CHAPTER 34

RISK-BASED MANAGEMENT STRATEGIES AND INNOVATIVE REMEDIES FOR SURFACE WATER PROTECTION: A CASE STUDY

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Abstract: Releases of chlorinated aliphatic hydrocarbons have impacted soils and groundwater at a South Carolina facility. Plume discharges into nearby tributaries have contaminated surface waters with up to 4,600 μg/L of trichloroethene. Hydrogeologic studies, flow modeling, and pilot tests were performed to develop surface water protection remedies.

Part of the groundwater plume migrates off-site to the northeast and discharges into an underground storm water pipe and into a pond. Studies found that >99 percent of chlorinated hydrocarbons in the pond and downstream tributary originate from infiltration of contaminated groundwater into piping upstream of the pond. A surface water protection plan was developed using risk -based, innovative treatment approaches. The plan proposed plume containment by the subsurface pipe and *in-situ* treatment of water in the pipe. Risk -based components of this remedy included fencing the pond and developing wildlife - and human health-based standards for the pond and its downstream tributary. Successful pilot testing was conducted using air diffusion and ozone oxidation for water treatment inside the pipe.

Remedies for off-site surface waters west and south of the facility utilize *in-situ* enhanced reductive dechlorination treatment barriers around the tributaries. Trichloroethene was reduced in surface water and in the aquifer by 43% -99% in these areas.

Key words: Chlorinated hydrocarbons, trichloroethene, surface water remediation, air diffusion, ozone treatment, reductive dechlorination

1. INTRODUCTION AND BACKGROUND

The project site is a former manufacturing plant located in western South Carolina. Historical operations caused releases of trichloroethene (TCE) and other chlorinated aliphatic hydrocarbons (CAHs) to soils and groundwater beneath the facility. The complex structural and hydrogeologic conditions of the underlying saprolite-fractured rock aquifer system allowed the groundwater plumes to migrate in multiple directions away from the property. These plumes migrate off-site and discharge into three separate unnamed first-order streams at distances up to 1,500 feet from the facility. Concentrations of TCE as high as 4,600 micrograms per liter (μg/L) were detected in surface water northeast of the site (i.e., the northeast tributary). Trichloroethene concentrations up to 1,800 μg/L were detected in springs that feed the southern tributary. A separate plume from a waste pit source is encroaching on the western tributary, where very low concentrations of CAHs are periodically detected in surface water.

The state regulatory agency required that a surface water protection plan (SWPP) be submitted for impacted water bodies. To support the SWPP, surface water studies, groundwater-to-surface water flow modeling, contaminant fate modeling, and treatability pilot tests were conducted. These studies concluded that each of the three impacted surface water bodies has unique physical and hydrologic conditions and highly variable plume distribution in the adjacent aquifer. Additionally, exposure risks are different for each area based on accessibility to the surface water, presence and quality of ecological habitats, and beneficial use of each water body in the watershed. ENSR determined that a single cleanup remedy was not applicable to all three areas and developed an approach that uses innovative, risk-based cleanup methods and management approaches for the contaminated surface water. The following sections describe procedures used to develop and implement the SWPP.

2. REGIONAL GROUNDWATER FLOW AND PLUME MIGRATION

Comprehensive hydrogeologic studies have been conducted to determine plume distribution and subsurface controls on plume migration (Watkins et. al., 2002). The site is located on a topographic ridge that forms a drainage divide between two watershed sub-basins. A regional hydrologic divide traverses this area in a northwest to southeast direction (see Figure 1). The underlying saprolite-fractured rock aquifer is a single groundwater system