REMEDIAL ACTIONS TO ALLEVIATE GROUNDWATER POLLUTION FROM A FORMER INDUSTRIAL WASTE DISPOSAL SITE

Robert A. Paschke, Supervisor
Environmental Engineering & Pollution Control
3M Company
St. Paul, MN 55133

Michael A. Santoro, Manager
Environmental Engineering & Pollution Control
3M Company
St. Paul, MN 55133

Allan G. Gebhard, Vice President
Barr Engineering Company
Minneapolis, MN

Prepared for the

57th Annual Conference of the Water Pollution Control Federation

September 30-October 4, 1984

Session 15

New Orleans, Louisiana

INTRODUCTION AND BACKGROUND

During the 1940's and 50's, several companies, including 3M, hired a waste disposal contractor to dispose of waste materials from their manufacturing plants. The approximately 60 acre disposal site was located in an undeveloped, low land area about 10 miles from the City of St. Paul, Minnesota, in what is now the City of Oakdale, Minnesota. The site included a burn area for off/spec products and other waste materials, a drum recycling operation, and several waste disposal areas for both organic and inorganic residues. Originally, disposal of the waste was incidental to the drum reconditioning and recycling operation. However, as the amount and volume of waste increased, the waste disposal activity grew and the disposal contractor found it necessary to dispose of wastes in trenches and other low areas in the site. By 1960, most of the available disposal areas on site were filled and the disposal site contractor ceased operations.

Since 1960 the disposal site became covered with foliage and the property changed hands, all of which obscured the past usage. After learning about this site in 1978 from some of the area residents, the state pollution control agency conducted a preliminary investigation and notified the potentially responsible parties in early 1980, including present and past land owners, transporters and waste generators.

Later in the year, the responsible parties were called to a meeting at the state pollution control agency to discuss a course of action. In the absence of any specific proposals, 3M pointed out the need for an immediate technical investigation of the site area to determine the scope of the problem. 3M volunteered to fund the necessary investigation and with the approval of the state pollution control agency, Barr Engineering, a Minneapolis, Minnesota, based independent consulting firm, was hired to conduct the investigation in late December, 1980. Prior to this investigation, little information was available on wastes that were deposited in the sites, the hydrogeology of the area, and the quality of surface water and groundwater in both the shallow and deeper site aquifers. Recollections regarding the history of the sites were often conflicting, which made it difficult to develop the scope of the investigation.

Based on the information that was available and on the suggestions of the state pollution control agency and other units of government, the hydrogeologic investigation was designed to meet the following objectives:

1. Obtain a definition of the disposal site limits including the locations of areas that were used to dispose of the wastes.

2. Define the site hydrogeology including directions of groundwater movement and characterization of the underlying soils and bedrock in the vicinity of the site.

3. Determine the concentration and extent of possible contamination in the soil and groundwater beneath the disposal site and in the surface water.

4. Recommend any further studies and/or remedial measures that would be warranted by the results of the investigation.

Due to the limited information that was available on the disposal sites, the description of the wastes and the hydrogeology of the area, a phased approach was used and the work scope was modified as information from data collection activities became available.

A total of 3 phases were required in this investigation to thoroughly understand the site hydrogeology and determine the extent of the problem. The work plan for each phase of the investigation was reviewed and approved by the state pollution control agency, the U.S.EPA, other regulatory agencies, and the local units of government.

The first phase of the study involved the placement of deep bedrock borings and a number of shallow monitoring wells and soil borings around the disposal site. Samples of soil and groundwater were analyzed to define the extent to which waste from the site had migrated into the shallow groundwater. In addition, several groundwater level measurements were taken to define the direction of groundwater movement in the site aquifers. Evaluation of the data from this initial phase showed that additional study would be required to further define the waste disposal areas, the site geology, and the extent of the horizontal and vertical migration of potential contaminants through the bedrock aquifers underlying the site.

The primary goal in the final two phases of this study was to understand the mechanisms of contaminant migration from the shallow groundwater to the deep aquifers, and based on this knowledge, develop a remedial action plan that would remove the primary sources of contamination and control the movement of contaminants into the deep aquifers underlying the site. The results of the hydrogeologic investigation which was completed in April, 1983, are summarized in the next section of the paper.

SUMMARY OF PHASE I, II, III HYDROGEOLOGIC STUDY

DISPOSAL SITE LIMITS

To define the limits of the disposal site, Department of Transportation aerial photographs from the present time back to the mid-1940's were reviewed for evidence of disposal activity. Evidence of waste disposal activity identified on the aerial photographs included burial trenches, areas of surface disposal, and several burned over areas. On the basis of this information and interviews with retired and present employees, it was determined that there were three separate disposal areas. Field surveys were carried out to further delineate the sites. Combining the aerial photograph information with the sites survey data helped to define the boundaries of the three disposal sites shown in Figure 1. The three sites shown on the map were named the Abresch, Brockman, and Eberle Sites after the owners of the sites at the time of disposal activity. A brief history of each site and the types of waste disposal activities that occurred at each site follows:

Abresch Disposal Site - *This was the largest disposal* site with an area of about 50 acres. Initially, waste disposal was limited to the most southerly portion of the site, near the former Abresch drum recycling operation. Aerial photographs indicate that wastes were dumped in shallow trenches and burned on a regular basis. Sometime after 1955 and continuing until near the end of the site use in 1960, surface waste disposal occurred in low lying areas and in several trenches located on higher ground. A typical burial trench generally appeared to average about 10 feet in width, about 150 feet in length, and likely did not exceed 15 feet in depth. The burial of waste in trenches occurred principally in the northern portion of the site. (Department of Transportation records indicate that waste was encountered during construction of a highway through this portion of the site.) Sometime after 1957 it appears that most of the waste disposal occurred immediately south of what is now the highway. Because of the shallow groundwater table, the majority of the waste placed in the Abresch site south of the highway was likely placed on the ground surface and partially covered with soil. In the later years of the Abresch site, it appears that greater quantities of waste including domestic rubbish were also being deposited at the site.

Brockman Disposal Site - The aerial photographs indicate that waste disposal activities at the Brockman site began sometime in the 1940's and ended in the early 1950's. The method of waste disposal used at the Brockman site is not readily apparent from the aerial photographs. The area of land alteration at the Brockman site was approximately 5 acres. Interviews with past and present employees indicate that the Brockman site often was used when trucks could not access the low lying areas of the Abresch site.

Eberle Disposal Site - The Eberle site was used for the open burning of waste, primarily off-spec products and solid waste, and no evidence of surface disposal or waste burial in trenches is evident in the aerial photographs. The area of land alteration at the Eberle site was approximately 2 acres.

SITE HYDROGEOLOGY

To determine the direction of groundwater movement and to characterize the underlying soils and bedrock in the vicinity of the site, several shallow soil borings and deep bedrock borings were placed in and near the disposal sites. Available hydrogeologic data, including private well data, construction site borings and information from the Minnesota and U.S. Geologic Surveys were utilized, where possible, to optimize the boring location and provide reference data. Figure 2 shows the locations of on-site borings and wells and Figure 3 shows the location of offsite

borings and wells that were used to obtain groundwater levels in the underlying backrock formations. These measurements were used to determine the direction of the groundwater movement in both the shallow and deeper site aquifers.

Disposal Site Soils and Geology

Soil borings placed during the investigation showed that the soils overlying the bedrock in the vicinity of the disposal sites are complex and generally consist of alternating units of sandy to clayey sandy alluvium and glacial till, which is a heterogeneous mixture of sand, silt, and clay.

Bedrock borings placed during the investigation indicated that a limestone formation (Platteville limestone) underlies all three sites. Beneath the Eberle and the northern portion of the Abresch site, the Platteville limestone is overlain by a shale layer (Decorah shale) which is an aquitard where it is present. The Platteville limestone formation is approximately 20 to 35 feet deep in the area and is a source of supply water for some private wells that still exist in the area to supplement the municipal water supply. The Platteville is characterized by fractures and solution channels.

The Platteville formation is underlain by a 3-6 foot layer of shale (Glenwood shale). This formation is generally considered to retard the movement of groundwater from the Platteville limestone to the underlying bedrock aquifers.

Underlying the Glenwood shale is a sandstone (St. Peter sandstone) at a depth of approximately 100 feet. This is an important aquifer in the St. Paul area and is used for industrial wells and a limited number of older municipal and private wells. The St. Peter sandstone is between 150-165 feet thick in the vicinity of the disposal sites.

The formation underlying the St. Peter sandstone is a dolomitic formation (Prairie du Chien group) which is characterized by fractures, joints, and solution channels and is about the 125-135 feet thick in the area.

The Prairie du Chien group is underlain by a sandstone (Jordan sandstone) which is a coarse to medium grain sandstone about 80-85 feet thick in the area. Because there is no aquitard separating the Prairie du Chien and Jordan, they are often considered to be one hydrologic unit even though the rate of groundwater movement through the two units can be significantly different. Together, these two units form the primary bedrock aquifer in the St. Paul area and are used as a source of municipal potable water by many suburban communities.

Because the groundwater flow systems of interest in this study do not appear to involve formations below the Jordan formation, and because no wells in the vicinity of the disposal sites penetrate below the Jordan, the remainder of the bedrock sequence is not described in this paper. A geologic column in the vicinity of the disposal sites showing the previously mentioned formations and their approximate thicknesses is shown in Figure 4.

Initially, during the early stages of the study there was a concern that a major bedrock valley might be located very near the disposal sites. If a bedrock valley did exist, the valley would penetrate the Glenwood shale and would be a direct route for contaminants to move into the deeper aquifers. However, deep bedrock borings and a detailed seismic study showed that the major bedrock valleys in the disposal site area were approximately 3 miles west and approximately 1 mile east of the disposal sites. The generalized location of these major buried bedrock valleys and their proximity to the disposal sites are shown in Figure 5.

Groundwater Movement

The data from the shallow monitoring wells showed that the direction of groundwater movement in the shallow groundwater beneath the Abresch and the Brockman sites is toward the small streams and ponds that are located in and adjacent to the two sites. The flow in the shallow groundwater beneath the small Eberle site is easterly. Downward movement of groundwater is occurring from the surficial water table to bedrock with rates of vertical movement on the order of 1 to 3 feet per year.

The direction of groundwater movement in the Platteville limestone was difficult to determine since the flow is through fractured zones and solution channels. Water level measurements and groundwater quality data, however, indicated that flow through the Platteville was to the southwest from the sites. Vertical movement of water from the Platteville limestone to the underlying St. Peter does not occur in the vicinity of the disposal sites because of the Glenwood shale which acts as an aquitard between

the two formations. Water level measurements in the St. Peter wells indicate that the groundwater movement in the St. Peter sandstone near the sites is also toward the southwest. Figure 6 shows the general groundwater movement in the shallow site aquifers and Figure 7 shows the generalized groundwater movement in the Platteville limestone and the St. Peter sandstone.

GROUNDWATER AND SURFACE WATER QUALITY

Groundwater samples collected from shallow monitoring wells placed within the limits of the disposal sites were analyzed for possible contaminants. Analysis of the samples indicated that the contaminants in the shallow groundwater are mostly volatile organic solvents and that the highest concentrations are present beneath the northern and a small southern portion of the Abresch site. The extent of the shallow contaminant plume in these areas is shown in Figure 8. A typical analysis showing the types and the concentration of the shallow groundwater contaminants is shown in Table 1. Samples taken around the perimeter of the Eberle, Brockman and Abresch sites indicate that little lateral migration of contaminants had occurred through the groundwater in the shallow glacial drift. Samples collected from the surface waters in the Abresch and Brockman sites showed that low concentrations of volatile organic compounds are present in the small ponds within the Abresch site and in the small stream that flows eastward from the Abresch site. This data supports the conclusion that the shallow groundwater moves into the ponds and leaves the Abresch site via the small stream to the east. Samples taken in this stream a few miles from the Abresch site show no evidence of contamination.