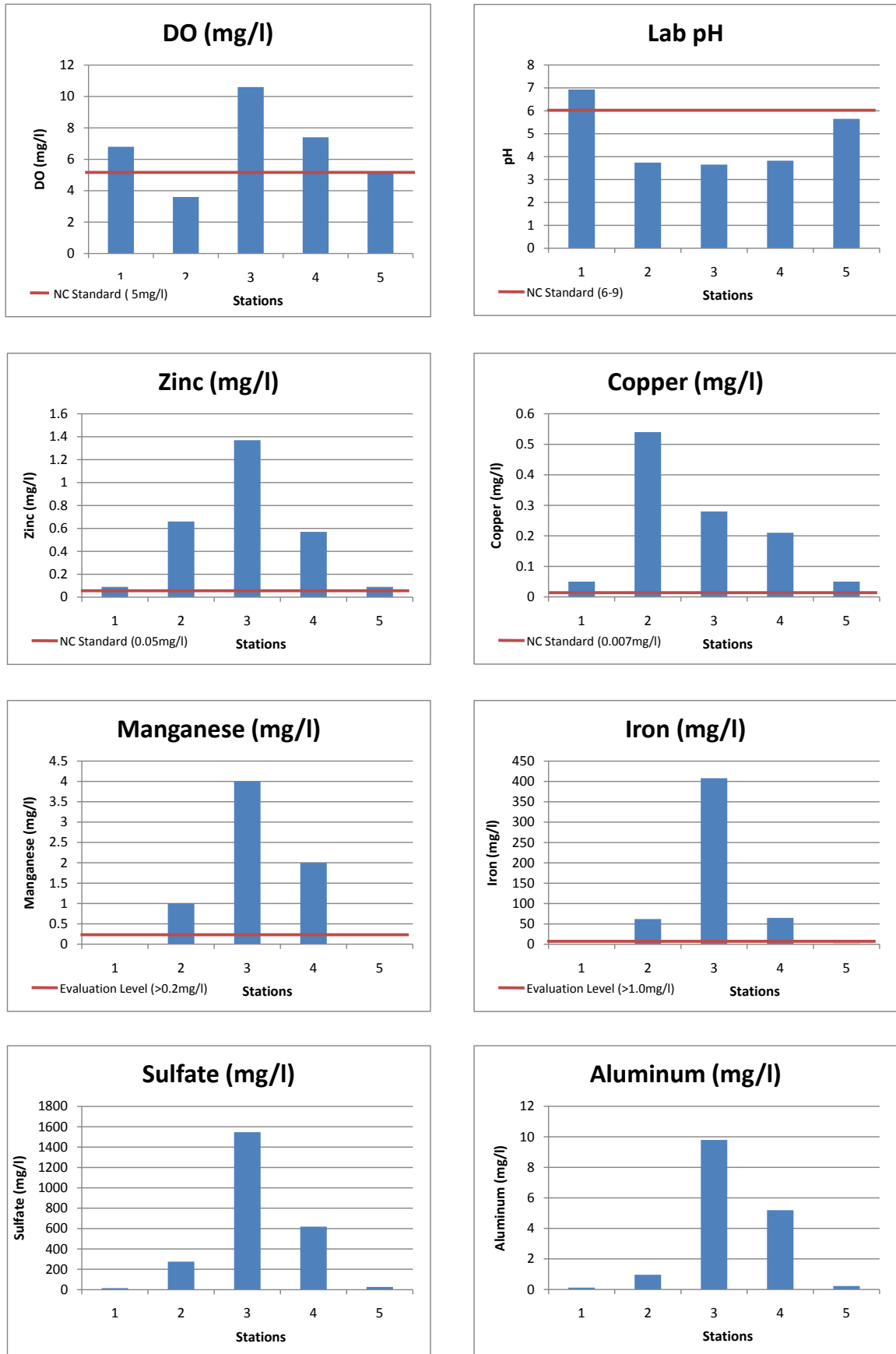
The study concluded the primary sources of the contaminates/pollution were 1) erosion of the face of the larger dam (north side of the dam), 2) adits that release acid mine discharge (AMD) from the former underground mine that is upstream of the intermittent pond, and 3) AMD generated within the tailings pile. Due to the contaminate levels found during this study and the degree of environmental and human health hazards, the state coordinated with the EPA to have the mine designated as a Superfund site (Borden and Behrooz, 2009).

FIGURE 4-3: SAMPLE LOCATIONS FOR THE 319 WATERSHED RESTORATION PLAN PROJECT FUNDED BY THE 319 GRANT*



* Imagery by Google Earth

FIGURE 4-4: AVERAGES FOR FIVE MONITORING SITES SAMPLED FOR THE ORE KNOB 319 PROJECT



DWQ & Environmental Protection Agency Region 4 Activity

DWQ and EPA Region 4 conducted site visits in 2007 to check on the degradation status of the embankment and tailings. During the February 2007 visit, the concrete pipe used to divert stream flow under the tailings pile to the settling pond was blocked at both inlet and outlets causing the flow to filter through the tailings. The 60 foot dam (Figure 4-5: top right) exhibited rills up to three feet deep along with numerous seeps. Storm runoff and water seeping from the dam face would be collected in the settling pond before reaching Ore Knob Branch; however, the settling pond had been completely filled with sediment which likely eroded from the face of the dam. This surface and groundwater was monitored in 2007 and 2008 as part of a 319 grant project.

In April 2009, the site was proposed for the [National Priority List](#) which became official September 23, 2009. Since that time, federal agencies developed a clean up effort based on past studies and stabilization efforts. As of July 2010, actions have included:

- 💧 20,000 of 720,000 cubic yards of tailings and sediment excavated from the settling pond;
- 💧 Restored a freeboard in the settling pond so it now acts as a clarifier as water empties into Ore Knob Branch;
- 💧 Completed the diversion channel designed to reroute 200 gallons per minute of surface water around the tailings dam;
- 💧 Recycled soil and sediment excavated from the site to re-use throughout the rest of the site; and
- 💧 Completed a geotechnical stability analysis and a slope stability analysis for the tailings dam face.

In July of 2010, EPA Region 4 requested additional funding to complete the remaining restoration of the site. This will cover the capping of the tailings impoundment and add vegetation throughout the site, excavate tailings from Ore Knob Branch and excavate and stabilize the 1950's mine and mill site. Federal sediment and erosion controls will be put in place during the restoration efforts. However, federal measures are not as preventive as state measures; therefore, elevated turbidity levels are expected to occur in Ore Knob Branch, Peak Creek and possibly the South Fork until restoration is completed.

DWQ will continue to work with EPA as requested through the remainder of the project.

FIGURE 4-5: PHOTOS OF TAILINGS PILE AND DOWNSTREAM TAKEN DURING A SITE VISIT IN JULY 2007 BY DWQ. (TOP LEFT: TOP OF LARGER DAM FACING THE SETTLING BASIN; TOP RIGHT: SETTLING BASIN LOOKING BACK TOWARDS LARGER DAM; BOTTOM LEFT: TOP OF LARGER DAM LOOKING BACK ACROSS TAILINGS PILE; BOTTOM RIGHT: ORE KNOB BRANCH DOWNSTREAM OF SETTLING BASIN CULVERT.)



REFERENCES

Black and Veatch. March 2008. *Expanded Site Inspection Report Ore Knob Former Mine Site*. CERCLIS ID: NCN000409895. EPA Contract 68-W99-043, Work Assignment 700-SAEA-A4ND, Black and Veatch Project 048700.08.83. Asheville, NC.

Borden, Robert C. and Behrooz, Mehnroosh. January 1, 2009. *Ore Knob Mine Tailings Pile - Watershed Restoration Plan*. Department of Civil, Construction and Environmental Engineering. North Carolina State University. NCDENR, 319 Program Funded. Raleigh, NC. (http://h2o.enr.state.nc.us/basin-wide/319_Documents/documents/OreKnob_Watershed_Plan.pdf)

Note: URL addresses for hyperlinks found in this plan are listed in the [Acronyms & Definitions Chapter](#).

