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AN HISTORICAL SKETCH OF INDUSTRY ALONG THE BUFFALO RIVER, NEW YORK WITH A FOCUS ON CHEMICAL MANUFACTURERS

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ABSTRACT: The Buffalo River, New York has been designated an Area of Concern by the International Joint Commission due to poor water and sediment quality. Historically, the shores of the river were a heavily industrialized portion of the city of Buffalo. The river served several purposes: a means of transportation; a source of water; and, a waste receptacle. Direct industrial discharges have been identified as a source of pollution to the river. Similarly, past industrial practices, in particular, waste handling and disposal, have adversely affected the health of the river. This paper sketches a history of industry within three sewer districts that border the Buffalo River beginning in the late 1800s. The presence of industry from 1929 through 1990 are depicted in 30 year increments using MAPINFO, a desktop mapping program. A history of the chemical industries that were concentrated along an upstream stretch of river is also provided. As a whole, the chemical industries were major polluters; various waste disposal practices employed by these industries are discussed.

INTRODUCTION

Throughout the world, water pollution poses significant problems for health and safety. A major cause of water pollution is the past widespread practice of using water bodies as waste receptacles. Efforts to remediate the damage have been proposed. For example, regarding pollution within the Great Lakes Basin, the Water Quality Board of the International Joint Commission (IJC) has identified forty-three Areas of Concern in the United States and Canada and has recommended that Remedial Action Plans (RAPs) be developed for each of these areas.

The Buffalo River, New York (Figure 1) has been designated an Area of Concern by the International Joint Commission due to its poor water and sediment quality. Presently, contaminant sources include bottom sediments, inactive hazardous waste sites, combined sewer overflows, direct industrial discharge and other point and non-point sources. Historically, the Buffalo River attracted many industries to its banks, mainly because it was a focal point for water and rail transportation as well as a source of process and cooling water. The river also became a convenient receiving body for the disposal of industrial waste, thus evolving into its present environmentally degraded state.

The time period of interest to this study is approximately the late 1800s through 1990. The areas of interest are three sewer districts that border the Buffalo River (Figure 1). Sewer districts were chosen to delineate the area because the development of Buffalo's sewer system has had a notable impact on the environmental condition of the Buffalo River, in regards to both sanitary based and industrial pollution (Rossi, 1995). In fact, the city's sewer system continues to periodically discharge untreated sanitary and industrial waste during large storm events.

The primary objective of this study is to provide a history of the chemical industries present along the shoreline of Sewer District 18 and how their waste disposal practices contributed to the pollution of the Buffalo River. Secondary objectives are: (1) to present environmental background information on the Buffalo River; (2) to sketch a general history of industry in three sewer districts that border the Buffalo River, beginning in the late 1800s; and, (3) to illustrate the presence of industry from 1929 through 1990 in 30 year increments.

HISTORY OF THE BUFFALO RIVER

The environmental degradation of the Buffalo River over time is directly related to settlement along its shores and the subsequent growth of the city of Buffalo (Sauer, 1979). An early account of the river area describes it as an uninhabited marsh, infested with mosquitos (Bingham, 1931). Another historian describes the shores of the Buffalo River as the site for temporary Indian hunting and fishing camps; the river area apparently was a wealthy source of food but not a desirable location for settlement (Laux, 1960). Eventually, settlement of the area began in 1758 with the establishment of a trading post at the mouth of the river, and from that point in time evolved into what is now the city of Buffalo (Rundell and Stein, 1962).

There are three major pollutant sources to the Buffalo River: runoff, population, and industry. Sauer (1979) classifies the contributions of these major sources according to time. Pollutants from runoff - rainfall flowing over land into the river - dominate the Frontier Era (up to 1795), while pollutants generated from population activities characterize the Commercial Era (1795-1875). Industrial sources of pollutants fall within the Industrial Era (1875-present). The pollutants transported via runoff during the Frontier Era generally occurred naturally: the runoff carried pollutants related to the land's natural state (i.e. sediments and nutrients). Once settlement began, the runoff transported human contributions, in addition to the population wastes directly routed to the river. The growth of industry and its location along the Buffalo River gave rise to the practice of directly discharging extremely toxic pollutants, such as heavy metals and polynuclear aromatic hydrocarbons, into the river. Settlement and development, especially industrial development, introduced the most pernicious pollutants into the river.

The selection of Buffalo as the western terminus of the Erie Canal (completed in 1825) marked the beginning of efforts to increase the depth and width of the Buffalo River to make it navigable. Water transportation was a vital factor in the location of early industry, which required a navigable channel for its growth along the river's shores. Thus, to ensure industrial growth and the commercial success of the city of Buffalo, periodic dredging of the river was required. Dredging continues today; a minimum 6.7 meter channel depth is maintained by the U.S. Army Corps of Engineers.

The main effect of dredging from the standpoint of this research, was to increase the residence time of pollutants in the river (Sauer, 1979). A river discharge equation best illustrates this point: the rate of flow or river discharge (Q) is equal to width (W) x depth (d) x velocity (v). Dredging increased the volume of flow [(w) and (d)]; however, the rate of flow (Q) remained constant. Therefore, the velocity of the flow (v) decreased significantly, and any pollutants discharged into the river remained in the channel longer than they would have under natural conditions. It is important to note that flow rates were significantly lower during the summer months and further increased the residence time of pollutants. Finally, in dredging a polluted river, contaminated sediment is disturbed and may re-introduce pollutants into the water column, thus further degrading water quality (Palermo et al., 1992).

The Buffalo River became seriously polluted mainly as a result of the activities of man. Thus, with industrial and economic success came the legacy of profound environmental degradation.

INDUSTRIAL GROWTH

By the late 1800s, a number of industries were present in each of the three sewer districts. The shores of each district were attractive to industry for several reasons. First, the river was a navigable channel for incoming supplies and outgoing products. Second, there was plenty of water for process and cooling purposes. Third, the

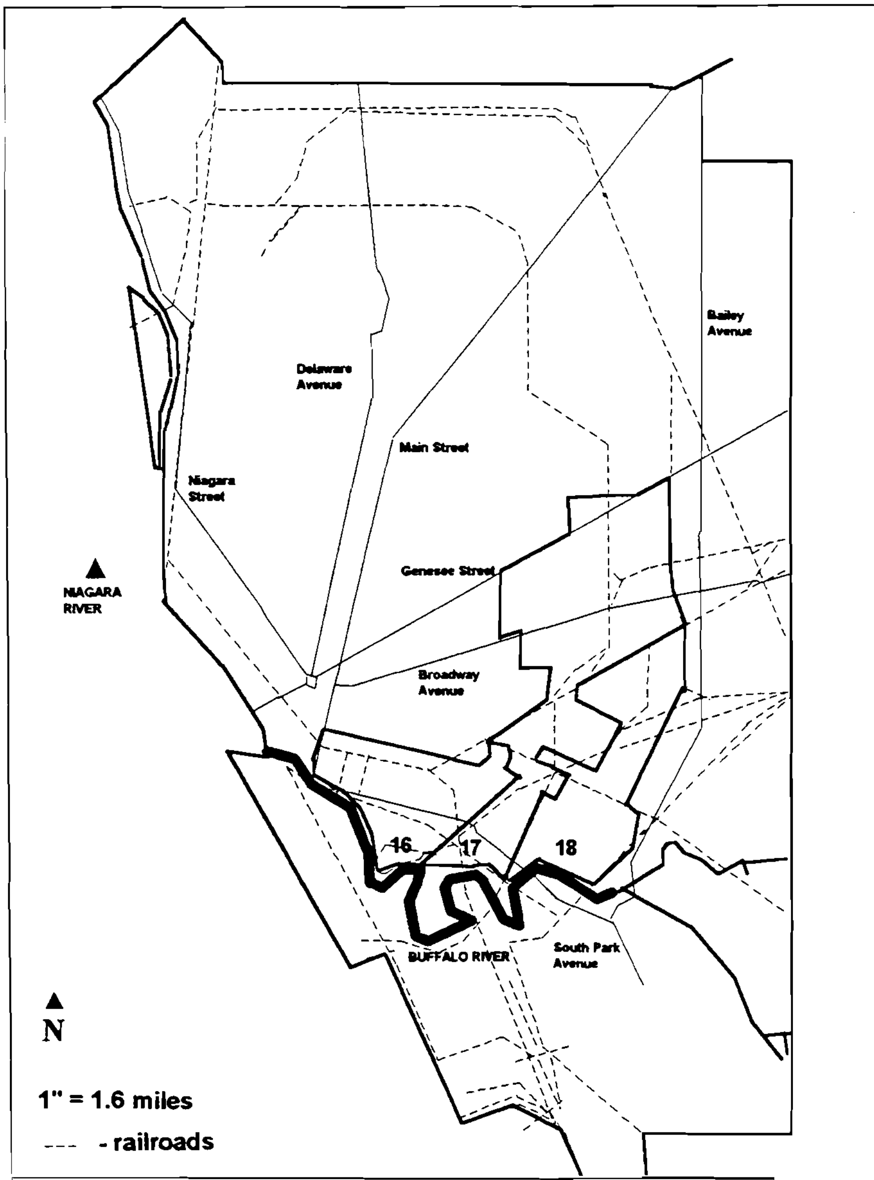


Figure 1 The City of Buffalo, NY; Sewer Districts 16, 17 and 18; The Buffalo and Niagara Rivers.

river was a convenient receiving body for the disposal of industrial waste. Rail transportation was also an option for shoreline industries. With two accessible forms of transportation, industries were able to minimize transportation costs. Bulky raw materials and products could be shipped by water, while smaller, lightweight items could be shipped by rail. Aside from the eastern end of Sewer District 16, there were no residential areas along the shores of the Buffalo River.

The industries located inland were generally less dependent on the river as a source of process and cooling water. Their main incentive for location was probably a combination of market and transportation accessibility. Railroad transportation was adequately developed in all three sewer districts, particularly inland from the Buffalo River (Figure 1). A significant portion of the inland area of each sewer district contains residential areas, thus providing a source of labor.

The trade wastes from industries located offshore were discharged to the Buffalo River via sewers routed directly to it (Rossi, 1995). Industrial discharge of this nature continued until 1883, when an intercepting sewer diverted offshore wastes, as well as sanitary and storm flow, to the Niagara River (Sauer, 1979). However, shoreline industries continued to discharge directly until 1938, when the primary treatment plant was operational.

A variety of industries were present in each of the three sewer districts. A database of industries through time, created primarily from historical editions of *Sanborn Insurance Maps* and *Buffalo City Directories*, identifies lumber, iron and steel, meat processing, oil refining and chemical industries as the most common. These general categories include numerous related industries such as foundries, electroplating, tool and die works, fertilizer, soap, glue, furniture, acid and dye manufacturing.

Interestingly, each of the three sewer districts contain at least one dominant type of industry. Sewer District 16 contains many iron and steel related establishments. From the late 1800s through the 1950s, iron and steel making operations were located along the shoreline and many support industries were offshore. Sewer District 17 was dominated by meat processing establishments and industries related to the use of their by-products (e.g. fertilizer, tanning and animal feed manufacturing). Two types of industry were prevalent along the shoreline of Sewer District 18, chemical and oil refining. The upper portion of this sewer district, adjacent to the concentration of meat processing related establishments in Sewer District 17, contained stockyards.

Figures 2-4 illustrate the presence of industry in the three sewer districts from 1929 through 1990. Due to a lack of systematic historical information on the identification and location of industry, the following method was used to create a database: (1) the streets in each sewer district were identified and alphabetized; (2) relevant numerical addresses were determined according to the sewer district boundaries; (3) the industrial occupants of each street were identified through city directories and tracked through time; and, (4) the information was prepared as a database and the maps created using MAPINFO.

Several trends are evident in examining the time series. First, industries generally tend to cluster along the shoreline and adjacent to railroad lines. Second, there was a gradual decline in the number of industries from 1929 through 1990. The total number of industries in 1929, 1960 and 1990 was 241, 191 and 91 respectively. Additional maps were created for the intervening years and exhibit the same trends. In all of the sewer districts of interest, the total number of industries peaked in 1929.

HISTORY OF CHEMICAL INDUSTRIES

As previously noted, a portion of the shoreline of Sewer District 18 was dominated by chemical industries. These industries are of particular interest for several reasons: (1) the chemical industries were present throughout the time period of interest; (2) the chemical industries experienced tremendous growth; (3) the chemical industries specialized in dye production which was the single largest source of pollution to the Buffalo River on a tonnage basis until its decline in the 1960s (Sauer, 1979); and (4) the past waste disposal practices of the chemical industries continue to have a negative impact on the river.

The chemical industries are concentrated in the southwest corner of Sewer District 18. A nearby peninsula (Figure 5) was used for chemical production and chemical waste handling. The general area for the chemical plants was desirable for several reasons. Initial selection of the site by Schoellkopf in 1879 was most likely due to its proximity to the Buffalo River. Chemical industries typically use vast quantities of water for process and cooling operations.

Transportation was equally important for the initial selection of the site because the majority of raw materials needed by the chemical industries were imported from Germany at that point in time. Proximity to water and rail transportation, raw materials, markets and an inexpensive source of hydroelectric power from Niagara Falls served to

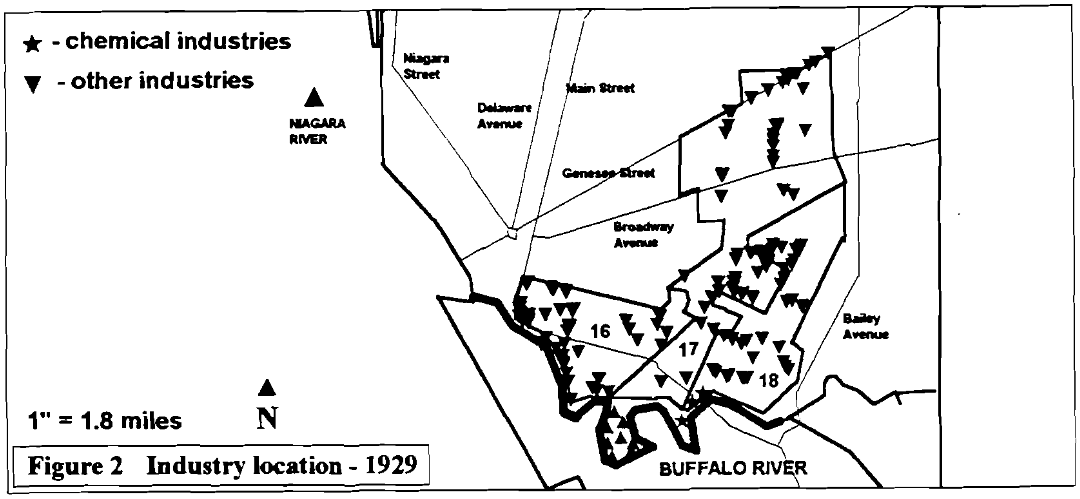


Figure 2 Industry location - 1929

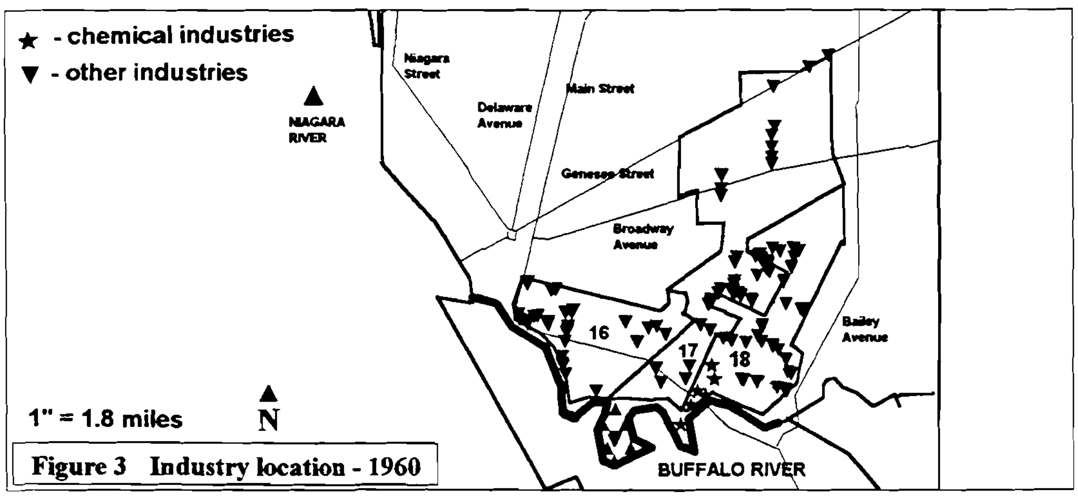


Figure 3 Industry location - 1960

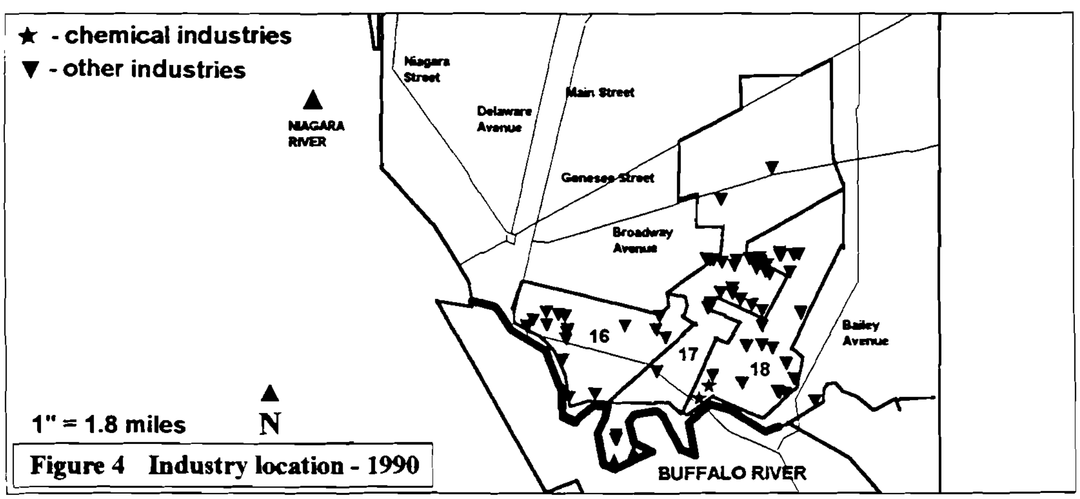


Figure 4 Industry location - 1990

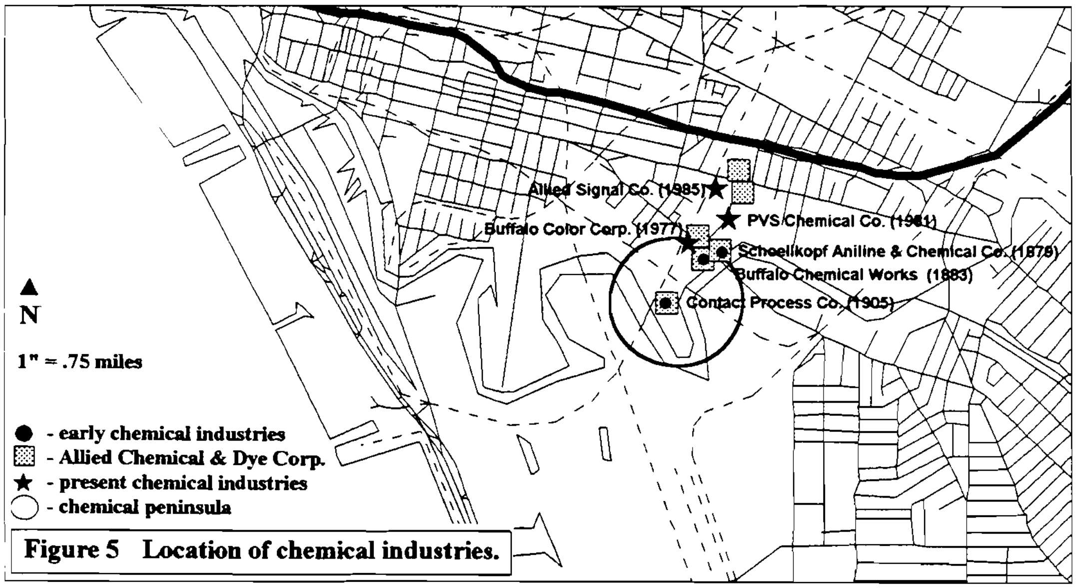


Figure 5 Location of chemical industries.

make the location desirable for expansion.

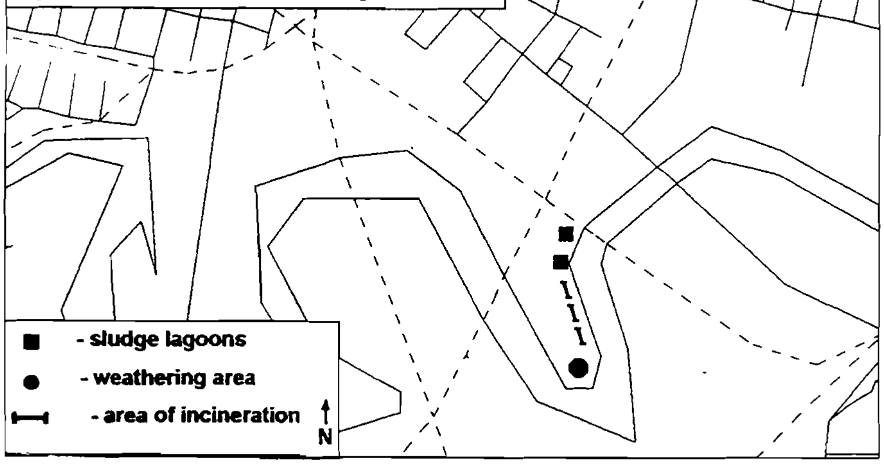
The history of the chemical company that grew to dominate the peninsula is best described as a series of mergers. In 1879, J.F. Schoellkopf founded the Schoellkopf Aniline and Chemical Company. By 1883, a second chemical company, Buffalo Chemical Works, was established by M. Kalbfleisch and Sons; by 1910 the name of the company had been changed to General Chemical Works. At some point in time after 1890, the Schoellkopf Aniline and Chemical Company became Schoellkopf, Hartford and Hanna. Meanwhile, in 1905, Schoellkopf founded the Contact Process Company for the manufacture of acids and other chemicals. In 1917, Schoellkopf, Hartford and Hanna merged with two other related chemical companies to form National Aniline and Chemical Company Inc. Vertical integration was achieved via the merger. Before the end of that year, National Aniline was producing more than half of all dyestuffs for the American market (Malcolm Pirnie, 1989).

By 1920, National Aniline merged with the Contact Process Company and the General Chemical Company to form the largest dye plant in the United States, the Allied Chemical and Dye Corporation (Kessel, 1923; Allied Chemical Corp., 1957). At the time, the plant occupied 8.9 hectares, had 118,422 m^2 of floor space and utilized 130 buildings (Kessel, 1923). Continuous data on the magnitude of operations was not available locally. However, the total value of products in 1929 for commercial acids was $3,189,687; it was $24,789,749 for dyestuffs (U.S. Department of Commerce, 1929). For the next thirty years, Allied expanded its dye and dye intermediate operations and also began to manufacture new products.

According to Malcolm Pirnie (1989), Allied Chemical began to decrease chemical production in 1963 when the manufacture of aniline ended. Chemical products continued to be eliminated, and in 1977 Allied Chemical sold the dye plant to Buffalo Color Corporation and the number of dye products was reduced from 1,800 to about 100 (Irvine et al., 1992). In 1981, PVS Chemical Corporation bought several production facilities. All structures on the peninsula were leveled in 1984. By 1985, Allied Chemical ceased chemical manufacturing; Allied Signal Company was established. Presently, Buffalo Color, PVS Chemical and Allied Signal continue production; they manufacture indigo dye for blue jeans, various acids and fluorine products, respectively. Figure 5 illustrates the history of the various chemical plants through time.

Within the scope of this study, it is not possible to address the numerous processes employed by the chemical industries and the

Figure 6 Chemical waste handling sites.



potential pollutant contributions from them. However, dye intermediate production, a mainstay of Allied Chemical, provides an interesting and manageable example, although simplified considerably. Dye intermediate production was initiated in 1915, when German imports ceased (Allied Chemical Corporation, 1957).

The raw materials, or crudes required for the production of dyes are obtained primarily from by-product coke ovens. Coal tar intermediates are produced from the crudes and serve as the basic material in chemical manufacturing. It is necessary to convert the coal tar intermediates into derivitives (dye intermediates). A multitude of derivitives can be produced as a result of chemical reactions. Nitration, reduction, oxidation, sulfonation, halogenation and condensation may be utilized on the aromatic hydrocarbons. In some instances, the intermediate produced from the reaction is subjected to further reactions to obtain the desired product. The use of acids, such as sulfuric and chlorosulfonic are often necessary as are heavy metal catalysts, various forms of ammonia and a multitude of other inorganic, organic and metallic compounds and dilutions. Heating, cooling, skimming and mixing may be required as well.

Due to a lack of information to the contrary, it is assumed the pollutants generated from dye intermediate production are residuals of the materials used. These materials include, but are not limited to polynuclear aromatic hydrocarbons (PAHs) such as napthalene and toluene, and heavy metals such as chromium, cobalt and copper (Abrahart, 1968). A multitude of pollutants, (including the PAHs and heavy metals listed) have been detected in both soil and groundwater samples taken at various locations on the peninsula (Lee et al., 1991).

In addition to the direct discharge of liquid trade wastes, the chemical industries employed solid waste disposal practices that may have contributed to the pollution of the Buffalo River. Allied Chemical Corporation in particular, engaged in practices that may have resulted in non-point source pollution of the river. For example, as late as 1976, heavy metal sludges containing iron, lead, chromium, zinc, copper, arsenic, mercury and cobalt were piled on the tip of the peninsula for weathering after which they were shipped to metal recyclers. The weathering process included dewatering of the sludges and must have contributed heavy metals to the runoff entering the Buffalo River as well as to soil contamination. This weathering area is presently one of three inactive hazardous waste sites located on the peninsula, in addition to two iron oxide sludge lagoons. Similarly, an incinerating area was located on the peninsula; from 1922-1954, liquid and solid wastes were burned in pits that were subsequently covered with dirt when the pits filled with ashes (Malcolm Pirnie, 1989). Figure 6 identifies the location of the sludge lagoons, incineration and weathering areas.

CONCLUSION

The immediate goal of the Remedial Action Plan for the Buffalo River Area of Concern is to restore and maintain the chemical, physical and biological character of the ecosystem (NYSDEC, 1989). The environmental problems and sources have been identified. However, an historical perspective offers important clues in identifying the nature and origin of these problems and sources.

In providing background information on the Buffalo River, one is better able to understand its progression from a pristine to polluted state. The history of industry, although a thumbnail sketch, identifies areas of concentration of related industries which enhances understanding of problems related to those areas. The database created to identify the presence of industry in the three sewer districts also contains information on the type of manufacturing conducted when possible. This database can be used to identify specific occupants at various locations through time and may augment the identification of potential problem areas. This is particularly useful in regards to recent interest in reclaiming former industrial sites, also known as brownfields, for development.

The focus on chemical industries offers a case study of the establishment, tremendous growth and significant decline of industry along the Buffalo River. Even if all chemical production in the area ceases, the pollution and stigma attached to the land remain. Similarly, industrialization along the Buffalo River forever changed the surface of the land; historically accepted, if not welcomed by many as physical evidence of prosperity. Using the chemical peninsula as a case in point, even though the physical presence has been removed, the subsurface legacy persists. Clean up of the peninsula is currently underway with plans to create habitats and attract wildlife as well as for a containment system for groundwater and four extraction wells for pumping to a proposed on-site treatment plant (Vogel, 1996).

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