Historical Industrial Waste Disposal Practice In Winnebago County, Illinois: 1870-1980

Craig E. Colten, Gerard E. Breen

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by

Craig E. Colten and Gerard E. Breen

Illinois State Museum
Springfield, Illinois

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HISTORICAL INDUSTRIAL WASTE DISPOSAL PRACTICES
IN
WINNEBAGO COUNTY, ILLINOIS: 1870-1980

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Craig E. Colten
and
Gerard E. Breen

Illinois State Museum
Springfield, Illinois 62706

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Acknowledgments

Ideally a project of this sort would be based on a systematically-compiled source of information, but in reality no such record exists. Consequently, we had to rely on a diverse set of documents, and much of what we have compiled here represents the assistance of capable archivists and public agency records officers. To them we owe sincere thanks. Special attention was afforded us at the Northern Illinois Regional History Center, the Rockford Water Department, the Sanitary District of Rockford, the Rockford Park District, the Rockford Public Library, the Rockford Museum Center, both the county and city planning agencies, the Illinois Environmental Protection Agency, the Illinois State Archives, and the Illinois State Historical Library.

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Abbreviations:

DENR - Department of Energy and Natural Resources
IEPA - Illinois Environmental Protection Agency
NIRHC - Northern Illinois Regional History Center
SDR - Sanitary District of Rockford
SWB - Illinois Sanitary Water Board
WCDPH - Winnebago County Department of Public Health
Abstract

Of all the urban, industrial counties in Illinois, Winnebago County has the largest share of its territory underlain by shallow aquifers which have been designated highly susceptible to contamination by land burial of municipal wastes. The entire Rock River valley, filled with glacial drift, is highly susceptible, and also is the focus of industrial activity, the source of much public drinking water, and the location of intensive residential land use. Several recent incidents of well contamination prompted a coordinated research effort, funded by the Hazardous Waste Research and Information Center, to assess the risks faced by the public who live in this area. The preparation of an historical geography of Rockford industry and waste disposal activities is one segment of this program.

Industrial inventories for select dates between 1880 and 1980, along with maps of industries form the core of the historical record. In addition, retrospective analysis of industrial processes allows a determination of the types of waste produced during the last century. A review of the waste disposal methods used between 1870 and 1980 and maps of industrial waste disposal sites, when combined, provide an accurate picture of potential hazards. Because the record of industrial waste disposal is incomplete, a series of generalized maps were produced to delimit areas of intensive industrial activity and documented land disposal of industrial wastes. They identify areas deserving thorough groundwater analysis.

The information contained in this retrospective analysis of Winnebago County industry suggest two important conclusions: 1) Disposal of hazardous industrial wastes is a problem that originated in the nineteenth century. 2) Casual land disposal since early in this century has created many potentially hazardous situations.
Executive Summary

Winnebago County water supplies came under careful scrutiny after the discovery of several tainted wells. Ground-water pollution is a particularly critical issue in Winnebago County because nearly half the public potable water is drawn from aquifers that are highly susceptible to contamination. The county also has a lengthy history of hazardous waste producing industries in areas above the water sources. Two questions posed by this investigation were when did manufacturing which produced hazardous by-products begin operating in areas of susceptibility and how did they dispose of their wastes?

The physical characteristics of Winnebago create a situation conducive to ground-water contamination. A deep valley, filled with sand and gravel deposits, underlies the Rock River. This valley serves as a reservoir for ground water used by municipalities, industries, and private citizens along its course. Rainfall percolates into the permeable sand and gravel, and subsurface movement directs the moisture from the valley margins toward the Rock River. Thus any liquid—water or industrial wastes—percolating into the sand and gravel moves through the underground system.

Ample local precipitation makes the sand and gravel aquifers a bountiful supply for potable water and numerous wells have been drilled into the outwash since 1945. Most urban and industrial development has taken place above the ground-water reservoir, creating greater demands for water and also placing the aquifer at greater risk.

Industries producing hazardous wastes began business in the late 1800s. By 1892 there were several plating companies in operation and by the 1920s numerous hardware companies used electrochemical processes to apply metallic coatings to their products. Their wastes included acids and cyanide. From the 1860s on, metal casting companies left heavy metals in the foundry sands they discarded. The rise of the machine tool industry in the 1920s introduced wastes composed of water and oil mixtures. Textile manufacturers, leather tanning operations, and printing companies, all mainstays of Rockford's economy, also produced hazardous wastes prior to 1940.
Disposal methods, while acceptable by contemporary standards, left much to be desired. A thorough survey of industrial waste disposal methods found most liquid wastes discharged into streams or dumped onto the ground. Land disposal was particularly common in southeast Rockford along the eastern side of the Illinois Central belt-line. With the completion of a regional sanitary district in 1932, many industrial wastes received primary treatment although several areas with high densities of industrial activity remained unserved by the sewerage system. Dumping liquid wastes containing cyanide remained a common practice into the early 1960s and several industries buried sludges on their property after they began treating their own wastes. Public landfills also became prime repositories for industrial sludges and solid wastes after 1945 and several were located above sand and gravel aquifers. As the U.S. Congress and the state legislature passed tougher environmental laws, Winnebago County industries gradually reduced the amount of liquid wastes and they shifted the burden from water to landfills during the last decade.

The major consequences of a century of indiscriminate waste disposal are:

1. Construction of a regional sanitary sewer system in 1932 did not halt water pollution, nor did it serve all Rockford area industries. Passage of environmental laws also exerted minimal restraint on the disposal of industrial wastes in water courses or susceptible land areas.

2. Consequently, extensive areas of Winnebago County water supply recharge zones have been exposed to recklessly discarded solid and liquid wastes for most of the last 100 years.

3. Contamination of public and private water supplies could have occurred long before monitoring efforts were initiated and are likely to continue.

Full appreciation of the impact of the industrial legacy can only be appreciated after more intensive analysis. Recommendations for handling the problem created by a century of industrial waste activity include:
1. Local manufacturers should volunteer to compile detailed histories of their own waste disposal activities for the length of their operations.

2. All water supplies in southeast and northwest Rockford should be carefully examined for the presence of industrial wastes.

3. Analysis of sediments and biologic life in the Rock River should be conducted to determine the level of persistent wastes.

4. All water supplies drawn from the sand and gravel aquifers in the Rock River valley should receive priority testing status.

5. Similar historical studies should be conducted in other Illinois cities with lengthy industrial histories.
CHAPTER 1 -- INTRODUCTION

The visible landscape of Rockford and Winnebago County does not suggest a legacy of polluting industries. There are few derelict smokestacks, few sprawling expanses of rusting industrial equipment, few districts filled with abandoned or vandalized factories, and no oil-covered lakes or rivers. Yet, manufacturing has played a vital role in Winnebago County's economy throughout the last century, and the industrial landscape is prevalent. Multi-story brick structures line the Rock River just south of downtown Rockford and the saw-tooth roofs of early twentieth-century factories stand along the belt-line railroad on the southeast side of town. Newer steel-frame plants cluster around interstate highway exchanges on landscaped property.

Invisible today are the cyanide wastes dumped into the streams and rivers in past decades, the solvents discarded in abandoned quarries, the petroleum products allowed to filter into the porous soils, and the industrial wastes poured down unused water wells. It is the unseen impacts of a century of industrial activity that concern us here. Nearly 40 percent of public drinking water supplies in Winnebago County is drawn from shallow sand and gravel aquifers in the Rock River valley (Kirk, et al., 1985), and fractured dolomite aquifers underlying glacial till supply a large share of the private wells in the county. Both of these drinking water sources are highly susceptible to contamination from land disposal of hazardous wastes (Berg, Kempton and Cartwright, 1984), and given the nature of waste disposal practices prior to regulation, the possibility exists that public water supplies may have been exposed to hazardous materials, and contaminants may linger in the ground water.

This report focuses on the past industrial geography of Winnebago County, Illinois (Fig. 1-1), giving particular attention to Rockford. It traces the changing pattern of industrial locations from 1870 to 1980 and chronicles the methods of industrial waste disposal used during that same time span. Because industries were not required to report how they handled their wastes prior to 1976, serious gaps exist in the documentation of historical waste management practices. This study combines a review of industrial technology with an examination of disposal methods and locations during the period preceding regulation in Winnebago County (See Gibb, et al., 1983; and Nickolai, 1981).
Figure 1-1. Winnebago County
Without an accurate assessment of past industrial activity, most attempts to trace contaminants to their sources remain speculative. By detailing the past locations of industries, former manufacturing processes, waste management techniques, and dump sites, this report reduces the level of conjecture and increases our ability to address the serious problem of ground-water contamination in Winnebago County.

Nature of the Problem

Two fundamental questions guide this inquiry. 1) When did industries that produced wastes with long-term environmental hazards begin operating in well recharge zones? 2) What changes in waste disposal practices might have brought hazardous substances into sensitive parts of the county? While neither of these questions may be answered fully, they are the sort of historical problems that can be addressed given the limited amount of information. In addition, they are the type of question that can provide guidance for later environmental monitoring. Because this investigation limits itself to historical records, terms such as "recharge zones," and hazardous materials will be used in a general sense. All industrial sites in a broad path up gradient from sand and gravel or shallow dolomite wells--in the Rock River valley this includes waste disposal sites in a path perpendicular to the river--will be considered to be within a recharge zone. In addition, it is assumed that wastes migrate from a disposal site, down gradient toward the river; no actual tests were made in the course of this investigation. The term "hazardous substances" refers generally to industrial wastes with flammable, toxic, reactive, or corrosive qualities. Because of the extensive time period covered, some readily degradable hazardous substances, e.g., sulfuric acid and phosphorous compounds used in fertilizers, will not be given the attention that more persistent ones receive. Waste disposal practices include the large-scale municipal programs of garbage removal and sewage treatment, recent incidents of irresponsible dumping, and permitted industrial waste disposal. Due to the changing types of wastes and the means used to handle them, Chapters 3-4 will focus on technological and industrial locations in Winnebago County. These factors have changed the most through time and thus require retrospective treatment.
The physical component of Winnebago County has not changed dramatically through the historic period, although the use of natural resources has. Chapter 2 will review the geology, hydrogeology, and the history of water use in Winnebago County. This discussion will serve as a foundation for the later sections on the industrial past. The physical geography of Winnebago County favored urbanized settlement along the Rock River and the deep sand and gravel deposits offered a bountiful supply of potable water. The concentration of urban and industrial land uses directly over the water supplies jeopardized the purity of drinking water for the largest number of people. A brief review of Winnebago County's industrial history will depict the type of hazards posed.

In 1870 Winnebago industries were still clustered near water-power sources in Rockford, Rockton, and Pecatonica. Factories generally were small, employed fewer than 50 workers, and produced either agricultural tools or products from agricultural goods. During the first period of industrialization most wastes were dumped into area rivers where bacteria decomposed the largely biologic refuse, and environmental impacts remained minimal owing to the small quantity of wastes. During the next few decades, the nature of Rockford industry began to change from artisan workshops to large-scale factories. Steam engines freed producers from hydro-power locations and manufacturing activities snaked out of the central business area along the trunk rail lines, up stream valleys, and onto the terraces along the Rock River. By 1891, thirty-one employers had more than 100 hands each (Brown and Rowe, 1891) and they were working with substances that could pose long term environmental hazards. Coke and coal-gas manufacturers produced wastes that may linger in the the soil, and metal-casting firms dumped foundry sands containing heavy metals (Coates, et al., 1982). In addition, textile mills discharged dyes to streams and furniture makers had finishes, adhesives, and machine oil to get rid of. Solvents used by publishers also pose long-term hazards.

Although there were a variety of industrial wastes before 1900, it was a relatively innocent age. Medical researchers had just developed the germ theory in 1890 and biological wastes, such as brewery stills, dairy refuse, or packing house slop, were considered to pose the greatest threat to public health. Water contaminated with these wastes or domestic sewage provided a favorable habitat for water-borne diseases such as typhoid, and sanitation officials directed their efforts against this
recognized problem. Given the prevailing theories of etiology, public health officials allowed and even encouraged water disposal of non-putrescible industrial wastes (Tarr, 1985a and 1985b). Toxic wastes were considered germicides and hence a safeguard against water-borne diseases. In accord with such thinking, most Rockford industries built private sewers to the Rock River or the nearest stream and allowed natural processes to carry away their effluents.

Land disposal was equally unregulated and practiced in an uninhibited manner. It was most common to use solids to fill up low spots on the factory grounds or elsewhere in the immediate vicinity (Melosi, 1981 and Ingle, 1982). The profusion of sand, gravel, and limestone quarries in Winnebago County provided ample space for unwanted solid wastes. The earliest municipal dumps occupied former quarries and industries often used these facilities if no space was available on their own property.

Up until 1926, Rockford industries enjoyed complete freedom in the way that they disposed their wastes. Even though an 1880 ordinance prohibited the release of "poisons" into the river (City of Rockford, 1880), manufacturers were never challenged. In 1926 city voters approved a referendum to create a sanitary district and to construct a sewage treatment facility. This move, a reaction to increased pollution of the Rock River, reflected a condition created by both domestic and industrial sewage. When the treatment works went into operation in 1931, some industrial wastes received treatment for the first time, but there were still no limits on the volume or the type of wastes factories could release into the municipal sewers (SDR, 1927 and 1931), nor were all factories immediately connected. (SDR, 1934). Nevertheless, 1932 represents a turning point in the history of Winnebago County industrial waste management. After that date, there was limited treatment of liquid wastes and land application of sludges (SDR, 1931 and 1934). The shift however was very gradual and required decades to complete.

One of the major industrial changes that occurred during the 1920s and prompted city officials to take a closer look at waste problems was the rapid expansion of electroplating in the Rockford area. Electroplating is a process that bonds metallic finishes to steel products and it gained widespread application during the 1920s with the expansion of the automotive industry. The
growth of metal plating in Winnebago County reflected a shift from agricultural tool and furniture manufacture to related products consumed by the older industries. Electroplated hardware, such as hinges, knobs, and latches, found a ready market among the furniture producers. The furniture makers, agricultural implement manufacturers, and the textile producers all required specialized machine tools supplied by new local firms. The introduction of these two sets of products created new types of industrial wastes. Electroplaters produced large quantities of acids that had to be replaced periodically and old batches usually went into the Rock River or one of its tributaries. Solvents and oils were wastes of the machine tool trade, and added to the water pollution problem. Reports of land dumping of liquid wastes suggest that not only was surface water being fouled, but ground-water contamination began quite early (SDR, 1927).

The sorry state of the economy during the early 1930s dramatically reduced the volume of industrial wastes, although during the 1940s production boomed again. Industries continued to fill in the belt-line rail loop in the southeast quarter of Rockford and others built in fringe areas, but always on rail lines. Wartime needs rejuvenated the demand for electroplated goods, spurring the economy in Rockford. By the end of the Second World War, Winnebago County was the third largest manufacturing county in Illinois and had more than fifty-six factories each employing more than one hundred workers (Alexander, 1949). In 1951, 65 percent of all jobs in the county were industrial. The largest share of jobs had shifted from furniture to metal finishing and machine tool manufacture. This re-orientation caused a rise in the volume of industrial waste produced, simply due to the processes involved in the newly ascendant industries. As producers fanned out across the terraces, following the rail lines, fewer were adjacent to the natural sewer, the Rock River. Without immediate access to the river or a tributary, the opportunity for land disposal of wastes increased in areas that could threaten public water wells. As late as 1960 there were manufacturers still not connected to the SDR, implicating them in probable land disposal activity. Nevertheless through the early 1960s, water disposal remained the chief pollution concern.

Between 1965 and 1980 the number of manufacturing employees grew only slightly, and although industrial wastes continued to be made, there were significant
reductions in the volume of toxic discharges to streams. Solid wastes increased, however, as electroplaters initiated pre-treatment of liquid wastes and eventually reduced the volume of toxic substances in their processes. Other producers also commenced treatment of liquid wastes and sludges rose as the new hazardous dilemma. Some area farmers accepted sludges from the SDR (SDR, 1984), some manufacturers shipped their wastes out of the county, and others stored it on site. Wherever the final resting place, the probability of leachates entering the soil increased. Before 1976 there was little control of waste disposal and a haunting variety of sites became the final resting place for hazardous materials. This report will trace these changes in greater detail, and in doing so, we hope it will illuminate the importance of the historical perspective in hazardous waste research.

Methods

Three distinct steps compose this report. The first is a series of periodic inventories of industries and their locations. The purpose of this section is to compile lists of the types of industries operating in Winnebago County as a means of identifying the major waste streams. Parallel, but distinct, is the review of waste disposal techniques employed during the last century. Not all wastes can be accounted for, but the documentary record provides valuable insights into historical events. A third step involves the delimitation of areas with high industrial density and those areas not served by sewers—this includes zones where manufacturers did not tie into sewage service. Combined, the three steps will provide a record of documented industrial waste disposal, as well as identifying zones of probable land disposal.

The industrial inventories are drawn from several different sources. For the first two, business directories supplied names of industries and their addresses, one even gave the number of employees and descriptions of products. In order to capture the character of business before the turn of the century, directories for 1882 and 1891 were selected (Brown and Rowe 1891, and Mathews 1882). The first sampling represents the workshop era, and the 1891 directory the incipient phase of modern industrialization. Fire insurance maps made in 1911-13 furnish detailed information about the lay-out of individual plants and
the processes housed within. Thus the Sanborn Maps for those dates were used (Insurance Maps, 1911 and 1913), and a county atlas provided a partial listing of the larger manufacturers for 1924 (Plat Book, 1924). An industrial geography prepared in 1948 includes much information on individual plants that cannot be found in directories and it serves as the primary source for that period (Alexander, 1949). It summarizes the war-related growth, but does not include the most recent phase of industrial location. The latter stage is represented by the list of hazardous waste generators prepared by the U.S. EPA (1985). It is more restrictive than the other sources, and it limits our attention to those firms producing hazardous wastes. For each earlier period, an attempt was made to map only hazardous waste-producing manufacturers.

Waste disposal sites are not as easy to identify and no source of systematic information covers the years prior to about 1980. The Illinois Environmental Protection Agency (IEPA) maintains site files on all permitted sites and they document the types of wastes interred and report violations or complaints about improper activity (IEPA, Ground Pollution Section, Site Files), however they do not include complete on-site storage and disposal information. The Winnebago-Rockford Planning Commission prepared a more complete listing of waste disposal sites (Nikolai, 1981). It included recent historical sites, and characterized the type of wastes found in each. Additional sources included newspaper reports, personal communication, Park District files, county public health agency complaint files, and Sanitary Water Board records. One of the most useful documents was a report prepared by the newly-formed Sanitary District of Rockford (SDR, 1927). It surveyed the volume and type of industrial wastes produced in the city to help planners design a sewage treatment facility. It is unique in the frank responses engineers made to the public health officials.

Two other surveys were made during the last half century, yet neither was successful in obtaining complete response (Rockford Chamber of Commerce, Industrial Survey, 1957; and WCDPH, 1972). To try to fill in some of the historical gaps, museum personnel conducted a mail survey soliciting information on past waste disposal activities. The results were dismal; fewer than two percent of the manufacturers contacted responded. Consequently, multipliers were used to estimate levels of waste for certain dates during the last one hundred years.
(Weston, 1974). Although not completely accurate, in lieu of cooperation from area industries, these estimates, based on the number of wage earners in major industrial categories, will suffice.

The final step consists of a series of maps delimiting both the areas of high industrial density and zones with limited sewage service or documented land disposal. These maps clearly display areas of high probability for ground-water contamination. A twenty-five acre grid was overlaid on the map of Rockford industries for the years 1924, 1932, 1948, and 1980. Industrial densities for each square were then determined. Areas with high densities indicate both a high concentration of industrial activity and the presence of small shops. The higher densities suggest a greater production of industrial wastes. Generalized areas of documented land and water disposal also appear on the series of maps. Based on a variety of sources they enable the delimitation of districts where industries did not tie into the sewer mains and resorted to land and water disposal of wastes. Thus these maps show where contaminants potentially entered the environment at certain dates.

Historical patterns of gasoline stations were also mapped in an attempt to locate possible abandoned underground storage tanks. The Rockford Fire Department maintains a listing of storage facilities, but it may omit stations that closed before 1977 when regulation of these devices began. Business directories were used to map stations that closed between 1948 and 1980.

Projected Results

This report will add to our understanding of industrial waste problems in Winnebago County in several important ways. First, it will illustrate the changing geography of industry in the county. This demonstrates that the distribution of industries was not static through time, and also allows for the identification of abandoned industrial zones. Given the nature of Rockford industry during the last century, even former industrial sites pose environmental threats. Second, by chronicling the extension of the local sewer system and documenting industrial waste disposal practices, areas of probable and confirmed land disposal can be mapped. When analyzed in terms of their relationship to domestic and public water wells, prudent action can be taken to protect water
supplies. Through a two-fold analysis of the industrial - and the waste disposal history, this report will argue that pre-World War II industrial waste disposal can continue to pose a threat and that all shallow aquifers in Winnebago County may have been exposed to industrial wastes at some time in the past. This is not to say all aquifers are currently contaminated or that water quality in the county is at a critically low level. The partial historical record documents casual methods of waste disposal in the past which could have produced incidents of water supply contamination that went unnoted during the century preceding regulation.
CHAPTER II -- PHYSICAL CHARACTERISTICS

In addition to the industrial history of Winnebago County, three critical factors influence the potential for human exposure to industrial wastes. Regional geology, ground-water resources and systems, and patterns of ground-water use during the last century all directly affect the movement of leachate from land disposal sites. This chapter will review these factors as a foundation for the following sections devoted to industrial and waste disposal practices of the past.

Geologic Framework

Bedrock and Unconsolidated Deposits

Three main components constitute the geology of Winnebago County. Two bedrock groups, Precambrian granite overlain by Cambrian and Ordovician sedimentary rocks, dip gently to the southeast (Fig. 2-1). Prolonged erosion of the uppermost layers has removed the Silurian and Maquoketa rocks and cut deep valleys through the Galena and Platteville Dolomites into the Ancell Group forming the ancient Rock and Pecatonica Valleys (Fig. 2-2). The resulting uneven bedrock surface collected unconsolidated glacial drift deposits during the Illinoian and Wisconsinan stages of the Pleistocene. These outwash sands and gravels, tills, and lacustrine deposits constitute the third major element and one that is extremely important to ground-water problems in the county. The overall effect of the deposition of glacial deposits was to fill the deep valleys and cover most of the upland layers of bedrock with till, thus subduing the irregular topography (Berg, Kempton, and Stecyk, 1984).

The glacial drift essentially covers the entire county except for isolated outcrops of bedrock. In the western uplands, the drift deposits are relatively shallow, usually less than twenty feet thick. In the ancient bedrock valleys of the Pecatonica and Rock Rivers the drift deposits are much thicker; exceeding 300 feet in the deepest parts of the ancient Rock Valley (Fig. 2-3). The stratigraphy in the uplands is non-uniform, but generally, top layers consist of windblown silt and sand, in which present day soils have developed. Buried soils and tills of Altonian or Illinoian Age complete the unconsolidated layers that cover the bedrock (Berg, Kempton and Cartwright, 1984). In the buried bedrock valleys drift fill consists partly of deposits of tills, lacustrine sands, silts and clays, and outwash sands and
<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>GROUP</th>
<th>FORMATION &amp; THICKNESS</th>
<th>GRAPHIC COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUATERNARY</td>
<td>0 - 0.7 m.y. B.P.</td>
<td>0 - 450 ft</td>
<td></td>
</tr>
<tr>
<td>SILURIAN</td>
<td>400 - 440 m.y. B.P.</td>
<td>50 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maquoketa</td>
<td>150 - 200 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Galena</td>
<td>250 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Platteville</td>
<td>100 ft</td>
<td>Glenwood 5 - 60 ft</td>
</tr>
<tr>
<td></td>
<td>Ancell</td>
<td>St. Peter 200 - 400 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potosi 50 - 100 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Franconia 50 - 100 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ironton - Galesville 75 - 170 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eau Claire 350 - 450 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mt. Simon 1000 - 1600 ft</td>
<td></td>
</tr>
</tbody>
</table>
Figure 2-2. Generalized Areal Geology of Bedrock Surface in Boone and Winnebago County. The Ancell Group consists of the Glenwood Formation and the underlying St. Peter Sandstone. The Rock Valley runs through the eastern half of the county with a north-to-south axis. The ancient valley of the Pecatonica River starts at the west-central border and follows a northeastward course to the Rock River. From Berg, Kempton, and Stecyk, 1984.
Figure 2-3. Drift Thickness in Winnebago County. The thickness of the upland drift west of the Rock Valley generally is less than twenty feet. East of the valley the thickness ranges from twenty to fifty feet. From Hackett, 1960.
gravel of Illinoian Age. The tills exist at the margins of the valleys and grade to layered deposits in the deeper part of the valleys (Fig. 2-4). Evidence of later glacial events is found in the deposits of Altonian tills that exist along the margins of the valleys and gravel outwash that cap the Illinoian deposits and create low terraces beyond the present floodplain of the Rock River (Fig. 2-4). The old Pecatonica Valley often held ponded water during the Illinoian and Wisconsinan and therefore it has thick lacustrine deposits of fine-grained sand, silt and clay along much of its course. Thick and extensive deposits of outwash sands and gravels exist within the valley along the lower reach of the present Pecatonica River (Berg, Kempton and Stecyk, 1984). In the upper reaches coarse-textured sand and gravel exist but they occupy a limited area (Hackett, 1960).

Bedrock Aquifers

The Galena-Platteville Dolomite is the most important aquifer for small-demand, rural domestic and livestock supplies (Hackett, 1960) (Fig. 2-5). It is not a practical source for high capacity wells, yet it provides a dependable supply for domestic users over an extensive area. Much of the uplands in the western two-thirds of the county has cover of less than twenty feet over the dolomite units and there are many dolomite outcrops (Fig. 2-3). A well-developed, vertically-oriented joint and fracture system in the upper seventy-five feet of the dolomites provides numerous conduits for water to penetrate and helps maintain a consistent supply of water (Berg, Kempton and Cartwright, 1984).

Because of their structure and the relatively thin cover, the dolomites have a high potential for contamination from surface sources (Walker, 1969; and Berg, Kempton and Cartwright, 1984). Liquid wastes or leachate from solid waste disposal sites have nearly unrestricted access to the aquifer in much of the upland areas. Any waste entering the Galena-Platteville Dolomites would move with little obstruction through the joint and fracture system, and have the potential to contaminate any water supply located downgradient.

The other major bedrock aquifers in the county are the St. Peter Sandstone of the Ordovician System and the Ironton-Galesville Sandstone, Eau Claire Formation,
<table>
<thead>
<tr>
<th>Stack symbol</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>wic</td>
<td>Capron</td>
</tr>
<tr>
<td>wicl</td>
<td>Clinton</td>
</tr>
<tr>
<td>wia</td>
<td>Argyle</td>
</tr>
<tr>
<td>win</td>
<td>Nimtz</td>
</tr>
<tr>
<td>g-o</td>
<td>Uppermost Glasford Formation outwash</td>
</tr>
<tr>
<td>gb</td>
<td>Belvidere</td>
</tr>
<tr>
<td>ge</td>
<td>Esmond</td>
</tr>
<tr>
<td>gor</td>
<td>Oregon</td>
</tr>
<tr>
<td>gc</td>
<td>Creston</td>
</tr>
<tr>
<td>gf</td>
<td>Fairdale</td>
</tr>
<tr>
<td>gh</td>
<td>Herbert</td>
</tr>
<tr>
<td>go</td>
<td>Ogle</td>
</tr>
<tr>
<td>gk</td>
<td>Kellerville</td>
</tr>
<tr>
<td>-l</td>
<td>Lacustrine</td>
</tr>
<tr>
<td>-o</td>
<td>Outwash</td>
</tr>
<tr>
<td>-a</td>
<td>Ablation</td>
</tr>
<tr>
<td>c</td>
<td>Cahokia alluvium</td>
</tr>
<tr>
<td>hm</td>
<td>Henry Formation, Mackinaw member sand and gravel</td>
</tr>
<tr>
<td>ec</td>
<td>Equality Carmi; Lake silts</td>
</tr>
</tbody>
</table>

**Figure 2-4. Legend. From Berg, Kempton, and Stecyk, 1984.**

**Figure 2-4a. North-to-South Cross Section Along Rock River Valley. Note the thickness of the outwash deposit in relation to the tills and lacustrine deposits.**
Figure 2-4b. West-to-East Cross Section Across Rock River Valley at Loves Park. Note the thickness and extent of the Henry Formation outwash (hm).

Figure 2-4c. West-to-East Cross Section Across Rock River Valley at Roscoe.
**Figure 2-5. Generalized Stratigraphic Section, Geologic Units, and Water-Bearing Properties of Rocks in Winnebago County. From Hackett, 1960.**

<table>
<thead>
<tr>
<th>Era/Period</th>
<th>Stage</th>
<th>Range in Thickness (feet)</th>
<th>Material</th>
<th>Water-Bearing Character</th>
<th>Geologic Diorologic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paleozoic</td>
<td>Ordovician</td>
<td>0-200</td>
<td>Dolomite, yellowish gray to buff or brown, mainly medium to coarse grained, some porosity and partial cementation in local beds, but may be distributed throughout formation.</td>
<td>Water-yielding character of Galena, Glean, and Pocahontas</td>
<td>Glacial driftaquifers</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td>3-30</td>
<td>Dolomite, light gray to buff or brown, medium to coarse grained, sandy to argillaceous, very fine to very coarse, moderate porosity and partial cementation.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td>90-135</td>
<td>Dolomite, light gray to buff or brown, medium to coarse grained, sandy to argillaceous, very fine to very coarse, moderate porosity and partial cementation.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td>400-500</td>
<td>Limestone, sandstone, and shale. Upper beds predominantly sandstone.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Pennsylvanian</td>
<td>1000-1500</td>
<td>Sandstone, siltstone, and shale.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Permian</td>
<td>2000-3000</td>
<td>Sandstone, siltstone, and shale.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td>Paleozoic</td>
<td>Cambrian</td>
<td>0-100</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Ordovician</td>
<td>50-100</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Silurian</td>
<td>100-200</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Devonian</td>
<td>200-400</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Mississippian</td>
<td>400-500</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Pennsylvanian</td>
<td>1000-2000</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
<tr>
<td></td>
<td>Permian</td>
<td>2000-3000</td>
<td>Dolomite, white, fine to coarse grained, medium to coarse grained, with variable sorting, clastic, and siliceous.</td>
<td>Permies and Middle Ordovician</td>
<td>Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.</td>
</tr>
</tbody>
</table>

**Glacial drift aquifers:**
- Permies and Middle Ordovician
- Thin and shallow, generally present in the local area, and may be developed in the form of isolated lenses.

**Sandstone aquifers:**
- Include sandstone beds in the Fox River, and other formations, generally 300 to 3000 feet thick, for supplies of up to 2000 gpm per well. Water supply for domestic and stock needs is generally available from 300 to 3000 feet thick, for supplies of up to 2000 gpm per well. Water supply for domestic and stock needs is generally available from 300 to 3000 feet thick. **PreCambrian**
- Includes dolomite and diabase rocks. Not an aquifer. The crystalline rocks are of low permeability, and are a barrier to downward movement of ground water from underlying formations.
and Mt. Simon Sandstone of the Cambrian System (Fig. 2-5). The St. Peter Sandstone and the basal layer of the Glenwood Formation down to the base of the Ironton-Galesville Sandstone are part of the Midwest Bedrock Aquigroup (Visocky, Sherrill and Cartwright, 1985). These sandstones, along with bedrock layers which lie between them, can be considered as a unit. The sandstones of the Eau Claire Formation and the Mt. Simon Sandstone make up the Basal Bedrock Aquigroup and also act as a single unit. The Mt. Simon is found at 1,080 feet in some wells in Winnebago County and reaches a thickness of 1,600 feet.

The St. Peter Sandstone unit underlies most of the county, and has been used extensively by small municipalities, privately-developed housing tracts, public institutions, parks and several industries whose water requirements are generally less than 300 gallons per minute (gpm). Most of these medium-volume wells are drilled through the thick glacial drift into the ancient Rock Valley where the Glenwood-St. Peter unit is the bedrock surface (Fig. 2-4). The greatest potential for contamination of this aquifer exists below Rockford where cones of depression exist allowing seepage from the overlying drift deposits (Sasman, et al., 1973 and Hackett, 1960).

The rock units of the Cambrian System are thick and exist under the St. Peter Sandstone beneath the entire county (Fig. 2-5). This system is the principal aquifer for high capacity wells, which are limited to large municipal and industrial users who can afford the high drilling cost. There are a small number of wells finished in the Cambrian System although the quantity of water supplied by these aquifers is greater than other aquifers in the county (Rockford Water Department, 1960). Over the years, due to significant withdrawals from the Cambrian aquifers, the hydrostatic pressure surface—the level water rises to in a non-pumping well—has decreased to a level approximately equal to that of the St. Peter Sandstone around the Rockford area (Hackett, 1960). In the area of this cone of depression the Cambrian aquifer is most susceptible to contamination from local sources due to induced seepage from overlying rock units. This situation is particularly true when a shallow outwash well that has been contaminated is located near a deep bedrock well. Away from the cone of depression, due to the depth of this aquifer, contamination sources only exist at wells used for waste disposal or improperly closed wells.
Glacial Tills

Winnebago County glacial tills, deposited immediately in front of and on the sides of glacial ice or subglacially due to pressure melting, are the predominant materials covering the bedrock surface and exist as a till plain in the uplands (Piskin and Bergstrom, 1975). In the ancient bedrock valleys in Winnebago County the tills are relatively thin lenses in comparison to the outwash deposits (Fig. 2-4). Tills are poorly sorted deposits consisting of sands, silts, and clays with lesser quantities of gravel, pebbles and boulders. The majority of the tills in Winnebago County are sandy tills (Berg, Kempton and Stecyk, 1984). The tills are not capable of supplying ample water for any practical purposes, although they may store large quantities. They also retard ground-water flow, but usually are permeable enough to allow recharge into or discharge from adjacent aquifers (Hackett, 1960). Because they slow ground-water movement and consist of variable-sized material, they potentially can inhibit contaminant movement and adsorb constituents in certain contaminant plumes (Berg, Kempton, and Stecyk, 1984).

Sand and Gravel Outwash Aquifers

Sand and gravel glacial outwash aquifers are found in the ancient bedrock valleys of Winnebago County. Glacial outwash is well-sorted, coarse-textured material deposited by meltwater streams flowing from the front of a glacier. Because sedimentation took place in a flowing water environment, the materials were well sorted and coarsest closer to the glacier face than at a greater distance. Many of the meltwater streams that deposited outwash in Winnebago County issued from an ice face within or just north and east of the county. For this reason, extensive areas of highly permeable sand and gravel more than one hundred feet thick and largely coarse-grained exist in the Rock Valley (Fig. 2-6) (Hackett, 1960). In the Pecatonica and Sugar River valleys thick lacustrine deposits cover large areas. Coarser outwash deposits exist in the tributary and main valleys, but are not as extensive nor as thick as the outwash deposits in the Rock Valley (Hackett, 1960).

Wells finished in outwash deposits in the Rock Valley tap ample water supplies. The highest capacity wells generally reach the basal part of the valley fill and range from 150-300 feet deep (Hackett, 1960; and
Figure 2-6. Occurrence and Distribution of Outwash Aquifers in Winnebago County. From Hackett, 1960.
Gibb, et al., 1984). In 1984 Winnebago County sand and gravel aquifers supplied an estimated 16.3 million gallons per day (mgd) (Kirk, et al., 1985). This withdrawal rate is approximately 39 percent of the total 41.4 mgd pumped from all aquifers in the county for similar uses. The glacial outwash aquifers are the second largest suppliers of water in the county and primarily serve large industries and municipalities. The potential for development of large water supplies from outwash sands and gravels is not as great in the Pecatonica and Sugar valleys. Dependable water supplies do exist in these valleys, but they occur in less continuous deposits, and little is known about their exact location.

The outwash deposits are very permeable and commonly are exposed at the land surface, allowing rapid recharge from streams and precipitation, when pumping has artificially lowered water levels (Hackett, 1960). Similarly, liquid waste and leachate from solid waste often have nearly direct access to the ground-water flow regimes of these outwash aquifers. Waste can enter the outwash aquifers at rapid rates depending on disposal methods, waste types, and water table depth. Glacial outwash aquifers that fill the ancient Rock Valley, and those that are found in the ancient Pecatonica drainage, are highly susceptible to contamination (Walker, 1969; and Berg, Kempton and Cartwright, 1984). Given the land-use history adjacent to and above these deposits, the potential for contamination of water supplies from the outwash aquifers is great.

**Hydrogeology**

**Flow Characteristics**

Ground water occurs below the land surface in the subsurface matrix where all pore spaces between soil and rock particles are saturated with water. The top of the saturated zone is the water table and it is the level to which water will rise in a non-pumping well finished in an unconfined aquifer. Water in an aquifer that is confined by a significantly less permeable rock layer will maintain a level in a nonpumping well known as its pressure surface or piezometric surface (Fig. 2-7).

In unconfined aquifers under natural conditions, the water table roughly parallels the surface topography;
Figure 2-7. Typical Aquifer in Illinois. Note the differences between the water table (unconfined aquifer) and the piezometric level or pressure surface (confined aquifer). From Berg, Kempton, and Cartwright, 1984.
it is high under the uplands and descends to intersect the land surface along streams, lakes, wetlands, and low ground (Fig. 2-8). Water in the saturated zone moves from areas of high potential energy to areas of low potential energy. Ground-water flow under these conditions generally follows paths from recharge areas at higher elevations to discharge areas at lower elevations. In Winnebago County essentially all interstream areas contribute to ground-water recharge and the major discharge areas are the Rock River and its tributaries.

Ground-water flow is highly complex, and in Winnebago County, movement must be classified as part of local, intermediate, or regional systems (Fig. 2-9). Outwash aquifers and surficial dolomites constitute local to intermediate flow systems, while the deeper bedrock aquifers are components of regional flow systems. Local precipitation and infiltration, from land surface water sources, recharge the local flow system. In contrast, regional flow systems receive their water in permeable surface outcrops usually some distance from areas of water use. Local and upgradient sources recharge both the outwash sands and gravels of the Rock Valley and the shallow dolomites. The St. Peter unit receives in-flow through outcrops in southern Wisconsin, while recharge to the Cambrian system is mostly from outcrop areas in central and northern Wisconsin (Hackett, 1960).

Another source of aquifer recharge, particularly in areas of significant pumpage, is leakage from overlying strata. Water withdraw in the Rockford area has lowered the piezometric surface sufficiently to allow this in Winnebago County.

Contaminant Characterization

The presence of hazardous substances in or near the surface can initiate a complex series of events if introduced to the ground-water zone. There are various sources and causes of contamination, pollution geometries, and disposal methods that can affect ground-water quality (Table 2-1). LeGrand (1965) provides a summary of the complex characteristics of contamination:

Difficulty in predicting the areal extent of a contaminated zone stems from the multiplicity of factors that need consideration, including: the great variety of waste materials, their range in toxicity and adverse effects; man's variable pattern of waste disposal and of accidental
Figure 2-8. Idealized Pattern of Ground-water Flow from Areas of High Potential Energy to Areas of Low Potential Energy.
Figure 2-9. Idealized Ground-water Flow Systems. Regional scale is from ten to hundreds of miles, intermediate scale from several to tens of miles, and local up to a mile. After Toth, 1963.
<table>
<thead>
<tr>
<th>Source or Cause</th>
<th>Pollution Geometry</th>
<th>Disposal Method</th>
</tr>
</thead>
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<tr>
<td></td>
<td>Point</td>
<td>Line</td>
</tr>
<tr>
<td>Municipal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewer leakage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Liquid wastes</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Solid wastes</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid wastes</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tank and pipeline leakage</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Mining activities</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Oilfield brines</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Agriculture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation return flows</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal wastes</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Fertilizers and Soil amendments</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pesticides</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spills and surface discharges</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stockpiles</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Septic tanks and cesspools</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Roadway deicing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saline water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intrusion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Interchange through wells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

Source: After Todd, 1980.

Table 2-1. Principle Sources and Causes of Ground-water Pollution
release of contaminants in the ground; man's variable pattern of water development from wells; behavior of each contaminant in the soil, water, and rock environments; ranges in geologic and hydrologic conditions in space; and ranges in hydrologic conditions in time.

Processes that influence the extent, concentration, and temporal attributes of contaminants in the ground-water zone include dispersion, sorption, and chemical/biological transformation (Mackay, Roberts, and Cherry, 1985). Dispersion is the spreading of contaminants in solution as they move with the ground water. Molecular diffusion and mechanical mixing are the two basic processes causing dispersion. Molecular diffusion is the movement of solutes from zones of high concentration to areas of low concentration. Mechanical mixing occurs due to physical attributes of the flow regime including pore geometry and local vectors of flow which cause the contaminated water to mix with non-contaminated water. The net result of these dispersion processes is the dilution of contaminant pulses and the retardation of contaminant concentration peaks (Mackay, Roberts, and Cherry, 1985).

Dilution of contaminants through dispersion processes can be viewed in both a positive and negative light. To the unwitting consumer whose water supply is contaminated the more the contaminant concentration has been reduced through dispersion the better. Looking from the perspective of remedial action, the greater the contaminant is concentrated the greater potential for successful contaminant removal. Lacking the free-flowing characteristics of surface water, dilution plays a less important role in ground water.

Sorption processes include adsorption, partitioning, and ion exchange among others. These processes involve the interaction of contaminants in the aqueous phase with aquifer solids along the flow path. The results of the interactions include the decrease of contaminant concentrations in the aqueous phase, the distribution of contaminants between the aqueous phase and aquifer solids, and the alteration of contaminant movement relative to ground-water flow (Mackay, Roberts, and Cherry, 1985).

Essentially, sorption processes retard contaminant movement and are dependent on the materials through which the plume passes. Highly porous, low permeability
materials such as clay prove to be very involved in sorption processes. Low porosity materials with high permeabilities maintained by fractures and joints tend to pass the contaminants along at an equal rate as the ground water. This minimizes the potential for chemical reaction and sorption to take place. Highly permeable, low porosity materials, like the outwash deposits in Winnebago County, minimally retard contaminant flow through sorption. In this case, contaminants generally move at an equal rate as the ground water which moves at relatively rapid rates.

Organic contaminants can be affected by complex biological and chemical processes. The effects of these processes are very important although not well understood. Biological and chemical processes often change contaminant constituents into non-toxic substances. Unfortunately, similar processes cause some contaminants to transform into more toxic, more complex substances. An important example involves trichloroethylene, a substance detected in a number of Winnebago County wells, which transforms into vinyl chloride which is a very stable substance. This transformation takes place under anaerobic conditions and along with being very stable vinyl chloride is also more mobile than trichloroethylene (Mackay, Roberts, and Cherry, 1985).

The effect of contaminated ground water depends on whether a well taps a local, unconfined, water table aquifer, or if it taps a regional, confined aquifer. Contaminants entrained in local water table aquifers usually are in the flow regime for a shorter time and are less likely to undergo sorption and dilution, thus they present a greater health risk.

Water Use History

Both industry and communities have relied on Winnebago County's abundant water supplies throughout the last century. From the outset of large-scale industrialization and development of municipal water systems, ground water has been the chief source. Initially shallow sand and gravel aquifers supplied the Rockford municipal system, but due to contamination in the 1880s deeper wells were drilled. During the first half of this century bedrock aquifers furnished most drinking water, although since the mid-1940s city crews have tapped sand and gravel sources again. Expansion of residential land uses into areas of susceptibility to
contamination followed, and consequently many more people in the county now risk exposure than prior to 1945. This section will review the development of the county's water-supply systems.

Public Water Supplies

Prior to 1874, city and rural residents of Winnebago County relied either on surface water supplies or shallow aquifers, and the back-yard well was by far the most common source. In Rockford, a city with over 11,000 residents in 1870, increasing demands on the ground-water supplies and growing concerns with as-yet-unexplained water-borne diseases prompted city officials to install a limited municipal water system. Completed in 1875, the first water works consisted of a shallow "infiltration" well drilled into the sand and gravel deposits on the western bank of the Rock River, a pumping station at the intersection of North and Well Streets, and twenty-one miles of buried pipe. Residential areas, downtown businesses, and 166 fire hydrants lined the mains of the new water distribution system (City of Rockford, 1911).

Continuing population growth soon made the initial system obsolete and an adjoining large diameter shallow well was added in 1881. This well could pump 1,000,000 gallons a day yet it proved inadequate to serve the growing city a mere two years after its completion (City of Rockford, 1911). In addition, the well's location was down gradient from residential privy vaults and cesspools and it became tainted. In 1885 the Mayor proclaimed the well water unfit for consumption and the city temporarily switched to river water (City of Rockford, 1911). City authorities began searching for "artesian wells" at the site of the original water works and drilled five wells which tapped deep sandstone aquifers (Mt. Simon) at depths ranging from 1,300 to 2,000 feet. Completed by 1891 these wells supplied less than half of the 2.5 million gallons used daily by Rockford's 23,000 citizens with the remaining amount coming from the condemned shallow sand and gravel wells (City of Rockford, 1911). Drillers completed five supplementary wells in shallow sandstone deposits (St. Peter--approximately 400 feet) in 1891. These wells increased the capacity of the city system to 7 million gallons a day (Smith and Larson, 1948). Additional wells drilled into the Mt. Simon Sandstone in 1897, 1913, and 1917 completed the first phase of development.
Between 1921 and 1926 the city began replacing portions of the original system by drilling six wells just west of the business district. Known as the Tay Street group, this cluster of wells all tapped the Mt. Simon Sandstone at depths exceeding 1,600 feet. Supplying over 5 million gallons daily, the Tay Street Group allowed city officials to close the shallow St. Peter Sandstone group wells. Thus by 1926, the city had abandoned all shallow wells in favor of supplies in excess of 1,300 feet below the surface (Smith and Larson, 1948).

With several additions before 1945, the city continued to expand the number of wells as the population increased, although few of those early wells remain in service (Fig. 2-10). Bedrock aquifers remained the principal source as the city drilled new wells in developing neighborhoods—each well primarily served the area nearby rather than supplying a central reservoir. By 1945, the water department pumped over 3.5 billion gallons annually to Rockford's 85,000 citizens (Fig. 2-11). Not only had the population increased but per capita consumption also rose reflecting the installation of flush toilets and indoor plumbing during the first half of the twentieth century.

Since 1945 several of the early wells have been abandoned and new wells drilled (Table 2-2). The newer wells tap both shallow sand and gravel deposits in the ancient Rock Valley and deeper sandstone aquifers (Stanley Consultants, 1979). In 1979 there were fourteen wells, drilled to depths ranging from 93 to 298 feet, pumping from the drift deposits. Most were located on the east side of the river in areas considered highly susceptible to contamination (Fig. 2-10) and also in areas where there has been a significant industrial development in the last half century (See Chapter 4). Overlying glacial till protects most of the deeper wells from contamination, but bedrock wells drilled through the outwash deposits may be exposed to contamination due to the highly permeable sand and gravel cover and the depressed piezometric surfaces resulting from pumpage.

Aggressive ground-water monitoring efforts by local health and water supply officials has lead to the identification of several ground-water contamination problems in the lowland valley resulting in the closure of a number of water wells (Fig. 2-12 and Table 2-3). At least serious contamination sites monitoring efforts
Figure 2-10. Public Water Supply Wells in Winnebago County. All these wells were serviceable in 1980 except those shown as closed in Fig. 2-12, and the pre-1945 outwash well which is the "infiltration well" of the early years of Rockford's water department. Sources: Rockford Water Department and Illinois State Water Survey.
Figure 2-11. Ground Water Withdrawal, 1890-1984. Dashed lines indicate no data. Source: Rockford Water Department.
<table>
<thead>
<tr>
<th>Well</th>
<th>Year Drilled</th>
<th>Depth (ft.)</th>
<th>Avg. Daily Pumpage (1984)</th>
<th>Volatile Organics Detected</th>
<th>Year closed or last pumped</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rockford</td>
<td>7A</td>
<td>1947</td>
<td>200</td>
<td>2.3 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>1950</td>
<td>256</td>
<td>1.43 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>1954</td>
<td>253</td>
<td>2.3 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>1957</td>
<td>235</td>
<td>1.36 mgd</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>8A</td>
<td>1959</td>
<td>245</td>
<td>1.47 mgd</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>9A</td>
<td>1961</td>
<td>242</td>
<td>0.16 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>1964</td>
<td>176</td>
<td>1.59 mgd</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>1964</td>
<td>94</td>
<td>1.79 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1966</td>
<td>222</td>
<td>1.23 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>28</td>
<td>1968</td>
<td>233</td>
<td>1.36 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>35</td>
<td>1971</td>
<td>214</td>
<td>2.43 mgd</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>38</td>
<td>1971</td>
<td>238</td>
<td>0.29 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>33</td>
<td>1973</td>
<td>94</td>
<td>0.21 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td>Loves Park</td>
<td>1</td>
<td>1955</td>
<td>148</td>
<td>0.21 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1955</td>
<td>190</td>
<td>2.17 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td>Rockton</td>
<td>5</td>
<td>1956</td>
<td>120</td>
<td>0.21 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td>North Park</td>
<td>1</td>
<td>1954</td>
<td>195</td>
<td>0.11 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1956</td>
<td>238</td>
<td>0.39 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1963</td>
<td>240</td>
<td>0.26 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1973</td>
<td>250</td>
<td>0.80 mgd</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1977</td>
<td>166</td>
<td>0.80 mgd</td>
<td>Yes</td>
</tr>
</tbody>
</table>


Table 2-2. Sand and Gravel Municipal Public Water Supply Wells.
Figure 2-12. Synthetic Organic Contamination Problem Areas and Affected Water Supply Wells - Rockford and Loves Park. Well numbers correlate with outwash wells in Table 2-2. Other numbers identify Rockford's bedrock wells and problem area numbers correlate with Table 2-3 and Appendix B. Sources: George Brettrager, 1985, and unpublished files of Winnebago County Department of Public Health.
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>FORMATION INFLUENCED</th>
<th>COMPOUNDS INVOLVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SE Rockford; approx. 11th and Harrison Ave.</td>
<td>Sand and Gravel</td>
<td>1,1 dichloroethylene; 1,1 Dichloroethane; 1,1,1 Trichloroethane; Trichloroethylene</td>
</tr>
<tr>
<td></td>
<td></td>
<td>trans 1,2 Dichloroethylene (&lt;500 ppb Total VOC's)</td>
</tr>
<tr>
<td>2. Steve's Standard/Aasco 11th St. &amp; Sandy Hollow</td>
<td>Sand and Gravel</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td>3. Anderson Phillips 56 Charles &amp; Highorest</td>
<td>Galena-Platteville</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td></td>
</tr>
<tr>
<td>4. Bulk Storage Terminals Cunningham &amp; Meridian</td>
<td>Galena-Platteville</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td></td>
</tr>
<tr>
<td>5. Mobile Home Park; Six Oaks; W. State Rd. near Pecatonica Rd.</td>
<td>Galena-Platteville</td>
<td>150-200 ppb VOC's</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td></td>
</tr>
<tr>
<td>6. Pierce Chemical Co. Meridian Road north of Safford</td>
<td>Galena-Platteville</td>
<td>base-neutrals and/or acid extractables (250-400 ppb Total VOC's)</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td></td>
</tr>
<tr>
<td>7. Rockton Watts Ave. &amp; Dingsan</td>
<td>Sand and Gravel</td>
<td>1,1 trichloroethane; Trichloroethylene; 1,1 Dichloroethane; 1,1 Dichloroethylene;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(traces to 1000 ppb)</td>
</tr>
<tr>
<td>8. Roscoe; Hononegab-Moorehaven Subdivisions</td>
<td>Sand and Gravel</td>
<td>Trichloroethylene; Trans 1,2 Dichloroethylene; 1,1,1-Trichloroethane; Tetrachloroethylene (Trace to 2000 ppb)</td>
</tr>
<tr>
<td>9. Acme Solvent/Fagel Pit Landfill Lindenwood Road</td>
<td>Drift above drk. &amp;</td>
<td>Trans 1,2 dichloroethylen; 1,1,1-Trichloroethane (trace to 500 ppb)</td>
</tr>
<tr>
<td></td>
<td>Galena-Platteville</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td></td>
</tr>
<tr>
<td>10. Peoples Avenue Peoples Ave. &amp; Magnolia</td>
<td>Sand and Gravel</td>
<td>Very high traditional contaminants (e.g., chloride, spec. cond.) suspected non-traditional (VOC's)</td>
</tr>
<tr>
<td>11. Sand Park landfill Riverside Blvd. east of Forest Hills</td>
<td>Sand and Gravel</td>
<td>Acetone, 2-butone</td>
</tr>
<tr>
<td>12. Frank's Industrial Waste - Pecatonica Rd.</td>
<td>Galena-Platteville</td>
<td>VOC's - solvents (traces to 1200 ppb)</td>
</tr>
<tr>
<td>13. Rockford Public Wells 7 and 7A; 11th &amp; 18th Av.</td>
<td>7 - 1500' (Sandstone)</td>
<td>1,1,2 Trichloroethylene; 1,1,1 Trichloroethane; 1,1,2,2 Tetrachloroethylene</td>
</tr>
<tr>
<td></td>
<td>7A - 200' (Sand &amp; Gravel)</td>
<td>(Total approximately 1200 ppb)</td>
</tr>
<tr>
<td>14. Loves Park Public Wells 1 and 2</td>
<td>both at about 200' in sand &amp; gravel</td>
<td>#1 about 100-200 ppb, #2 about 15-20 ppb.</td>
</tr>
<tr>
<td>15. Rockford Public Well 8 and 8A; Auburn &amp; Camp 8A - 246' (sand &amp; gravel)</td>
<td>1,1,2,2 Tetrachloroethylene; 1,1,2 Trichloroethane; 1,1,1 Trichloroethane (Total approximately 500 ppb)</td>
<td></td>
</tr>
<tr>
<td>16. Tipton Landfill - Telegraph &amp; Eddie Rds.</td>
<td>Galena-Platteville</td>
<td>Methylene chloride; Tetrachloroethane; Phenol - EPA Analysis mid '70s</td>
</tr>
<tr>
<td></td>
<td>Dolomite</td>
<td>(approximately 300 ppb)</td>
</tr>
</tbody>
</table>


Table 2-3. Synthetic Organic Chemical Groundwater Contamination in Winnebago County.
continue. Mixing of water from the sandstone and the sand and gravel wells in the delivery system has mitigated public exposure to harmful contaminants, but low level exposure may have occurred from the time the shallow wells went on line. The proximity of the sand and gravel wells to the industrial core of the city and the manner of industrial waste disposal in the past strongly suggests that this was the case. The neighborhood design of the water system would have minimized or precluded exposure to residents beyond the areas served by the sand and gravel wells, although water users in southeast Rockford are likely to have consumed contaminants before modern testing began.

In 1980 the Rockford Water Works pumped approximately 11.5 billion gallons to nearly 140,000 residents of the city. Much of the drop since the early 1970s can be attributed to the decrease in industrial water use (Sasman, et al., 1974).

Small towns throughout the county began replacing domestic wells with municipal water systems in the 1910s and 1920s and most expanded their systems with assistance from WPA funds during the 1930s (Table 2-4). They relied on bedrock aquifers as did North Park and Loves Park which initiated public water service in the mid-1950s. Approximately 92,000 county residents received municipal water in 1930, leaving only 11 percent dependent on domestic wells (based on the number of residents in communities served by public systems, U.S. Census, 1930). Despite the expansion of municipal systems and the increase in the actual number of people served (145,000-1960 and 171,000-1980), the percentage served by city and town systems fell below 70 percent in 1960 and remained at about 68 percent in 1980. This partly reflects the growth of unincorporated subdivisions since 1950 in the urban fringe of Rockford where private developers have opened numerous housing tracts with private water companies. Many cluster in the Rock River valley and depend on shallow sand and gravel aquifers (Fig. 2-10); those on the uplands generally rely on dolomite sources.

Private Domestic Water Supplies

All areas beyond municipal water supply systems and some in urbanized areas have continued to rely on private domestic wells. Increases in the number of wells in exurban areas and in sections of Rockford give rise to concern (Fig. 2-13). Rural non-farm residents,
<table>
<thead>
<tr>
<th>Locality</th>
<th>Date Service Began</th>
<th>Population Served (1930)</th>
<th>Water Source</th>
<th>Year Current Wells Drilled</th>
<th>Aquifer Tapped</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Beloit</td>
<td>1918</td>
<td>2,361</td>
<td>Private wells bedrock</td>
<td>1937</td>
<td>Bedrock</td>
</tr>
<tr>
<td>Durand</td>
<td>1917</td>
<td>554</td>
<td>Municipal system bedrock</td>
<td>1920</td>
<td>Bedrock</td>
</tr>
<tr>
<td>Pecatonica</td>
<td>1889</td>
<td>1,152</td>
<td>Municipal system sand &amp; gravel</td>
<td>1935</td>
<td>Bedrock</td>
</tr>
<tr>
<td>Rockford</td>
<td>1885</td>
<td>85,864</td>
<td>Municipal system bedrock</td>
<td>1922</td>
<td>Bedrock and sand &amp; gravel</td>
</tr>
<tr>
<td>Rockton</td>
<td>1904</td>
<td>1,077</td>
<td>Municipal system sand &amp; gravel</td>
<td>1909</td>
<td>Bedrock and sand &amp; gravel</td>
</tr>
<tr>
<td>Winnebago</td>
<td>—</td>
<td>—</td>
<td>Bedrock</td>
<td>1948</td>
<td>Bedrock</td>
</tr>
<tr>
<td>North Park</td>
<td>1954</td>
<td>—</td>
<td>Sand &amp; gravel</td>
<td>1954</td>
<td>Sand and gravel</td>
</tr>
<tr>
<td>Loves Park</td>
<td>1955</td>
<td>—</td>
<td>Bedrock &amp; sand &amp; gravel</td>
<td>1955</td>
<td>Bedrock and sand &amp; gravel</td>
</tr>
</tbody>
</table>


Table 2-4. Municipal Water Supplies in Winnebago County.
seeking the amenities of country living, accounted for many of the estimated 3,100 new wells drilled between 1970 and 1980. The census tallied more than 1,800 new households without public water supplies in census tracts bordering the Rock River (Fig. 2-14). Wells in this area generally tap sand and gravel aquifers, the sources most susceptible to contamination. Quarrying and industrial activity share the river valley adding to the potential for ground-water pollution. Both the set of Rock River census tracts and those with a heavy reliance on domestic wells (Fig. 2-15) deserve close monitoring activity.

Industrial Water Supplies

Industry has been the other large-volume user of ground water in Winnebago County. Although no exhaustive summary of early industrial users exists, several fragmentary records provide some clues to the sources and amounts of water used by manufacturers.

In 1911 eleven industries reported having their own wells. Eight drew process water from the St. Peter Sandstone (250 to 360 feet deep), one from a dolomite aquifer, and two others from shallow drift sources. All but three of the factories clustered on the west bank of the Rock River (City of Rockford, 1911). A decade and a half later industries had sunk a total of twenty-three wells. A survey conducted in 1927 was unsuccessful in obtaining full information about each well, however it reported that nine wells extended into the sandstone bedrock and only one continued to use sand and gravel aquifers (SDR, 1927). Ten businesses at that time had tied into the city water system. The reported usage of the private well owners exceeded 2 million gallons a day, only slightly less than the amount pumped by the city.

Paralleling the rise in overall municipal water use, industrial demands increased dramatically during the second quarter of the century. By 1944 manufacturers pumped 13.8 million gallons a day. This dropped slightly after the war to 12.5 million gallons daily, with 90 percent coming from sandstone sources, the balance from sand and gravel deposits (Smith and Larson, 1948).

The distribution of industrial wells mirrors the pattern of industry in Rockford. A dense cluster on the west bank of the Rock River supplied the high-demand textile mills, while the metal working operations east of the river are more scattered (Fig. 2-16). Manufacturers
Figure 2-16. Rockford Area Industrial Wells, 1927-1960. Several of the wells pumping in 1927 and 1948 were still being used in 1960. Sources: SDR, 1927; Smith and Larson, 1948; and Hackett, 1960.
added only a few new wells during the period between 1948 and 1960, and in fact, numerous wells have been closed during the last few decades as pumpage declined (Sasman and Baker, 1966).

Abandoned wells are suspected as prime conduits for contaminants entering bedrock aquifers (Lee, 1950; Klassen, 1986). Unauthorized dumping of liquid wastes into abandoned wells easily could have introduced hazardous materials to ground-water systems.

After a steep decline in industrial pumping between 1945 and 1960, industrial pumpage remained relatively constant from 1960 to 1970 (8.6 mgd-1960 and 8.6 mgd-1970) and both sandstone and sand and gravel sources continued to supply businesses. The total ground-water pumpage fell again during the 1970s and industries pumped significantly more than 6 million gallons a day in 1980 (Kirk, et al., 1982).

The presence of industrial wells can modify ground-water flow patterns, possibly deflecting contaminant streams away from public supplies or allowing downward migration of contaminants. In southeast Rockford, the cluster of industrial wells have long contributed to a cone of depression in the water table surface in the outwash aquifers (Smith and Larson, 1948). This could be a factor in well contamination in that area.

The following chapters will consider sources of contamination during the last 110 years.
CHAPTER III -- EARLY INDUSTRIALIZATION, 1870-1932

Changes in the scale of manufacturing and a growing public response to industrial pollution distinguish this first period of Winnebago County industrialization. From a small cluster of water-driven shops, Rockford's industries expanded to three main areas along the major rail lines. New process technologies introduced to the county brought new manufacturing wastes and forced public officials to contend with these problems. This chapter will trace the geographical and technological changes that reflect the modernization of Rockford industry and the responses made by public health officials to growing pollution problems.

Industrial Expansion

In 1870 Rockford industry reflected mid-nineteenth century manufacturing technology. Several grain milling shops, a foundry, and a machine shop lined the mill race of the Water Power District (Fig. 3-1). Wood-working concerns and agricultural tool producers rounded out the manufacturing complex. Most relied on power from turbines that extended into the mill race and powered belt-driven machinery or directly turned the heavy grinding stones. Steam engines gave an increasing number of producers freedom from the locational constraints of the water power district, but the scale of operations remained small. This was to change dramatically in the next few decades.

Between 1870 and 1880 the number of manufacturing establishments in Winnebago County nearly doubled from 86 to 167, and the number of wage earners climbed from 1,075 to 1,878 (U.S. Department of Interior, 1870, 1880). By 1900 Rockford alone boasted 450 manufacturers and 6,620 factory hands (U.S. Department of Commerce, 1902). While many of these operations were small shops or cottage industries, there was a significant rise in the number of factories and a diversification in the line of products. These two factors contributed to both a surge in the amount of industrial wastes and an increasingly complex mixture of effluents. However during the 1870s, the hazards posed to the general public were limited.

The 1882 city directory (Matthew's, 1882) listed 108 manufacturers. Of these, forty were either large scale factory operations or potential producers of hazardous wastes. Included in this group were plow
Figure 3-1. Rockford Water Power District. Established in the mid-1850s, the Water Power District served as the core of Rockford industrialization. From Roe, 1892.
manufacturers who operated foundries, breweries and
distilleries, furniture producers, publishers, two coking
plants, a number of machine shops, a watch factory,
textile mills, and a wire works. Although still strongly
tied to the local agricultural market, a growing
orientation to Chicago denotes linkages with a larger
economic system. This incipient connection was fostered
by the arrival of the Chicago Northwestern Railroad by
1852 and the subsequent completion of the Illinois
Central Railroad in 1884 (Nelson, 1952). Although too
distant to be considered a suburb of Chicago, Rockford
developed as an economic satellite to the regional
metropolis and they both made significant industrial
gains during the 1880s and 1890s.

By 1890 Winnebago County had taken on many of the
employment characteristics common to industrial areas.
Over 14 percent of the total population worked in
manufacturing sector jobs and 59 percent of the county
residents lived in a city. A Rockford directory claimed
thirty-one of the 118 local employers had work forces in
excess of one hundred hands (Brown and Rowe, 1891). The
industrial landscape also attests to the industrial-
alization process occurring in Rockford. Factories
required more space than the older shops and this
prompted two responses. Initially, factory construction
was vertical and the textile mills and other
manufacturers adjacent to the original water power
district built multi-story structures. The earliest
examples were frame or brick buildings but by 1920
concrete-frame buildings with massive windows were
common. Horizontal type construction was evident along
the rail lines, particularly on the east side of the Rock
River. There, furniture makers and later hardware and
machinery producers received free land from speculators
who hoped the sale of adjoining residential lots would
compensate their generosity (Nelson, 1952).

A map of industries in 1892 shows numerous
factories in the original water power district, with
extensions of new factories west and north along the
branches of Kent Creek and also to the south along the
Rock River (Figure 3-2a; Roe, 1892). On the east bank of
the river, there was a cluster of furniture factories
north of the business area and a second reaching eastward
along the Illinois Central line. Two other outliers of
industrial growth were developing; one along the Illinois
Central belt line in the southeast quadrant of town and a
second in north Rockford. Both these centers were early
nuclei for the machine tool and metal finishing trades.
Figure 3-2b. Rockford Industries, 1913. Source: Insurance Maps of Rockford, 1911 and 1913.
So by 1892, the basic pattern was in place; subsequent growth would move outward from the early cores (Fig. 3-3).

When considering wastes, the type of industry is often more important than the number of employees. By 1892 the three largest employers in Winnebago County were the furniture, agricultural tool, and the textile trades, with the leather working concerns a close fourth (Table 3-1; Brown and Rowe, 1891). Other business grew up to serve these operations such as the machine tool and textile tool manufacturers. Additional businesses were a silver plater, a metal galvanizing firm, pump makers, a watch factory and city gas and coke producers. In addition, an air brush manufacturing concern used a nickel plating process (Brown and Rowe, 1891). Each of these manufacturers produced wastes that could remain in the local environment and enter local water supplies.

During the first three decades of the twentieth century there was a significant surge in the number of workers employed in the machinery trades (Table 3-2). This partly reflects the founding of three of Rockford's largest companies before 1910; National Lock, Sundstrand, and Greenlee all began their Rockford operations between 1903 and 1905 (Round-Bits, 1967; U.S. W.P.A. Writers Program, 1941; and Nelson, 1952). Growth in the furniture trade continued, while printing and textiles dropped slightly during the 1920s (Table 3-2). One important manufacturing activity that was not tabulated separately by the census was the plating industry. Electroplating gained widespread commercial acceptance during the 1920s (Freeman and Hoppe, 1930) and Rockford became a major metal plating center. Many concerns specialized in metal plating, and several others used the process in the preparation of their finished products. Although not an exact measure of plating employees, the U.S. Census shows an increase in the number of employees making hardware from 56 in 1905 to 309 in 1929 (U.S. Department of Commerce, 1905 and 1930). They applied a variety of coatings to steel such as nickel, chromium, and brass.

The distribution of industries continued to expand within reach of the Illinois Central belt line on the southeast side of town (Fig. 3-3). Most of the new, large machine and hardware firms located in this section of town. Developers followed the manufacturers and constructed houses for the workers. Thus, between 1900 and 1930 there was a gradual filling in of the southeast
Figure 3-3. Expansion of Industrial Land Uses in Rockford, 1892-1913. Sources: Roe, 1892 and Insurance Maps of Rockford, 1911 and 1913.
<table>
<thead>
<tr>
<th>Industry</th>
<th>SIC</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile</td>
<td>22</td>
<td>1800</td>
</tr>
<tr>
<td>Furniture</td>
<td>25</td>
<td>2440</td>
</tr>
<tr>
<td>Shoe</td>
<td>31</td>
<td>795</td>
</tr>
<tr>
<td>Machinery</td>
<td>35</td>
<td>1269</td>
</tr>
</tbody>
</table>

Source: Brown and Rowe, 1891.

Table 3-1. Leading Employment Categories in Rockford, 1891.
<table>
<thead>
<tr>
<th>Year</th>
<th>All Industries</th>
<th>SIC 22</th>
<th>SIC 25</th>
<th>SIC 27</th>
<th>SIC 31</th>
<th>SIC 35</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>6,620</td>
<td>1,246</td>
<td>1,377</td>
<td>127</td>
<td>90</td>
<td>382</td>
</tr>
<tr>
<td>1905</td>
<td>7,239</td>
<td>1,270</td>
<td>1,605</td>
<td>138</td>
<td>99</td>
<td>630</td>
</tr>
<tr>
<td>1920</td>
<td>17,126</td>
<td>1,769</td>
<td>2,654</td>
<td>214</td>
<td>n.d.</td>
<td>2,905</td>
</tr>
<tr>
<td>1929+</td>
<td>19,916</td>
<td>1,410</td>
<td>3,369</td>
<td>174</td>
<td>n.d.</td>
<td>2,072</td>
</tr>
</tbody>
</table>

Source: U.S. Census of Manufacturers

* Figures underrepresent totals due to omission of large manufacturers in some categories.

+ Winnebago County totals.

Table 3-2. Rockford Employment in Selected Industries, 1900-1929*
quadrant of town. Local leaders encouraged industrial
development in this section because it was generally
downwind of the business district. In the 1918 plan for
Rockford, the chief planner urged "districting" or zoning
that would limit future industrial expansion to the belt
line area (West, 1918). This suggestion was intended to
prevent industrial encroachment on residential areas and
to keep industrial air pollution away from the city.
Although the planners' recommendations were not fully
heeded, use of the belt line area by industries continued
(Fig. 3-3); this brought industrial activity into a zone
of sand and gravel aquifer recharge.

The Impact of Industrial Wastes

Little evidence remains to document industrial
wastes practices used before 1927, but the limited
sources available clearly indicate that manufacturers
relied heavily on natural watercourses to transport their
wastes. Water removal was the most common method used
throughout the country in the late nineteenth century
(Tarr, 1984a and 1984b), and the river orientation of
factories supports this supposition for Rockford. A
municipal sewer system directed some factory wastes to
the river, although the rapid expansion of industries to
the southeast left several without city services and
without a natural drain. Thus, land disposal was the
most likely practice in areas beyond the limits of the
sewer system.

Local governments claimed jurisdiction in waste
disposal matters during the nineteenth century and in
Rockford reactions to industrial nuisances came as early
as 1880 when the city council passed an ordinance
prohibiting smoke stacks within the city. It forbade
stacks that emitted "noxious, nauseous, or offensive"
substances (City of Rockford, 1880). The statute was
aimed specifically at manufacturing activities and was
intended to protect the neighbors of smoke-spewing
plants. Local industries responded by building taller
smoke stacks, exemplified by the 153 foot high stack at
the sugar works (Rockford Evening Republic, 2 June 1896).

Although in 1880 the germ theory of disease had
yet to be confirmed, health officials recognized a link
between putrescible wastes and water-borne diseases.
Acting in accord with this notion, the Rockford common
council forbade the construction of sewers into the Rock
River north of the Water Power District dam. This
statute, passed in 1880, specifically mentioned
industries such as breweries, still-houses, slaughter-houses, tanneries, and soap factories as contributors to water pollution (City of Rockford, 1880). As written, the act had no impact on local industries that either clustered in the Water Power District below the dam or lined tributaries of the Rock River which entered downstream from the dam. It did reflect a growing concern with water quality problems, and these concerns were to grow during the next few years.

The principal concern was with the contamination of private and public water wells in the city. Outhouses and water-closets draining into privy vaults tainted neighboring wells in the porous sand and gravel soils. To remedy this situation the city sold several bonds in 1882 to finance construction of a municipal sewer system (City of Rockford Annual Report, 1882). It combined storm and sanitary sewers and accommodated some industrial wastes, and it carried all sewage directly to the Rock River. Private sewers were also constructed, mainly by manufacturers, and some drained into the pool above the dam on the river causing politicians to label it a "cesspool" (City of Rockford, 1911). Despite dissatisfaction with the foul river water, by the early 1880s the even poorer quality of municipal well water forced city officials to use river water until new wells could be drilled into bedrock aquifers in 1885 (City of Rockford, 1911).

A general preoccupation with sanitary sewage continued throughout the remainder of the nineteenth century and into the twentieth century. A city health officer attributed scarlet fever and diphtheria epidemics to "the want of a proper sewer" (City of Rockford Annual Report, 1902-03). He also remarked that Rockford "enjoys the distinction of having the most defective sewerage system of any city of its size in the state" and charged that the river was a "menace to public health" (City of Rockford Annual Report, 1902-03). Within two years, steps had been taken to alleviate the problem of diseases with the construction of nine miles of new sewers, although most emptied into the river above the dam (City of Rockford Annual Report, 1904).

With the exception of the 1880 ordinance against industrial discharges into the Rock River, manufacturers had been left to their own devices in handling their wastes during the early twentieth century. The General Ordinances of 1916 prohibited "trades and manufactories" from creating nuisances that may endanger the public
health (City of Rockford General Ordinances, 1916). Such nuisance ordinances generally applied to operations working with biological, putrescible wastes which caused unpleasant odors. As long as these wastes were diluted and sent down river, no action was taken to interfere with industries. Water disposal remained the primary means of liquid waste disposal while solids were piled up on the factory site or used to fill in excavations or low spots near the plant.

Until the 1920s the sewer system of Rockford had been constructed on an ad hoc basis. When neighborhood wells became tainted, the city extended the combined sewer to solve the problem. A near doubling of population between 1910 and 1930 forced an inadequate system to handle far more sewage than it was capable of. Expansion of the industrial districts also placed greater demands on the sewers and the river. To address the problem, city leaders proposed forming a regional sanitary district with the power to build a unified system for Rockford and adjoining communities. A first step was taken in 1923 when the city authorized a sewer survey to be taken (City of Rockford Annual Report, 1927). Several years later, following what a Sanitary District historian called a period of "considerable local publicity," local voters approved a proposition to create the Sanitary District of Rockford (SDR) (Fig. 3-4; SDR, 1952; and Rockford Republic, 3 November 1926). Its creation came none too soon, for local industries were already complaining river water was "impossible to use" in their manufacturing processes (Illinois Department of Transportation, Rock River Permit Files, Correspondence, 9 March 1931).

One of the most significant outcomes of the election, in terms of the historical record, was the compilation of a survey of industrial wastes for 1927. To gather adequate information for the treatment plant design, the SDR asked local manufacturers what type of wastes they would be sending to the treatment facility and in what quantity. They also queried how they handled their wastes at that time (SDR, 1927). Local manufacturers dumped approximately 4.8 million gallons of liquids into natural water courses or sewers each day and these flowed into the Rock River. The engineers conducting the survey concluded that the Rock River could assimilate the organic matter of the sewage and that the industrial wastes had no "unusual characteristics" (SDR, 1927).
Figure 3-4. Stream Pollution. This cartoon appeared in the Rockford newspaper in 1926 during the effort to establish a sanitary district and it reflects nationwide efforts during that era to curtail stream pollution. From Rockford Daily Republic 13 August 1926, p. 6. Courtesy of the Illinois State Historical Library, Springfield, Illinois.
Of primary importance to the SDR were the wastes from the textile mills, dairies, paper products plants, the meat packing plant, and the tannery (SDR, 1927). They produced significant quantities of biological wastes that increased the biological oxygen demand in local streams and also caused offensive odors (Table 3-3). The acids of the plating companies would corrode sewer pipes, and for this reason, they were inventoried too, although the engineers felt they would cause no problems at the treatment works or in the sewers. They were dumped in smaller quantities and thus were considered far less consequential.

Not all metal finishing and fabricating wastes went into sewers or the streams. In a summary of those companies that were visited by representatives of the SDR, seven discharged acid or other effluents into watercourses (Table 3-4); the remaining five either dumped liquids directly on the ground or allowed them to seep into the soil through a cesspool. Most of those practicing land disposal were near the limits of the existing city sewer system and had few options other than to construct a private sewer or dump on the ground (Fig. 3-5). The expense of laying lengthy pipelines deterred these belt-line companies from following such an option, and most resorted to land disposal—an activity that went on openly. Prevailing theories of public sanitation provided no reason to prohibit dumping oil, acids or gasoline on the ground. Soil filtration was a common method of sewage treatment, and it was believed "natural filtration" would cleanse any impurities from industrial wastes (Toulman, 1937).

The SDR survey concluded that Rockford's wastes could be treated adequately, and design and construction of a facility proceeded. In 1932 the sewage treatment works went into operation. It provided anaerobic digestion and the sludge was used as fertilizer on agricultural land (SDR, 1984). Many industries declined to link into the system immediately, so although service was made available, it was not universally accepted. As a consequence untreated wastes continued to flow into streams and it is assumed they were also dumped on the land.

Other Possible Contaminant Sources

There are three other sources of possible groundwater contamination that existed during this first
<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of Firms</th>
<th>Approximate gallons per day</th>
<th>Character of Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textile</td>
<td>4</td>
<td>200,000</td>
<td>aniline dyes, wool washings</td>
</tr>
<tr>
<td>Dairy Products</td>
<td>3</td>
<td>25,000</td>
<td>bottle washings, cottage cheese and skim milk wastes</td>
</tr>
<tr>
<td>Metal Products</td>
<td>20</td>
<td>n.d.</td>
<td>pickling liquor, acids, oils, oakite</td>
</tr>
<tr>
<td>Paper Products</td>
<td>2</td>
<td>2,400,000</td>
<td>straw and paper wastes</td>
</tr>
<tr>
<td>Leather Products</td>
<td>1</td>
<td>1,100,000</td>
<td>grease, tan liquor with water</td>
</tr>
<tr>
<td>Meat Packing</td>
<td></td>
<td>150,000</td>
<td>floor washings, grease</td>
</tr>
</tbody>
</table>

Source: SDR, 1927

Table 3-3. Rockford Industrial Wastes, 1927
<table>
<thead>
<tr>
<th>Company</th>
<th>Wastes</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Lock</td>
<td>sulfuric &amp; nitric acid solutions</td>
<td>city sewer</td>
</tr>
<tr>
<td>Greenlee Bros.</td>
<td>sulfuric acid (10 carboys/year)</td>
<td>not connected to river or sewer</td>
</tr>
<tr>
<td>Ingersoll Milling Machine Co.</td>
<td>oil and water solution (1000 gal/wk)</td>
<td>&quot;dumped on the ground&quot;</td>
</tr>
<tr>
<td>Elco Tool and Screw Co.</td>
<td>acids, oakite</td>
<td>&quot;dumped either into a cesspool or on the ground&quot;</td>
</tr>
<tr>
<td>Mattison Machine Works</td>
<td>foundry quenching water</td>
<td>city sewers</td>
</tr>
<tr>
<td>Washburn Co.</td>
<td>sulfuric acid (200 gal/week)</td>
<td>private sewer to Kent Creek</td>
</tr>
<tr>
<td>Spengler-Loomis Manufacturing Co.</td>
<td>metal cleaning solution (oakite)</td>
<td>cesspool</td>
</tr>
<tr>
<td>Emerson Brantingham</td>
<td>sulfuric acid</td>
<td>Kent Creek</td>
</tr>
<tr>
<td>Sundstrand</td>
<td>cyanide, caustic (1000 gal/month), muriatic acid</td>
<td>city sewer</td>
</tr>
<tr>
<td>Rogers Bros. Galvanizing</td>
<td>sulfuric acid</td>
<td>dumped in cesspool on ground (1931)</td>
</tr>
<tr>
<td>Rockford Drop Forge</td>
<td>solution of sulfuric acid and &quot;nitrate&quot;</td>
<td>&quot;washed&quot; into sewer</td>
</tr>
<tr>
<td>Damascus Steel</td>
<td>gasoline (50 gal/mo.)</td>
<td>&quot;thrown on ground&quot;</td>
</tr>
<tr>
<td>Smith Oil Co. (1931)</td>
<td>oil, grease</td>
<td>discharged into Kent Creek</td>
</tr>
<tr>
<td>George D. Ryan Corp. (1931)</td>
<td>enameling wastes</td>
<td>city sewer</td>
</tr>
<tr>
<td>W.F. and John Barnes Co. (1931)</td>
<td>quenching water</td>
<td>into Rock River</td>
</tr>
</tbody>
</table>

Source: SDR, 1927 and SDR, 1931.

Table 3-4. Metal Fabricating and Finishing Waste Disposal Methods, 1927
Figure 3-5. Documented Disposal Practices in Rockford, 1927. Industries along streams generally used the watercourse as an open sewer, but manufacturers near the fringes of the sewer system frequently dumped liquid wastes directly on the ground. General urban refuse filled the five quarries, although industrial wastes were included. Source: Sanitary District of Rockford, 1927 and local newspaper accounts.
period; road oil, underground storage tanks, and landfills. Each of these will be considered in the following section.

Few municipal roads had hard surfaces at the turn of the century and normally during the dry summer months city crews sprinkled water on the streets to control dust. Exceptionally dry conditions during 1910 caused water shortages and also excessively dusty conditions. Searching for an alternative to water, the city engineer purchased a "carload of road oil" to be applied to "residential streets." He concluded that the experiment was superior to sprinkling and that the practice should be continued (City of Rockford, Annual Report 1910). The practice apparently was continued with mixed acceptance. An editorial cartoon in 1926 was critical of motorists who ignored the viscous road covering and splashed passing vehicles (Fig. 3-6). Other communities also used oil; Winnebago reported a surplus of 8,000 gallons at the end of the dry season in 1926 (Rockford Daily Republic, 7 August 1926). During the same summer, plans were being made to hard surface 103 miles of county roads (Rockford Daily Republic, 30 June 1926), but road oiling remained a common practice for years to come.

Storage tanks for gasoline and other substances were in common use during the later years of this period. Numerous factories stored liquids used in their manufacturing processes either in buried tanks or above ground. For insurance purposes most tanks were located outside the factories as a safeguard against explosions. Exposed to weather these tanks could develop leaks and materials could escape into drains or seep into the earth. Process liquids stored in 1911-13 included aniline dyes, naphtha, turpentine, linseed oil, benzene, acids, and oils (Insurance Maps, 1911 and 1913). In addition to leaking tanks, spills could occur and did. In July, 1926 benzene poured from a storage tank at the Emerson-Brantingham plant, drenching fire-fighters in the process. They hosed down the floor, washing the benzene through the drains and into Kent Creek (Rockford Daily Republic, 23 July 1926). Smith Oil Company on the North Branch of Kent Creek also allowed their product to escape. The Sanitary District reported that "considerable oils and greases were being discharged into the waters of Kent Creek..." (SDR, 1931). Whether this release was accidental or intentional cannot be determined, but it does indicate storage tanks were not failproof.
Figure 3-6. Road Oil Cartoon. Winnebago County residents perceived road oil as a aesthetic nuisance rather than a potential health hazard in 1926. From Rockford Daily Republic 30 July 1926, p. 5. Courtesy of the Illinois State Historical Library, Springfield, Illinois.
Increasing use of automobiles during the 1920s created a demand for more gasoline stations in Rockford. Between 1920 and 1930 the number of stations increased from 6 to 125 (McCoy's, 1920 and 1930). Early fuel suppliers stored gasoline above ground in tanks allowing gravity to feed the product into waiting automobiles. In 1919 Illinois legislators passed a law requiring all tanks to be stored underground, buried at least two feet beneath a concrete slab, and limited the capacities to 6,000 gallons (Illinois Department of Insurance, 1934). To prevent rusting of the steel containers, they were to be coated with asphaltum or other sealants. Most of the early stations opened under this regulation were located in the business section of Rockford, although few of the original facilities remain open today (Fig. 4-4). Abandoned tanks may have drained into the sand and gravel aquifers or they may still contain volatile liquids.

Old quarries filled with municipal refuse pose the other potential threat to ground water in Winnebago County. Although general garbage is not considered a long-term hazard to water supplies, the tendency for dump operators and scavengers to mix industrial and domestic refuse increases the likelihood of hazardous substances ending up in landfills. In addition, several of the more recent landfills have caused contamination of private and public wells and the same could have occurred during earlier periods (U.S. EPA, 1976; Bacon, 1985).

In 1912, scavengers hauled municipal garbage "to the country, where it [was] placed under the ground. A very small proportion [was] fed to hogs" (City of Rockford, 1912). Refuse was collected only eight months of the year and this included plate scrapings and kitchen wastes. Seasonal collection had been criticized for several years because winter accumulations became offensive in the spring and there was no systematic collection of tin cans and ashes (City of Rockford, 1927). In an attempt to remedy this situation, quarries were put into use for landfills by 1924. An excavation east of Kiswaukee at about Eleventh Avenue received approximately 70,000 loads of rubbish between 1924 and 1926 (Fig. 3-5). Included in the mixture were tin cans, boxes, ashes, automobile wrecks, "and everything which Rockford people discard..." (Rockford Daily Republic, 30 July 1926). It reached its capacity in 1926 and a "hole" belonging to Illinois Central west of Kiswaukee was pressed into service. Within four months nearly 9,000 loads were dumped in this second municipal landfill, and by 1928 three official city dumps existed within the city.
limits. Together they received 75,000 loads of garbage annually. The director of the Department of Sanitation expressed concern over their dwindling capacity and added that there was insufficient "low land" in the town for landfills, and he suggested incineration replace the dumps (City of Rockford, 1928). Use of open pits continued, however, and the amount of refuse climbed to 80,000 loads in 1929 (City of Rockford, 1929). Unfortunately the exact location of the three city dumps is not known, but several quarries were identified (Fig. 3-5).

Wastes Outside Rockford

Little large-scale manufacturing existed outside Rockford in the period prior to 1932. Those industries operating in the rest of the county processed agricultural or forest products and generally discharged biological wastes into water courses. Such activity caused short-term imbalances in the aquatic communities of the streams, but posed only minimal long-term hazards.

Rockton, like Rockford, grew up around a water power district on the Rock River. The earliest industries were grist mills, but by the turn of the century two paper mills had arrived (Sanborn, 1904). These would have emitted the high biological oxygen demand type wastes that affected the quality of stream water in Rockford. Dairy products were the economic mainstay in the town of Pecatonica. In 1912 a dairy and a creamery were the principal industries there (Insurance Map of Pecatonica, 1912). Neither was large, although they added to the load of biological wastes in the Pecatonica River. Only in Winnebago was there a metal-working firm. Enameling of refrigerators produced about 100 gallons of sulfuric acid wastes each week and they were dumped into the upper reaches of Kent Creek (SDR, 1927). Riverside industries in Beloit and South Beloit also contributed to stream pollution in the Rock River system. The largest industries in Beloit produced metal goods, chiefly machines, and agricultural products (Hodge and Ely, no date). Their wastes were solvents and oils.

There were many quarries that later were used for landfill, but before 1932 the smaller communities did not feel the pressure to remove town rubbish to distant dumps. Low places along the rivers sufficed although most towns did have designated municipal refuse pits for non-combustible garbage like tin cans and ashes (Bigelow,
1985). Hogs continued to consume much of the putrescible kitchen wastes, while privy vaults and cesspools received domestic sewage.
Between 1932 and 1980 major improvements in industrial waste treatment were implemented in Winnebago County. Until the mid-1960s, regulation of waste disposal remained largely a local prerogative and there was little enforcement of municipal ordinances. State agencies had acquired some authority over industrial wastes, but had no effective powers of enforcement. Strict regulation awaited passage of tough federal and state laws aimed at halting stream pollution. This chapter will consider two periods; the first lasting from 1932 to 1967 and the second from 1968 to 1980. The earlier period witnessed the rise of metal plating trades in a legal climate that tolerated the dumping of cyanide, solvents, and acids in local watercourses. By the end of the period, steps were being taken to restrict uninhibited dumping of industrial wastes. When effective water clean-up actions began in 1967, Winnebago County entered a period characterized by a shift to more complete treatment of liquid wastes and production of more land interred wastes.

The Introduction of Treatment, 1932-1967

Industrial Transition, 1932-1967

The most notable change in Rockford's industrial geography during the period from 1932 to 1967 was the phenomenal growth of the machine tool (SIC 35) and the fabricated metals trades (SIC 34). Accompanying their rapid expansion was the gradual decline, although not a complete disappearance, of the textile and furniture trades (SIC's 22 and 25). The latter two businesses had provided a seed bed for the metal and machine trades, but with the growth of the automobile industry and the demand for metal goods during World War II, new markets for machine tools and automobile parts prompted rapid expansion. Contemporaneously, both textile and furniture manufacturers shifted their operations to Southern states which offered lower labor costs. In Rockford the furniture trade, once the hallmark of Rockford industry, held on but experienced no expansion.

These generalizations are borne out by the increases in both the number of establishments and the number of workers in machine and fabricated metals trades (Table 4-1 and 4-2). In the post-war years, textile producers fell from nine to three operations while
<table>
<thead>
<tr>
<th>Year</th>
<th>Food Products (SIC 20)</th>
<th>Textiles (SIC 22)</th>
<th>Furniture (SIC 25)</th>
<th>Printing (SIC 27)</th>
<th>Chemicals (SIC 28)</th>
<th>Leather Goods (SIC 31)</th>
<th>Primary Metals (SIC 33)</th>
<th>Fabricated Metals (SIC 34)</th>
<th>Machinery (SIC 35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1937*</td>
<td>34</td>
<td>--</td>
<td>28</td>
<td>21</td>
<td>3</td>
<td>--</td>
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<td>21</td>
<td>85</td>
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* Rockford only

Table 4-1. Winnebago County Industrial Establishments, 1937-1967
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<th>Furniture SIC 25</th>
<th>Printing SIC 27</th>
<th>Fabricated Metals SIC 34</th>
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<td>995</td>
<td>12,598</td>
<td>18,035</td>
</tr>
</tbody>
</table>


Table 4-2. Winnebago County Industrial Employment, 1949-1967
furniture makers declined less precipitously from twenty-eight to twenty establishments. The number of employees in the furniture plants fell to a low point in 1959 but then climbed again during the 1960s. This modest gain in no way compares with the expansion experienced in the metal trades. The number of establishments climbed from three to eighty-five for fabricated metal goods and from fifteen to 218 for machinery makers. The number of workers employed by these two industries exceeded 30,000 by 1967 and represented more than 61 percent of the manufacturing jobs.

Expansion of industrial activity proceeded outward from the established industrial cores during this period. Metal fabricators expanded their operations southward from the Water Power District and westward beside the rail yards (Fig. 4-1). The greatest growth came to the belt-line area on the southeast side of town, where metal working industries were already established and property with rail sidings was still available. Consequently, the metal-working shops concentrated in this section of Rockford. Low-cost government loans and federally sponsored projects allowed expansion in northern sections as well. A division of W.F. and John Barnes made armor-piercing shells during World War II in north Rockford (Oberg, 1945-46) and Woodward Governor moved to Loves Park in 1941 (Alexander, 1949). The significance of the new industrial locations was an abandonment of sites with access to surface water and a shift to the low terraces. Most factories requiring process water could tap the plentiful sand and gravel aquifers or subscribe to municipal service. Sewage removal needs could be met by the Sanitary District or disposal companies, although the porous sandy soils also offered "natural filtration" possibilities for unwanted liquid wastes.

By 1964 more than 1,600 acres in Rockford Township were devoted to industrial land uses and a total of 3,080 acres in eastern Winnebago County. Planners at the time recommended that some restraints be placed on uncontrolled industrial expansion, and they urged that industrial activity be eliminated from residential areas (Rockford-Winnebago Planning Commission, 1967). Although they did not specify where such "incompatible" land uses occurred, it is apparent there were concerns over industrial encroachment on residential areas. The map accompanying their report depicts some gradual expansion of industrial activity from the previously established districts, but most expansion occurred on property.
Figure 4-1. Rockford Industrial Land Use Change, 1948 to 1980. Sources: Alexander, 1948 and USEPA, 1985.
already controlled by manufacturers. Railroad facilities
still dictated locational patterns and the highway-
oriented distribution was just emerging.

Internal practices and technological changes
provided the greatest impact on waste streams during this
period. Electroplating was used in several growth
industries, including the manufacture of automobile
parts, furniture hardware, and general hardware. These
industries proved to be one of the largest contributors
to the new types of industrial wastes. Automation of
electroplating enhanced the productivity of workers,
thus, the growing number of employees in metal finishings
indicates a geometric increase in waste production.
Batch sizes increased as well, contributing further to an
increase in the volume of wastes produced by the plating
firms. Acids and cyanide remained the main wastes
produced by the electroplaters, but unlike the conditions
in 1927, the relative proportion of plating wastes was
much more significant in 1967.

Several machine tool manufacturers either
modernized their entire plants or added modern wings
during this period. The W.F. and John Barnes Company
remodeled their entire shop in 1940, introducing new
machinery and technology in the process (Finkenstaedt,
1965). The major changes in the machine tool industry
were the increasing scale of the machinery produced, the
stronger metals used, and the specialization of the
product (Wagoner, 1966). Also oil-tube drills became
commonplace and these were joined by hydraulic equipment.
This equipment produced small volumes of waste, which
from a manufacturer's point of view was not a disposal
problem. The Woodward Governor Company also completed a
new factory in 1941 and their processes included metal
plating, fabrication, and assembly of governors for
aircraft, diesel engines, and hydro-electric equipment.

Metals used in Rockford businesses arrived from
Chicago or the Pittsburgh area and there were several
foundries operating in the area shaping the steel for the
machine tool manufacturers. They produced foundry sand
wastes and quench waters. Other firms producing
hazardous wastes in the area were an adhesives company, a
paint producer, and an industrial chemical manufacturer.
The manner in which their effluents were handled will be
discussed in the next section.
Industrial Waste Disposal, 1932-1967

The completion of the Sanitary District of Rockford in 1932 did not halt industrial discharges to the Rock River. The system was originally intended to accommodate all industries in the city, but initially services were not offered to all sections of the community and some factories that were offered service did not immediately take advantage. In 1934 the Sanitary District prepared a summary of continuing river pollution. It listed eight industries who refused to connect even though an interceptor ran by their businesses (SDR, 1934). The "offenders" included two textile producers, two furniture makers, and a city gas manufacturer. Nine other firms, which had yet to cease river pollution, had no immediate access to the interceptor sewer and connections would be expensive. This second group included another city gas company, an agricultural implement firm, a machine tool manufacturer, a textile, a cardboard box, and a chemical company. In addition, the Water Power District was listed as another area unserved by the SDR. Several metal working and textile firms operated in that small area on the banks of the Rock River. The report stated that "it is hoped that all offenders can be made to see their duty to connect" (SDR, 1934). Such appeals indicate that there was no viable legal means to force all firms to connect to the sanitary district, consequently some took years to complete their linkages.

Some companies acted quicker than others. In 1937 the Rockford Mitten and Hosiery Company authorized their treasurer to spend approximately $5,000 to connect with the Sanitary District (NIRHC, Rockford Mitten and Hosiery Collection, 1937). The work was completed by late spring that year and their aniline dye wastes were diverted from the river. Greenlee Brothers reportedly separated its storm and sanitary sewers in 1941, thereby sending only industrial wastes to the SDR. Nearly a decade later, in 1950, they eliminated the dumping of petroleum products into the sewer system (WCDPH, Industry Files, 1972).

Other firms required municipal pressure to act. The city of Rockford ordered "property owners" in the Water Power District to stop dumping sewage into the Rock River by the end of 1948 (Rockford Register-Republic, 29 June 1948). This followed a fish kill and also a polio epidemic that had aroused public concern over putrescible wastes. In response to a complaint by local fishermen,
the Sanitary Water Board sent inspectors to Rockford during the summer of 1951, and they found that a recent fish kill was due to discharges of high concentrations of cyanide wastes from Washburn Plating. The Sanitary District reported that the firm had dumped 6,500 gallons of plating wastes containing 2.6 ounces of cadmium and 5.7 ounces of sodium cyanide per gallon into the river (IEPA, SWB Microfilm, 17 July 1952). The company was in the process of connecting to the Sanitary District, but the work was not completed at the time of the inspection (IEPA, SWB Microfilm, 16 August 1951). The Sanitary District recommended against requiring the plating firms to treat their wastes, suggesting instead that by "good housekeeping" and "careful operating procedures" they could avoid future fish kills. They went on to state that if industries avoided releasing highly concentrated cyanide solutions, fish kills could be prevented (IEPA, SWB Microfilm, 24 July 1952).

Nevertheless, intermittent releases of toxic substances continued to cause fish kills. Several years after the cyanide controversy, the Rock River Clean Streams Committee accused the Smith Oil Company of "allowing a considerable amount of oil spillage to flow down a natural drain of Kent Creek" (SDR, Cyanide Files, 7 August 1962). Again in 1972 similar complaints were filed with the Winnebago County Department of Public Health (WCDPH, Complaint File, 16 June 1972). Other firms tolerated dumping waste oil into storm sewers which drained into the Rock River as late as 1969 (WCDPH, Field Investigation Report, July 1969). Unauthorized dumping of oil in north Rockford storm sewers merely caused an oil slick in the Rock River, but it indicates not all wastes went to the Sanitary District, even when service was offered.

Upstream from Rockford, installation of sewage treatment systems lagged behind the halting progress of the county seat. In 1938, South Beloit and Rockton industrial wastes received no treatment (Illinois State Planning Commission, 1938). Metal working wastes, along with aniline dyes and paper wastes flowed downstream through Winnebago County from these communities. South Beloit and Rockton installed primary sewage treatment plants in 1956 and 1962 respectively. Other communities in the county also installed some form of treatment during this period: Durand, a stability pond-1962; Pecatonica, a primary treatment-1966; and Winnebago, a stability pond-1958 (Dyer and Tamblyn, 1973). Some industrial wastes received treatment at these facilities,
but much of the manufacturing effluent continued to drain into waterways through 1967.

The Sanitary District of Rockford itself has come under criticism in the past for releasing toxics into the Rock River. Fish kills have occurred during most droughts since World War II resulting from the release of anaerobically treated liquid sewage with high concentrations of cyanide. During prolonged periods of lower-than-average precipitation, the river stage falls and cannot sufficiently dilute the SDR effluent. As early as 1951 the SDR began to analyze the problem. They determined that the wastes from plating companies and metal heat treatment facilities caused the fish kills. To combat the problem they advised companies that were tied into the sewer system to dilute their discharges and to schedule releases with the Sanitary District chemist (SDR, Cyanide Files, 13 November 1951). Subsequent analyses of incoming plating wastes showed tremendous variation in the concentration of wastes, ranging from 1.5 to 64,000 parts per million (ppm). After treatment at the SDR, effluent released to the Rock River ranged from 0.5 to 4.1 ppm of cyanide (SDR, Cyanide Files, 1952). The higher measurements fell within the range of 0.75 to 3.0 ppm cyanide capable of causing fish kills (SDR, Cyanide Files, 13 November 1951).

Problems continued whenever low-flow conditions existed, and several major fish kills in 1963 refocused attention on the problem. In a preliminary report, the SDR concluded that batch releases of cyanide, contrary to their recommended procedure, caused high concentrations in their effluent on several occasions during the summer of 1963 (SDR, Cyanide Files, undated report). The report advised an inventory of cyanide users be made and a meeting of plating companies be called. The SDR tabulated a list of forty-three cyanide users who consumed more than 630 tons of cyanide in 1963 (SDR, Cyanide Files, 1963). After holding a meeting to discuss the problems with its customers, SDR issued an open letter stating that all concentrated solutions of cyanide to the district sewers were "strictly prohibited" (SDR, Cyanide Files, 13 March 1964). By the summer of 1964 most electroplaters were transferring their cyanide sludges to a central collection point where the wastes were held in a railroad tank car. When the car was filled, the waste was sent to Kansas City for destruction by a commercial waste treatment firm (SDR, Cyanide Files, Memo, 2 July 1964). In addition, two companies installed cyanide recovery equipment. Following these responses,
the SDR expressed its satisfaction that the problem had been solved: "Industry has cooperated excellently in the problem and will undoubtedly continue to do so."(SDR, Cyanide Files, Memo, 2 July 1964) The optimistic tone of the SDR was not borne out because cyanide concentrations continued to exceed lethal levels. Progress reports showed levels in the range of 2.5 to 3.0 parts per million (ppm) during the summer of 1964 and in the fall of that year 144,123 fish succumbed to plating wastes (Rockford Republic, 15 October 1964). The following year, Paul Carlson, a local public health official, told the Rockford Chamber of Commerce that effluent from the SDR remained four to five times above the state's allowable level for copper and cyanide. Twelve local firms, he stated, were within the allowable range while another fifteen were above the limits (Rockford Register Republic, 15 March 1967).

The continuing discharge of cyanide wastes to waterways and the response of the Sanitary District suggests that land disposal had yet to emerge as a major problem during the early 1960s, although there were numerous cases of indiscriminate disposal of plating sludges on industrial property or rural farmland. During the late 1950s and into the 1960s, electroplaters in Rockford began to treat their cyanide wastes and thereby increase the amount of solid wastes (Table 4-3, see SIC 342). Although the table shows fluctuations due to the erratic rise and fall of employment figures, the pre-1960 estimates are most likely too high while the 1960s estimates are more accurate. Existing technology offered several means of removing the cyanide from the liquid effluent. Chlorination of cyanide wastes was in use since the mid-1940s but the process for removing cyanide produced a toxic waste (Dobson, 1947). Local producers favored chemical precipitation which produced a cyanide-laden sludge (Weeg, 1985). Most platers placed the sludges in barrels and hired disposal firms to haul the material away (Weeg, 1985). There is evidence that the producers had little knowledge of where the sludges finally were interred. During a meeting of cyanide waste producers, company representatives revealed that a "junk man" picked up their sludge and carried it to an unknown destination (SDR, Cyanide Files, Minutes, 23 October 1963). Some of the barreled wastes ended up in Ogle County and some found its way into the local municipal landfills and abandoned quarries.

Not all sludges left the manufacturers property however. One industry spokesman reported he knew of two
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<td>20,715</td>
<td>18,641</td>
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(1) Tons of solid wastes.


* Change in classification, plating dropped.
# Plating specifically listed (346). Earlier Censuses combined plating (346) with metal stamping (347).

Table 4-3. Winnebago County Solid Waste Estimates, 1949-1967 (1)
companies that "pile it up in yards." Mr. Cotta of Washburn Company revealed that their disposal method was to store it until it was "built up" and then they dug a hole in the parking lot and buried it (SDR, Cyanide Files, Minutes, 23 October 1963). The extent of this type of operation is unknown, but from the partial record, it seems to have been quite common.

The Sanitary District also produced sludges containing cyanide and heavy metals that required land disposal. Until 1964 sludge was dried on SDR property and then was given to farmers wishing to use it as fertilizer (SDR, 1984). This resulted in widespread application of the sludge across the county. In 1964 however, the sludge digestors failed due to toxic poisoning. Following this occurrence, the SDR installed a vacuum filter system and disposed of the filter cakes in the municipal landfill on South Main Street (SDR, 1984).

The existence of numerous municipal landfills, within the city limits and the uncontrolled nature of land disposal during this period should arouse concern with the hazards posed by the landfills. Despite dissatisfaction with landfills and predictions of short life spans, mixed dumping in the municipal refuse pits remained common throughout the 1960s. The city has tried to reclaim several large sand and gravel quarries by allowing them to be used as landfills, and two exemplify the hazards posed by retired dumps. The Peoples Avenue dump (Fig. 4-2) was brought into use by 1942 (City of Rockford, Annual Report, 1942), and accommodated "garbage, ashes, and rubbish" (Rockford Register Republic, 31 May 1948). City owned but privately operated, the dump received in excess of 90,000 tons of refuse in its peak year of operation (USEPA, 1976). Not only was municipal garbage heaped into the retired quarry, but commercial industrial waste disposal firms used the pit as well. Use of the quarry for industrial wastes was common, particularly for foundry sands (USEPA, 1976). In addition, it is possible commercial industrial waste disposal firms (transporters) used the dump as well. Several electroplaters reported Roto-Rooter was their disposal company in 1972 (Winnebago County Department of Public Health, 1972), and Roto-Rooter has used a quarry adjacent to the Peoples Avenue Dump as a disposal site (Rockford Star, 16 June 1983). Earlier use of municipal landfills has not been documented (and could not be confirmed by the Roto-Rooter spokesmen), but it is probable. The consequences of indiscriminate dumping in
Figure 4-2. Land Disposal Sites of Industrial Wastes. Land disposal of industrial wastes has been concentrated in the Rock River valley, although well contamination has been reported in areas removed from the river. Sources: Sites containing industrial wastes abstracted from Nickolai, 1981; personal communication, and newspaper reports.
the Peoples Avenue landfill will be discussed in more detail in a later section.

Even more severe problems resulted from use of the Sand Park quarry as a municipal landfill (Fig. 4-2). Acquired by the Rockford Park District in 1947, Sand Park was the site of the old Lindskold gravel pit and covered an area of forty-one acres (Rockford Register Republic, 1947). During the first half of the 1950s, the site was used as a municipal dump (Rockford Park District, Sand Park File, n.d.), and by 1964 neighbors complained of the foul odors and of the rat problem created by the dump (Rockford Star, 12 July 1964). Suspicions that the pit contained industrial wastes were voiced in the early 1980s. The Public Health Department discovered volatile organic compounds (VOC's) in public water wells nearby and they suspected industrial sources (Chicago Tribune, 2 May 1983).

A third municipal landfill that is reported to have received hazardous substances is the Martin Park site in Loves Park. In 1947 the President of Woodward Governor Company donated eight acres of property to the Park District. The site contained an old meander scar of the Rock River where municipal refuse was dumped during the 1940s and early 1950s (Fig. 4-3; Rockford Park District, Martin Park File, n.d.). Among the reported wastes placed in the site are "possible chemical waste" from a World War II munitions plant (Nickolai, 1981). The site was opened to public dumping in 1955.

Three other serious land disposal incidents began before 1967 and continued on after that date. Pierce Chemical, located just northwest of Rockford (Fig. 4-2), was accused of emptying its "waste water which contains solvents from a holding lagoon directly into the North Branch of Kent Creek" (Rockford Star, 17 June 1983). They have manufactured organic chemicals since the 1950s and residents of the area suspect that well contamination is due to a leaking lagoon. In another incident, rural well users claim barrels of waste from a Rockford paint producer contaminated their water between 1963 and 1972 (see Tipton Farm, Fig. 4-2; Rockford Register Star, 12 November 1981). The third and perhaps most notorious incident of blatant and irresponsible waste disposal was the Acme Solvent site. Dumping of solvents and sludges from a solvent reclamation service began at the site off Lindenwood Road in the 1960s and continued until 1972 (Fig. 4-2). It was then that the Winnebago County Board of Health filed suit forcing Acme to halt the dumping of
Figure 4-3. Martin Park (Loves Park), 1950s and 1985. The upper photograph shows the former stream channel being filled with general urban refuse; reportedly various industrial wastes were included. The lower view illustrates present uses of the area as a municipal park. Upper photograph courtesy of the Rockford Park District.
wastes on its property (Rockford Star, 5 July 1972). The effects of industrial waste disposal at these sites will be discussed in a later section.

Sludge from the SDR also was used throughout the county as fertilizer on agricultural land. Beginning with the opening of the sewage treatment facility in 1932 a supply of sludge was available for farmers to haul away to their fields (SDR, 1984). As farmers substituted artificial fertilizers for organic sludges after World War II, the Sanitary District purchased land across the river from its treatment works for burial of the excess sludge. Still, some farmers continued to use the sludge and at least twenty-one were identified in a survey of waste disposal sites (Fig. 4-2; Nickolai, 1981). Examination of soil conditions at test plots showed that the sludge built up concentrations of heavy metals (SDR, 1984).

Additional sources of contaminants were related to petroleum products stored in underground tanks. In 1939 Smith Oil Company reported a shortage of 3,400 gallons of oil (NIHC, Smith Oil Refining Company, Sales Records, 1927-1940). Whether this shortage represents leakages, spills, or just sloppy book-keeping is uncertain, but it does reflect current concerns of public health officials. One of their worries is leakage from abandoned and forgotten gasoline storage tanks. Stations that closed before 1977 were not required to report the location of the abandoned tank, nor were they required to provide safeguards against leakage or accidental rupture. In Rockford alone, 149 stations closed between 1947 and 1968 (Fig. 4-4). Tanks now have to be drained but this was not the case for the 149 stations identified.

Street oiling continued as another source of possible ground-water contamination. The practice continued through the 1930s and in 1940 the city used six railroad "cars" of oil to suppress dust on alleys.
Figure 4-4. Gasoline Station Closures, 1947-1980. The highest density of station closures is found in the central area of Rockford. Each closure represents at least one buried tank and in many instances two. Some may have been removed even though removal was not required by law prior to 1977. Source: Polk's City Directory of Rockford, 1947, 1961, 1969, 1975, 1980.

Legal Changes Affecting Waste Disposal

A series of laws passed between 1965 and 1976 forbade the haphazard manner of waste disposal tolerated in earlier decades. The federal Water Quality Act of 1965 was the first comprehensive legislation aimed at controlling water pollution, but it left the drafting of water quality standards and enforcement to states, and consequently compliance was erratic and slow (Beard, 1975). In Illinois, the SWB responded by drawing up a new set of pollution regulations in 1967 (SWB, 1967). Like earlier Sanitary Water Board guidelines, these were not rigid statutes but merely suggested limits for chemical concentrations in effluents. Not until the passage of the Federal Water Pollution Control Act Amendments of 1972 were significant gains made in water clean-up efforts. The 1972 law sought to eliminate entirely the use of water bodies as sinks for refuse disposal and to curtail all water discharges by 1985. Most significantly, this act accelerated the shift of industrial waste disposal from water to land.

Attention to the land disposal of solid wastes began at the national level in 1965 with the passage of the Solid Waste Disposal Act. This first legislative action merely offered technical assistance to cities and provided funds for research on the solid waste problem; it did not regulate the disposal of wastes. Legislation with enforcement provisions had to wait until 1976 when Congress passed the Resource Conservation and Recovery Act (RCRA). This statute authorized the Environmental Protection Agency to control hazardous wastes from their point of origin to their final disposal site. Illinois also passed legislation in 1976 which allowed the IEPA and the Illinois Pollution Control Board to mandate, through a rigid permitting system, exactly where hazardous solids were interred (Illinois DENR, 1983).

The water pollution control laws had a direct impact on the Rockford area, chiefly in the form of imposing limits on the concentrations of cyanide that could be discharged into the Rock River. By 1974, the SDR, to avoid prosecution from the IEPA, set concentration limits on influents of both heavy metals and cyanide (SDR, 1981). This allowed them to continue accepting industrial wastes, but only those that had received pre-treatment. As a consequence, more indus-
tries installed treatment equipment and thereby began producing larger quantities of solid sludges. Many of the sludges and untreated liquids were hauled to less-than-reputable disposal sites in the period after 1972 (Busch, 1986). Two examples of unsafe disposal operations are the Byron/Johnston site in Ogle County and the Acme Solvent dump in south Winnebago County. Both these operations were closed in the early 1970s, but they exemplify the shift to land disposal sites that characterized the final period of this study.

Industrial Developments

Between 1970 and 1980 there were few changes in the basic composition of industries in Rockford. Although suffering a temporary sag in the mid-1970s, metal fabricating (SIC 34) and machine tool firms (SIC 35) remained the primary sources of employment in Winnebago County (Table 4-4). The number of companies in these trades increased although the number of employees fell. This suggests a shift to small shops and also increasing mechanization of operations. Both furniture (SIC 25) and printing (SIC 27) remained relatively stable in the number of establishments, but the number of workers in the furniture business fell sharply. Chemical plant workers (SIC 28) also increased significantly during the decade.

One major difference between production methods used in 1967 and those employed in 1980 was the reduction of cyanide used in plating operations. Due to restrictions placed on effluents, manufacturers sought to alter the chemistry of electroplating; by finding substitutes for cyanide, platers were able to reduce one of the troublesome elements of their sewage (Larson, 1985 and Weeg, 1985).

Other important waste streams that remained were the solvents used in the manufacture of automobile parts and printing, and the lubricants used in most mechanical operations.

Waste Disposal and Treatment, 1968-1980

By the late 1960s most metal finishing companies had connected their sewers to the Sanitary District, but increasing public awareness of the consequences of water pollution and the impact of high production caused a
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<th>Textiles (SIC 22)</th>
<th>Furniture (SIC 25)</th>
<th>Printing (SIC 27)</th>
<th>Chemicals (SIC 28)</th>
<th>Primary Metals (SIC 33)</th>
<th>Fabricated Metals (SIC 34)</th>
<th>Machinery (SIC 35)</th>
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<tr>
<td></td>
<td>Number of Establishments</td>
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<td>49</td>
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<td>321</td>
<td>937</td>
<td>1,676</td>
<td>973</td>
<td>11,800</td>
</tr>
</tbody>
</table>


Table 4-4. Winnebago County Manufacturing Employment, 1970-1980
reaction to fish kills in the river. In 1964 the Sanitary District forbade concentrated discharges of cyanide to the sewage treatment facility and the following year the Sanitary Water Board ruled that "no cyanide compound may be discharged to any waters of the state." (SDR, Cyanide Files, undated Correspondence, 1965)

Compliance with the Sanitary Water Board recommendation was not immediate however. A review of industrial waste disposal methods conducted by the Winnebago County Department of Public Health in 1972 revealed considerable effort had been expended to divert cyanide and oils from the sewers. Alternate disposal methods included incineration, chlorination, reclamation, and neutralization (Table 4-5). Although the surveyors did not gather responses to all their questions, such as where wastes were transported to, their review of disposal methods indicates a major shift from water to land disposal methods in the years between 1968 and 1972. At least ten manufacturers contracted with scavengers to haul liquid wastes away from their property. The waste transport companies contacted were either unable or unwilling to report where they hauled wastes in the early 1970s. The municipal dumps were likely repositories, as was the Byron/Johnson dump in Ogle County (Illinois DENR, 1983). Because the transporters were largely unregulated and unmonitored in 1972 it is also probable that other undetected dump sites were used to handle the large volume of liquid wastes produced between 1972 and 1976.

Despite the diversion of most liquid wastes to landfills, hazardous wastes were not completely removed from the sewer system. In 1975 heavy metals and cyanide continued to enter the Sanitary District treatment works (SDR, Cyanide Files, Correspondence, 1976). The IEPA sent letters to seven plating operations advising them that their effluent still contained heavy metals and cyanide, but that their discharges were within allowable levels. The SDR warned thirteen other producers that they were not within compliance. Twenty-four additional producers were notified that, although they were providing pre-treatment, they needed permits to continue such activities. These letters, part of the RCRA motivated effort to regulate waste disposal, indicate that cyanide was still a problem more than a decade after the Sanitary Water Board urged the cessation of cyanide discharges.
<table>
<thead>
<tr>
<th>Company</th>
<th>Wastes</th>
<th>Disposal/Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acme Solvent</td>
<td>-solvent wastes</td>
<td>-transported to city dump &amp; private pit</td>
</tr>
<tr>
<td>Rockford Hardware Manufacturing Co.</td>
<td>-cyanide</td>
<td>-destruction with HGH</td>
</tr>
<tr>
<td></td>
<td>-oils</td>
<td>-transported off site</td>
</tr>
<tr>
<td>Precision Casting</td>
<td>-oils, trichlorethylene</td>
<td>-oils transported _</td>
</tr>
<tr>
<td>Rockford Products</td>
<td>-chronic and nitric acid</td>
<td>-incinerated</td>
</tr>
<tr>
<td>A &amp; H Precision Products</td>
<td>-oils</td>
<td>-transported off site</td>
</tr>
<tr>
<td>Joseph Behr &amp; Sons</td>
<td>-acids</td>
<td>-diluted into SDR</td>
</tr>
<tr>
<td>Eagle Pencil</td>
<td>-oils and cyanide</td>
<td>-both reclaimed</td>
</tr>
<tr>
<td>Mattison Machine</td>
<td>-solvents</td>
<td>-transported off site</td>
</tr>
<tr>
<td>Smith Oil Co.</td>
<td>-residue of reclaimed oil</td>
<td>-incinerated</td>
</tr>
<tr>
<td>Valspar</td>
<td>-no response</td>
<td>-barreled</td>
</tr>
<tr>
<td>W.F. and John Barnes</td>
<td>-oil</td>
<td>-transported off site</td>
</tr>
<tr>
<td>Rockford Republic Furniture</td>
<td>-solvents</td>
<td>-transported</td>
</tr>
<tr>
<td>Special Machine Co.</td>
<td>-oils</td>
<td>-incinerated</td>
</tr>
<tr>
<td>Active Tool &amp; Die</td>
<td>-oils</td>
<td>-stored off site</td>
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<tr>
<td>Bouzine Plating</td>
<td>-cyanide</td>
<td>-chlorinated</td>
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<tr>
<td>J.L. Clark</td>
<td>-grit from metal blasting</td>
<td>-neutralized, SDR</td>
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<tr>
<td>General Electric Cabinet Plant</td>
<td>-solvents</td>
<td>-transported off site</td>
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<tr>
<td>Greenlee</td>
<td>-oils</td>
<td>-transported off site</td>
</tr>
<tr>
<td>Rockford Drop Forge</td>
<td>-oils</td>
<td>-transported off site</td>
</tr>
<tr>
<td>National Lock</td>
<td>-oils, cyanide</td>
<td>-transported off site</td>
</tr>
</tbody>
</table>


Table 4-5. Industrial Waste Disposal Methods, 1972

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Land disposal of solvents and chemical wastes became serious concerns in Winnebago County during the 1970s as well. Four serious cases of well contamination in rural areas have resulted in law suits and well closures. In addition, reckless operation of a waste treatment facility near Pecatonica has earned the site a Superfund designation. A review of the more severe cases that were curtailed between 1970 and 1980 follows.

**Acme Solvent**—In 1972 the Winnebago County Board of Health filed suit against Acme Solvent, the owners of a landfill in south Winnebago County, (Fig. 4-2) to clean up their property. Inspections conducted by the IEPA in 1972 found seven open pits, covering several acres, filled with liquid sludge from their solvent reclaiming process (IEPA, Site Files, Acme Solvent). In addition, approximately 15,000 barrels of unidentified liquid wastes were found on the site (Rockford Star, 17 July 1983). Acme had been using the site since the 1960s as a dump for their wastes, mainly xylene and toluene sludges. In 1981 several domestic water wells were found to be contaminated with chlor-organics, including tetrachloroethylene and dichlorethane—both animal carcinogens (IEPA, Correspondence, 18 August 1981). Although the well contamination came nearly a decade after the site was closed (1972), cleanup operations took years to complete and movement of contaminants to nearby wells was possible. However, State Water Survey personnel reported the general gradient for ground-water flow would be to the southwest and not to the northwest in the direction of the wells. This does not preclude contamination from this source however.

**Pierce Chemical**—Pierce Chemical is a manufacturer of organic chemicals with a production plant northwest of Rockford (Fig. 4-2) that has been in operation since the 1950s (Rockford Star, 17 June 1983). Neighbors of Pierce Chemical began complaining of unpleasant odors and water pollution of a branch of Kent Creek in the late 1960s. One resident of the area claimed chemicals seeped into his water well which tapped a shallow dolomite aquifer (Rockford Star, 6 December 1966). In 1983 Pierce Chemical paid to drill a new well for the complainant, although they refused to acknowledge guilt for phenol contamination of his well (IEPA, Inspection Report, 4 January 1983). Pierce Chemical claimed it stored no "priority pollutants" in the unlined lagoons on its site (Fehr, Graham and Associates, 1985), although they held priority pollutants in underground storage tanks on their site. When inspected in 1984,
engineers determined there were no large holes in the tanks, but to guard against continued leakage, they drained the tanks (IEPA, Site Inspection, 25 July 1984). Examination of a contaminated plume extending from the Pierce Chemical site showed benzene and toluene, but these contaminants did not appear in the dolomite aquifer, nor did they traverse the valley between Pierce and the contaminated well (IEPA, Correspondence, 17 May 1985). The source of the well contamination is still undetermined.

Tipton Farm—Between 1963 and 1972-5, Valspar Paint Company of Rockford barreled its liquid wastes (WCDPH, Waste Disposal Survey, 1972) and had them shipped to the Tipton farm in central Winnebago County (Rockford Register Star, 2 September 1981). Neighbors of the Tipton farm have filed suit claiming that wastes leaked from the barrels, percolated into the soil and contaminated their drinking wells. Valspar claims that their wastes contained none of the substances the complainants were exposed to—aluminum and arsenic (Illinois 17th Judicial Circuit Court, 1984). Two suits are still pending and the culpability of Valspar and the Tipton family have yet to be established legally.

People's Avenue—The city began use of a large sand and gravel quarry as a municipal landfill during the early 1940s. Owned by the city and operated by an independent contractor, the pit received a mixture of industrial, domestic, and commercial wastes until about 1972 (USEPA, 1976). Leachate from the landfill moved readily through the sand deposits and eventually contaminated four industrial wells, four residential wells, and a major municipal well. Foul tasting water prompted investigations as early as 1954, but no wells were closed until 1966. Contaminants included chlorides, iron, coliform bacteria, and other substances. Increases in the amount of these contaminants between 1957 and 1970 prompted the city to close its well No. 14 in 1970.

Hononegah Estates—The County Health Department, as part of a survey of domestic water quality, analyzed water from five homes in a northern Winnebago County suburb in 1983. The houses were part of the Hononegah Estates subdivision opened in the mid-1970s and all relied on individual wells for potable water supplies. Analysis showed surprisingly high concentrations of trichloroethylene (TCE), an industrial solvent. Further examination of the area by the State Water Survey, identified a plume of contaminant originating in the
vicinity of a local manufacturer and moving at roughly
the rate of one foot per day (Wehrmann, 1983). Wells
have been capped, although the residents could have been
drinking TCE-contaminated water anywhere from one to ten
years. Contamination of this sort underlines the need
for regular examination of water supplies even in areas
designated as low priority regions (Gibb, et al., 1983).

Frinks--The final site is north of Pecatonica in
western Winnebago County and the IEPA recently declared
it a "Superfund" site (Rockford Journal, 9 October 1985).
Situated across the Pecatonica River from the nearby
community, it is in an area where glacial till overlays
fractured dolomite. Since the early 1970s the owner of
the site has treated and stored hazardous substances.
Included among the industrial wastes Frinks handled were
solvents, oils, and acids, a typical array of Rockford
industrial wastes. Neighbors have complained of dolomite
well contamination, offensive odors, and haphazard
handling of dangerous materials. Storage methods used in
the past included lagooning, contrary to IEPA wishes, and
between 1972 and 1975, wastes oils containing heavy
metals were sprayed on country roads to control dust
(IEPA, Site File, 1980-85). Designation of this site as
a "Superfund" site is intended to expedite clean up
efforts (Hutton, 1985).

Other Sources of Contamination

Since 1977, municipal regulations in Rockford
require all gasoline station operators to excavate and
remove any abandoned underground storage tank. The
Rockford Fire Department keeps a record of all storage
facilities and monitors the proper closing of gasoline
stations. Before 1977 regulations only required owners
to fill abandoned tanks with sand. This type of
protection would not prevent leakage or explosions if
ruptured by earth-moving equipment (Redman, 1986). There
were at least 117 station closures between 1968 and 1978,
most falling between 1974 and 1977. Each station had at
least two tanks and possibly more. Consequently, there
were over 230 tanks buried under Rockford that escaped
the current regulations (Fig. 4-4). Each that remains
buried is a possible source of ground-water
contamination.
CHAPTER V -- SUMMARY ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

The documentation of industrial waste disposal in Winnebago County is far from complete, largely because records either do not exist or were not made available to the authors. In an attempt to produce a generalized depiction of areas subjected to land and water disposal, a series of maps were produced which combine the locations of documented disposal incidents with maps of industrial density. The purpose is to extrapolate geographically and delimit zones of probable and proven exposure to hazardous materials. Although speculative, the series of maps shown in this chapter are based on the available historical evidence and merely extend well-documented disposal practices into areas of known industrial activity. A fundamental assumption is that industries dumping wastes on the ground or in streams did so because it was the most convenient method of waste disposal, and it stands to reason that their manufacturing neighbors employed similar methods.

Summary Analysis

The final series of maps show only a forty-nine square mile area roughly centered on Rockford. Despite recent revelations of serious ground-water contamination beyond the urbanized areas of the county, this choice was made because 1) there were a greater number of documented incidents in Rockford, 2) both population density and water usage has been greatest in Rockford, and 3) industrial activity in the city has exceeded that in surrounding areas. Certain rural areas may have been subjected to equal amounts of industrial waste disposal, but the historical record did not reveal this.

The series of maps show industrial and hazardous waste activity in 1927, 1934, 1948, and 1980. They represent periods rather than exact dates due to limits of the historical record. The 1927 map depicts industrial activity in 1924 (Plat Map, 1924) and documented disposal activity in 1927 (SDR, 1927). The same industrial base was used for 1934, although waste disposal boundaries reflect more recent activity (SDR, 1934). Although there may have been some changes in the number of industries between 1924 and 1934, increases of the late twenties and the closures of the early 1930s were likely to have offset each other. The Alexander

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report (1948) supplied industries for the 1948 coverage and various reports from the SDR provided the limited information on documented disposal sites. Each of the pre-1950 maps depicts the location of hazardous waste-producing industries selected from inventories of all manufacturers. The 1980 map shows hazardous waste generators, according to the U.S. EPA designations. Lower industrial densities for 1980 may result from the source of information rather than any real changes in industrial distribution. Many small-volume hazardous waste producers would not be included in the U.S. EPA files, although they may have been tallied in earlier counts. Two changes that did occur in the period between 1948 and 1980 bolster the reliability of the lower 1980 densities however. Many firms moved out of the city to industrial parks on the city fringe, presumably reducing the density in older industrial districts, and consolidations could have reduced the number of companies without reducing the actual number of plants. Although use of the U.S. EPA source presents a very different method for selecting industries, it supplies a reliable listing of manufacturers actually generating hazardous wastes.

For each period, a twenty-five acre grid was overlaid on the map of industries for each period and grid cells were assigned shading to correspond to the number of industries within their boundaries. The resulting maps depict general areas of greater or lesser density of hazardous waste producing industries. Because the grid constitutes a series of arbitrary lines, the maps cannot delimit actual industrial land use, instead they are suggestive of general areas of industrial activity.

Documented disposal areas include sites of confirmed industrial waste disposal and also intervening territory. An attempt was made to select and map sites where significant spills or illegal land and water dumping occurred. Sources included public health and environmental protection agencies. Undoubtedly there are other sites that were not mapped, hence the choice to create general areas of industrial waste disposal. The areas link nearly contiguous sites to represent generalized areas of known direct land and water disposal. For 1927 and 1934 the disposal areas delimit zones of documented disposal for single years. The two more recent maps contain waste sites identified in the years preceding the industrial inventory.
A final map combines all the areas of documented waste disposal, and zones of high industrial density, and it proposes general ground-water flow patterns based on historical piezometric levels (Sasman, 1967).

1927 (Fig. 5-1)--Unrivaled as an authoritative source, the 1927 SDR report reconstructs the pattern of land dumping prior to the construction of the Sanitary District treatment works. Indiscriminate and uninhibited disposal of industrial wastes concentrated in three areas of the city. Along the lower stretches of both branches of Kent Creek manufacturers found a suitable natural sewer for their liquid wastes, and solid wastes were used as fill in the rail yards. An additional branch of this west bank concentration was the textile district located on Rock River just north of the mouth of Kent Creek. The wastes issuing from this district were largely liquid, but some solids could have accumulated in the pond above the dam. The second major area was the east bank furniture/machine-tool cluster, lining a two-mile stretch of the Rock River the industries there could have contributed to sediment accumulations above and below the dam, although it is unlikely that they produced large volumes of solid wastes. The final cluster is divided into two sub-sections that in effect form one area of concern. The belt-line railroad area of southeast Rockford constituted the largest zone of metal-working firms in 1927; it was an area at the margins of the municipal sewerage system and was farthest from a convenient natural sewer. Consequently it is not surprising that in an era when land disposal was considered less harmful than water disposal, manufacturers in these zones freely admitted to that practice. And of critical importance is the fact that domestic wells lined the down-gradient path of ground water moving under this area.

1934 (Fig. 5-2)--The 1934 survey by the Sanitary District of Rockford shows a small constriction in the size of the riverfront disposal areas, but the Water Power District remained without sewerage service for years. Other west bank manufacturers also continued to use the water courses as natural drains and avoided tying into the sanitary sewer system. The obvious concern of the 1934 report was to document those industries still dumping large quantities of putrescible wastes into the major streams of the city. Metal-working firms were considered insignificant (SDR, 1927) and they may not have been included in the 1934 inventory. This would account for the complete absence of documented land
Figure 5-1. Historical Hazardous Waste Activity, 1927. The dashed lines encircle areas where documented waste disposal occurred. It is possible that land disposal occurred in other areas with higher densities of industrial establishments. Sources: Waste disposal areas after SDR, 1927; industries from Plat Book, 1924.
Figure 5-2. Historical Hazardous Waste Activity, 1934. With the completion of the Sanitary District in 1932, fewer areas were without service and the areas with factories actively dumping in streams and on the ground diminished. Sources: Waste disposal areas after SDR, 1934; industries from Flat Book, 1924.
disposal in 1934. The other possible conclusion is that all the belt-line firms sought connections to the SDR, however given the widespread avoidance of the SDR by west-bank companies this is doubtful. It is quite likely that land disposal of solvents, oils, and acids continued throughout the belt-line industrial area during the 1930s, although there is no evidence to support or deny this.

1948 (Fig. 5-3)--The 1948 coverage indicates the Water Power District continued to discharge liquid wastes to the Rock River and a few other isolated incidents of water or land disposal occurred. The use of several large quarries as municipal dumps in the late 1940s provided off-site disposal facilities for industries. Three such pits were opened for public use in the 1940s and two have had deleterious effects on water supplies in their vicinity (see pp. 79 and 89). Although the new municipal dumps provided substantial space for industrial and domestic wastes, the feverish level of industrial production during the war years may have produced wastes that were disposed on-site yet went unrecorded.

1980 (Fig. 5-4)--Scattered incidents remained the main sources for industrial wastes in the years preceding 1980. The Water Power District finally installed connections to the SDR and most water disposal ceased during the 1960s. The low density of manufacturers in the belt-line area represents a trend that is contrary to the increasing number of small shops shown in the U.S. Census (Table 4-4). Both metal fabricators and machinery producers showed an increase in the number of establishments between 1970 and 1980, with a corresponding decrease in the number of employees. This indicates an increase in the number of small shops and mechanization of the larger shops. Small shops would not be included in the U.S. EPA hazardous waste generator file and collectively they could have been producing significant quantities of waste that did not receive proper disposal. Thus the entire belt-line area must be considered as a likely source area of ground-water contaminants.

A composite of the four maps identifies four major areas of concern (Fig. 5-5). The two most obvious are the zones between the Loves Park dump sites and the Rock River and also the zone riverward of the belt-line industrial area. Both have been subjected to long-term exposure to industrial contaminants and water supplies tapping aquifers beneath this zone should be monitored.
Figure 5-3. Historical Hazardous Waste Activity, 1948. The small areas of documented land and water disposal may reflect inadequate reporting rather than a reduction in pollution. Sources: Waste disposal activity, Rockford newspapers, 1947-48 and Sanitary Water Board records; industries from Alexander, 1948.
Figure 5-4. Historical Hazardous Waste Activity, 1980. Small and scattered land disposal sites reappear due to increased vigilance by public health authorities. Industrial densities appear to decrease due to out-migration of factories to suburban locations and also due to U.S. EPA reporting methods. Source: Hazardous waste activity, IEPA, site files; WCDPH, 1972; and Rockford newspapers, 1965-1980; industries from U.S. EPA, Generator File, 1980.
Figure 5-5. Rockford Hazardous Waste Activity, 1870-1980. This composite of Figures 5-1 -- 5-4 combines areas of high industrial density and known land or water disposal. Areas of probable ground-water contamination are based on ground-water flow patterns. Source of ground-water flow patterns: Sasman, 1967.
for contaminants. A third area of concern is the zone in sections 12 and 13 west of the Rock River. Numerous incidents of improper disposal of industrial wastes occurred there and public water supply contamination may have already resulted. A final area is the bed of the Rock River. Long a repository for a variety of industrial wastes, both from Rockford and upstream communities, the pool above the dam is a likely collecting place for a variety of contaminants, and downstream accumulations are also possible.

Conclusions

A previous report implies that hazardous wastes in Winnebago County are largely a post-1945 issue (Gibb, et al., 1983), but this is not the case. Both the type of wastes produced and the disposal methods used throughout the last century posed threats to the public in Winnebago County and may continue to do so.

Several industries that produced hazardous wastes appeared in Rockford before 1900 and continued operations well into the twentieth century. Included in this group were the "city" gas producers, metal platers, printers, and textile manufacturers. By the 1920s, metal finishing rose in importance in the Rockford economy and companies using one of several plating processes produced a host of toxic wastes. Oils and hydraulic fluids used in the machine tool trades also composed another hazardous waste stream. Solvents such as toluene and xylene were available during the 1920s and are likely sources of ground-water contamination. Finally, road oil and petroleum products that leaked from buried containers also could have tainted public water supplies.

Although the city installed a public water supply system in 1874, many sections of the city continued to rely on shallow drift wells that served individual homes or neighborhoods. Several subdivisions developed during the 1920s installed private water systems, while other areas of the city continued to draw potable water from backyard wells. As late as 1950, more than 2,000 households had no piped running water (U.S. Census, 1950)—suggesting they relied on well water. The shallow wells tapping water supplies in the sand and gravel aquifer were most susceptible to contamination.

Early disposal methods increased the possibility that Rockford residents have been exposed to industrial
wastes for much of the last century. Industries adjacent to area streams dumped most of their liquid wastes into the water courses before 1934. Even after that date, indirect stream discharges continued. While river water was not a primary drinking water supply, for a brief period in the 1880s it was the source for potable water. During the early 1900s the city pumped river water into the mains when fire-fighters required extra water and this surely introduced industrial pollutants into the local water system. Consumption of river fish also could have contributed to local exposure.

Industries not convenient to watercourses frequently turned to "land filtration" waste treatment techniques—that is they dumped liquid and solid wastes on the ground. The fragmentary record shows such practices were widespread and continued openly into the 1960s, since then there have been scattered incidents and it is likely unreported cases occurred. On-site disposal took place in the belt-line industrial district, along Kent Creek in west Rockford, and in the northern section of Rockford near the west bank of Rock River. Public wells drilled in the sand and gravel aquifers since 1945 have been contaminated and domestic wells in southeast Rockford also have declined in quality. This report does not establish a direct connection between the reported cases of land dumping and well contamination, but the evidence suggests that there is a relationship.

Additional sources of ground-water pollution were the numerous landfills in retired quarries where wastes were placed in direct contact with exposed ground water. Even before 1927 three old sand pits had been filled with municipal refuse, and foundry sand containing heavy metals was a likely part of the fill. During the 1940s several more quarries began to receive a mixture of municipal and industrial wastes; two have caused public well contamination. The existence of numerous other unlined landfills throughout the county pose additional hazards.

A final area of concern that became increasingly important during the last decade of the study period are the small metal-working shops. Many have worked with hazardous substances, oils, solvents, and hydraulic fluids, yet they have been the last to conform to on-site treatment regulations. Collectively they may compose one of the least recognized sources of hazardous materials in the county, and due to the high cost of proper disposal, some have resorted to improper disposal. Although
individually they may not pose a significant risk, as a group they represent a viable source of contaminants.

The specifics of Winnebago County's industrial waste disposal history are unique, but the general pattern is not. The general sequence of uninhibited dumping of wastes before 1945 was common in communities throughout the country. Rockford, like most other cities of its size, lagged behind metropolitan centers in its response to waste-related problems, but when local officials did take action, they looked to larger cities for engineering expertise. The array of wastes sanitation engineers had to deal with in Rockford was not considered unusual and no special waste treatment techniques were developed for Rockford's wastes. Thus, in the first half of the twentieth century, Rockford was considered an ordinary mid-sized industrial city and it was not the only city where industries casually disposed of wastes that later were to affect public water supplies.

While Winnebago County has experienced numerous incidents of ground-water contamination, the response by public health agencies has been commendable. Potentially hazardous problems have been identified in a timely fashion and action has been taken to mitigate ground-water contamination. Given the geology of the county and the industrial history, Winnebago County residents could have fared worse then they have.

Recommendations

Based on the historical evidence, and lack of it, several recommendations can be made.

1. Winnebago County industries should compile detailed histories of their waste disposal practices. These histories should include all manufacturing site addresses, dates of operation at former addresses, dates of installation of any pollution abatement or waste treatment equipment, dates of interruption of operation of this equipment, names of firms transporting waste and dates of affiliation with transporters, information on all on-site disposal of wastes. Industries should also report on the use of closed wells as sumps for unauthorized waste disposal. Such information should be supplied from the date of the creation of the company to
the present. Only with this type of information can a more complete and comprehensive analysis of public risk be made.

2. Detailed water quality examinations should be made of domestic, industrial, and public water supply wells in the areas shown in Figure 5-5. These areas were likely sites of contamination in the past, and contaminants may linger or continue to be present due to recent introduction to the environment. Movement of water in these zones would be affected by well pumpage, and this could deflect water into well draw-down zones.

3. Analysis of aquatic and biological life in the Rock River should be conducted to determine the long-term impacts of industrial dumping in the waterway. Examinations should be conducted both in the pool above the Rockford dam and downstream areas.

4. Outside the Rockford area, examination of domestic wells in the vicinity of the South Beloit and Rockton landfills should be made. Both could potentially contain industrial wastes in addition to municipal refuse. All areas with high reliance on shallow ground-water sources and areas experiencing recent residential development along the Rock River should be targeted for monitoring as well.

5. Historical analyses of past industrial waste disposal in other industrial centers in Illinois can assist with the identification of undetected ground-water problems. Prompt attention should be given to the East St. Louis region and the Peoria metropolitan area.
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<thead>
<tr>
<th>LOCATION</th>
<th>FORMATION INFLUENCED</th>
<th>NO. WELLS SAMPLED</th>
<th>COMMENTS</th>
<th>COMPOUNDS INVOLVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SE Rockford Approx. 11th and Harrison Avenue</td>
<td>Sand and Gravel</td>
<td>&gt;100 wells</td>
<td>Survey still in progress (June 12, 1984)</td>
<td>1,1 dichloroethylene, 1,1 Dichloroethylene, 1,1,1 Trichloroethylene Trichloroethylene trans 1,2 Dichloroethylene (&lt;50 ppb Total VOC's)</td>
</tr>
<tr>
<td>2. Steve's Standard Amoco Station 11th St. &amp; Sandy Hollow</td>
<td>Sand and Gravel</td>
<td>11 wells (monitoring wells)</td>
<td>(Feb. 10, 1985)</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td>3. Anderson Phillips 66 Charles &amp; Higcrest</td>
<td>Galena-Platteville Dolomite</td>
<td>1 well (possible others)</td>
<td>Survey still in progress (Feb. 25, 1985)</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td>4. Bulk Storage Terminals Cunningham &amp; Meridian</td>
<td>Galena-Platteville Dolomite</td>
<td>at least 2 wells (residential)</td>
<td>Survey still in progress (Feb. 12, 1985)</td>
<td>hydrocarbons-gasoline</td>
</tr>
<tr>
<td>5. Mobile Home Park Six Oaks W. State Rd. near Pecatonica Rd.</td>
<td>Galena-Platteville Dolomite</td>
<td>1 public well</td>
<td>Survey still in progress (Summer, 1985)</td>
<td>150-200 ppb VOC's</td>
</tr>
<tr>
<td>6. Pierce Chemical Co. Meridian Road north of Safford</td>
<td>Galena-Platteville Dolomite</td>
<td>at least one residential well</td>
<td>IEPA has info; Pierce (1982 or 1983)</td>
<td>base-neutral and/or acid extractables (250-400 ppb Total VOC's)</td>
</tr>
<tr>
<td>7. Rootton Watts Ave. &amp; Dingman</td>
<td>Sand and Gravel</td>
<td>28 wells (including 10 monitoring wells)</td>
<td>Boloit Corp. has about 10 monitoring wells; (Spring 1982)</td>
<td>1,1 trichloroethylene Trichloroethylene 1,1 Dichloroethylene 1,1 Dichloroethylene (traces to 1000 ppb)</td>
</tr>
<tr>
<td>8. Roscoe Hononegah-Moorehaven Subdivisions</td>
<td>Sand and Gravel</td>
<td>approx. 144 wells (incl. 5 temporary and 9 permanent monitoring wells)</td>
<td>(Jan-Feb. 1983)</td>
<td>Trichloroethylene trans 1,2 Dichloroethylene 1,1,1-Trichloroethylene Tetrachloroethylene (trace to 2000 ppb)</td>
</tr>
<tr>
<td>9. Ace Solvent/Pagel Pit Landfill Lindenwood Road</td>
<td>Drift above bdrk. &amp; Galena-Platteville Dolomite</td>
<td>approx. 30 monitoring wells, 5-6 residential wells</td>
<td>Superfund Site. (April, 1991)</td>
<td>Trans 1,2 dichloroethylene 1,1,1-Trichloroethylene (trace to 500 ppb)</td>
</tr>
<tr>
<td>10. Peoples Avenue Peoples Ave. &amp; Magnolia</td>
<td>Sand and Gravel</td>
<td>1 public well, at least two industrial wells, perhaps many private wells since abandoned</td>
<td>All wells now influenced are not in use. U.S. EPA now investigating with monitoring wells. (late 60s-early 70s) Very high traditional contaminants (e.g., chloride, spec. cond.) suspected non-traditional (VOC's)</td>
<td></td>
</tr>
<tr>
<td>LOCATION</td>
<td>FORMATION INFLUENCED</td>
<td>NO. WELLS SAMPLED</td>
<td>COMMENTS (Date 1st Identified)</td>
<td>COMPOUNDS INVOLVED</td>
</tr>
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</tr>
<tr>
<td>11. Sand Fork landfill</td>
<td>Sand and Gravel</td>
<td>Approx. 7 6 monitoring wells; perhaps influencing LF, FWS wells 1 &amp; 2</td>
<td>U.S. EPA has monitoring wells installed (May, 1971 suspected)</td>
<td>Acetone 2-butaneone</td>
</tr>
<tr>
<td>12. Frink's Industrial Waste - Pecatonica Rd.</td>
<td>Galena-Platteville</td>
<td>5-7 residential wells; 5 or 6 monitoring wells</td>
<td>(Summer 1982)</td>
<td>VOC's - solvents (traces to 1200 ppb)</td>
</tr>
<tr>
<td>13. Rockford Public Wells</td>
<td>7 and 7A 7A - 200' (Sand &amp; Gravel); 1st, 2nd Ave.</td>
<td>2 public wells probably some industrial wells</td>
<td>Closed - not in use (December 1981)</td>
<td>1,1,2 Trichloroethylene 1,1,1 Trichloroethane 1,1,2,2 Tetrachloroethylene (Total approx. 1200 ppb)</td>
</tr>
<tr>
<td>14. Loves Park Public Wells 1 and 2</td>
<td>both at about 200' in sand &amp; gravel</td>
<td>2 public wells possibly commercial wells also</td>
<td>Operate on demand; #1 very little use (#1 March 1982, #2 December 1981)</td>
<td>#1 about 100-200 ppb #2 about 15-20 ppb.</td>
</tr>
<tr>
<td>15. Rockford Public Well</td>
<td>8 and 28 Auburn and Camp Ave.</td>
<td>2 public wells probably some industrial wells also</td>
<td>Closed - not in use (February 1982)</td>
<td>1,1,2,2 Tetrachloroethylene 1,1,2 Trichloroethylene 1,1,1 Trichloroethane (Total approx. 500 ppb)</td>
</tr>
<tr>
<td>16. Tipton Landfill - Telegraph &amp; Bidie Rds.</td>
<td>Galena-Platteville Dolomite</td>
<td>5 monitoring wells and 1 or 2 residential wells</td>
<td>U.S. EPA Superfund Investigation-Contractor (March 26, 1959, suspected; Mid '70's, USEPA analysis)</td>
<td>Methylene chloride Tetrachloroethylene Phenol - EPA Analysis, mid '70's (approx. 300 ppb).</td>
</tr>
</tbody>
</table>


Appendix B. Synthetic Organic Chemical Groundwater Contamination in Winnebago County
Appendix C. Rockford Industries, 1948
Source: Alexander 1948.
ROCKFORD AREA INDUSTRIES, 1980

INDUSTRY TYPES (SIC)
☆ FOOD PRODUCTS (20)
# TEXTILES (22)
× FURNITURE (25)
□ CHEMICAL PRODUCTS (28)
■ PRIMARY METALS (33)
☒ FABRICATED METALS (34)
△ MACHINERY (35)

Appendix D. Rockford Industries, 1980