DOE/EIS-0007-D

DRAFT
ENVIRONMENTAL IMPACT STATEMENT

Low Btu Coal Gasification Facility and Industrial Park

Georgetown, Kentucky

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Washington, D.C. 20545

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SUMMARY

A. Introduction

This draft Environmental Impact Statement (EIS) evaluates the potential environmental impacts which may be associated with the construction and operation of a low-Btu coal gasification facility and the attendant industrial park in Georgetown, Scott County, Kentucky. A notice was placed in the Federal Register July 29, 1977 (42 FR 38628) announcing the preparation of this EIS and comments and suggestions were solicited. This statement evaluates potential site specific impacts which fall within the range of those potential impacts evaluated for the low-Btu coal gasification program in the draft Environmental Impact Statement, Coal Research Development and Demonstration Program (ERDA-1557-D), issued by the Energy Research and Development Administration (ERDA) in September 1977. As a result of the Department of Energy (DOE) Organization Act, ERDA was abolished October 1, 1977, and replaced by DOE who has the responsibility for this Program.

On March 30, 1976, ERDA issued a Program Opportunity Notice (PON) to stimulate interest in the integration and evaluation of low-Btu coal gasification technology in operational environments. Several plans were submitted in response to the PON including the one by Irvin Industrial Development, Inc. (IID) which is covered in this EIS.

Although the industrial park will not receive DOE funding and could proceed without the gasifier, impacts from construction and operation of the industrial park are evaluated in this EIS. Potential impacts were determined from expected construction activities and operations of the industrial park.

B. Description of the Proposed Action

Irvin Industrial Development, Inc., proposed to build a low-Btu coal gasifier in Georgetown, Kentucky. They plan also to develop an industrial park which would be fueled by the gasifier. A 174-acre plot of industrially zoned land south of Lemons Mill Road has been purchased. Construction of the gasifier would require 22-27 months. Construction of the industrial park would be complete in 7-10 years.

The gasification unit would contain two fixed-bed Wellman-Galusha gasifiers. Each would have an average feed-rate of approximately 1.5 tons of coal per hour and produce approximately 205,000 cu. ft. of gas per hour. The product gas would have a heat content of 150-165 Btu/cu. ft. One of the gasifiers would be used for production and one for experimentation to be converted over to production at a later date. Research and tests would be conducted by the Institute of Mining and Minerals Research, University of Kentucky.

The system design incorporates several pollution control devices. These include a dust collector, tar trap, spray tower, electrostatic precipitator, Peabody biological treatment system, and Holmes Stretford process. Approximately 80 percent (14.5 lbs/hr) of dust and ash would be removed by the dust cyclone. Approximately 12-15 gallons of condensible components (tars and oil)/ton of coal gasified would be removed. The Holmes Stretford unit would remove hydrogen sulfide (H_2S), ammonia (NH_3), and hydrogen cyanide (HCN). Thirty-eight pounds of sulfur, 6.6 lbs of salt, and 44.8 lbs of water would be generated per hour. IID has applied for and received a permit for disposing of the dust and ash in the Georgetown/Scott County landfill. However, no disposal method for the tars and sulfur has yet been determined. Possible methods include selling these wastes as raw materials for other industrial processes or disposing of them in secure landfills.

From information provided by IID, a scenario has been devised whereby the industrial park is tenanted by user-industries over a 7-10 year period. The user-industries would be a commercial heat treatment facility, a miniature light bulb manufacturer, a glass products manufacturer, a wood laminator, a ceramic tile manufacturer, a stamping and metal fabricator, and a porcelain products manufacturer. Total floor area requirements would be approximately 700,000 square feet. Total number of employees would range from 426-532. The product gas from the coal gasification unit would supply 410-540 billion Btu of energy per year to the user-industries.

C. Existing Environmental Setting

1. Physical and Biological Environment

Irvin Industrial Development, Inc. proposes to locate the gasifier and industrial park on a 174-acre site south of Lemons Mill Road in Georgetown. Although this acreage is currently under cultivation, it has been zoned industrial since 1973. There are two existing industrial facilities in the area and a Southern Railway line runs along the western edge of the site.

The entire Georgetown area is characterized by gently rolling upland, marked with numerous sinkholes and underlain by soluble limestone. Such geologic formations give rise to a complicated pattern of subterranean channels and caverns. Many springs are located in the area and one of them, Royal Spring, surfaces in downtown Georgetown and serves as the principal source of drinking water. Consequently, the movement of groundwater is an important aspect of this study. The exact feeder routes to Royal Spring are not known. A major conduit probably does not lie beneath the proposed park site, but most of the site certainly lies within the recharge zone.

The U.S. Department of Agriculture is currently inventorying the nation's land in an effort to identify those farmlands which are prime or unique. The Kentucky Soil Conservation Service has designated 144 (83%) of the 174 acres at the proposed site as prime farmland.

The major streams in the area are North Elkhorn Creek to the north and Cane Run to the south. North Elkhorn Creek is the larger and is approximately 68 miles long. It drains nearly 120 square miles of farmland. It has an average slope of 3.4 feet per mile and an average flow of 164 cubic feet per second. Cane Run joins North Elkhorn Creek four miles downstream from Georgetown. Its drainage basin is approximately ten square miles, and it is eleven miles long. Cane Run loses water to underground drainage in various reaches through its course. Both streams have been designated as being water quality limited. A water quality limited stream is defined as any stream "segment where it is known that water quality does not meet applicable water quality standards and/or it is not expected to meet applicable water quality standards even after the application of the effluent limitations required by Section 301 (b)(1) (A)...and 301 (b)(1)(B)... of Public Law 92-500" (Lykins and Smith, 1976).

The Environmental Protection Agency has established ambient air quality concentration limits for priority classes. Regions of the country have been given priority classifications ranging from I to III, I representing the greatest pollution and III representing the least. The proposed site lies within the Blue Grass Air Quality Control Region. This region has been classified as Priority II for particulates and Priority III for sulfur oxides, carbon monoxide, nitrogen oxides and photochemical oxidants (hydrocarbons). There are no identified nonattainment or noncompliance areas within the Blue Grass Air Quality Control Region.

The proposed site is currently under cultivation. Ecologically significant areas of the site include the woodlots and fencerows and pasture-hayfields. Of the total 173.6 acres, corn cultivation accounts for 76.4 acres (44 percent); pasture-hayfield, 50.3 acres (29 percent); fencerows, 24.3 acres (14 percent); woodlots 8.7 acres (5 percent); a farmstead, 5.2 acres (3 percent); roads, 5.2 acres (3 percent); and burley tobacco, 3.5 acres (2 percent).

Many species of birds may be found at the proposed site. These include robin, starling, grackle, redwing blackbird, cardinal, song sparrow, brown-headed cowbird, common yellowthroat, prairie warbler, eastern meadowlark, and house sparrow. Gamebirds found at the site include quail and mourning dove. Mammals which have been seen at the site are oppossum, raccoon, striped skunk, red fox, cottontail rabbit, gray squirrel, fox squirrel, woodchuck, white-footed mouse, and meadow vole.

Thirty-six species of fish have been found in North Elkhorn Creek. Largemouth bass, smallmouth bass, black crappie, and white crappie were the major sport fish collected. These species account for approximately 3 percent of the fish population. Pan fish (primarily rock bass), suckers, carp, and catfish account for approximately 30 percent of the fish population while minnows, darters, and sculpins account for 67 percent of the total population.

Information on benthic macroinvertebrates for North Elkhorn Creek are sparse. Twelve major groups of organisms have been reported; the most abundant were caddisflies, worms, and midges.

No rare and endangered species are known to inhabit the industrial park site. However, the turkey vulture which is classified as threatened by the National Audubon Society has been observed on the site which is included within the feeding range of the turkey vulture.

2. Socioeconomic Environment

Scott County is one of the most rapidly growing areas in Kentucky, showing a population increase of 16.7 percent between 1960 and 1970. In 1975, the population was 18,654. Georgetown showed an increase of 23.5 percent over the same time period and in 1975 had a population of 8892. Both Scott County and Kentucky have shown a steady increase in the percentage of urban-based population and a corresponding decrease in rural-based population.

Scott County has shown a steady increase in per capita income, which was $4,502 in 1974. In 1969, the median family income for Scott County and Georgetown was $7,568 and $8,193, respectively. The annexation of the proposed park site into the city of Georgetown in January, 1978 will subject industrial park facilities which would inhabit the site to Georgetown city taxes.

Scott County ranks low in terms of unemployment. In 1976, 3.0 percent of the population was unemployed. Fifty-two percent of the work force works in Scott County while 30 percent works outside the county. Eighteen percent of the work force did not report county of employment.

Georgetown is the locus of all manufacturing activities in Scott County. There are 26 light industries in the county that manufacture products such as pens, tools, electrical wire, dog food, pool covers, and fertilizer. Agricultural activities are extensive. Major crops are hay, tobacco, and wheat. Livestock production plays a large role and is concentrated in horses and cattle.

The Georgetown/Scott County area is served by vocational-technical schools, colleges and universities. Georgetown College, offering masters degree programs, is located in the city. The public schools were recently absorbed into the Scott County school system. With the exception of two grade schools, all have excess capacity ranging from 50-500 spaces. In 1970, the median number of school years completed by Scott County residents was 10.7.

There is one hospital in Georgetown, John Graves Ford Hospital, with a 40-bed capacity. Georgetown's physician/population ratio of 1:900 far exceeds the Federal minimum standard of 1:3500. Georgetown and Scott County have police protection services employing 26 individuals. Both areas are served by volunteer fire departments with a combined force of 40.

There is a strong need for additional housing in the Georgetown area. There is currently a very low vacancy rate. It has been estimated that 145 additional housing units would be needed in Georgetown in 1980 and 306 in 1990.

The road system in Scott County varies in quality. Interstate 64 runs north-south and skirts the eastern edge of Georgetown. U.S. highways and state roads transect the area. The only access to the proposed park site is Lemons Mill Road, a narrow, winding 2-lane county road. However, a 4-lane access road has been planned if the industrial park is constructed.

Two rail lines run through Scott County, intersecting in Georgetown. These are the Frankfort and Cincinnati line and Southern Railway. The latter is located adjacent to the proposed park site. The only airfield in Scott County is Marshall Field, located one mile south of Georgetown. Blue Grass Field outside of Lexington is the nearest airport offering commercial passenger service.

There are several historical sites in Scott County. Two of these, the Aulick House and the James Thorn House, are located near the proposed park site.

D. Environmental Impacts of the Proposed Action

Impacts were examined on two levels, those resulting from construction and those resulting from operation. Impacts from both the gasifier and the industrial park were identified in relation to the physical, biological and socioeconomic environments.

1. Construction

Grading and site preparation would result in disruption and displacement of soils over most of the 173.6 acres. Exposed soils would be subject to erosion during periods of rainfall. The extent of erosion would depend upon the number and intensity of rainfall events and erosion control and conservation practices used during construction. Application of the universal soil loss equation shows a total soil loss of 1440 tons during the 7- to 10-year construction period. Soil losses per industrial lot would range from 37 to 170 tons. An estimated 53 tons would be lost from the gasifier site.

Based upon the topography of the site, surface runoff would move to North Elkhorn Creek, Cane Run, or a small pond to the west. Potential pollutants released from the site would include sediments, organic matter, and oil and grease. It was estimated that if all eroded sediment entered North Elkhorn Creek during low flow conditions, i.e., 50 cubic feet per second (cfs), the sediment load carried by North Elkhorn would increase by 0.6 mg/l. This represents a five percent increase over the average total suspended solids concentration of 11.0 mg/l. The sediment load of Cane Run would increase by a maximum of 3.2 mg/l during flows of 10 cfs if all eroded sediment entered its waters. Increases in turbidity would be temporary and related to major rainfall events. The overall quality of water in both streams is expected to be unchanged.

Similar calculations, assuming that 30 percent of runoff would enter Royal Spring, show that there would be a large increase in suspended sediment (up to 50 mg/l) during periods of low flow (0.5 mgd). If such were the case, Royal Spring would be in violation of water quality standards for total suspended solids.

Changes in ambient air quality would occur as a result of transporting construction materials to the site and movement of heavy equipment on the site during construction. The major emissions would include fugitive dust and vehicle exhaust. Gaseous emissions would be primarily carbon monoxide, hydrocarbons, and nitrogen oxide. Emissions from vehicles transporting materials over the 7- to 10-year construction period would be 20-30 tons of carbon monoxide, 3.3-4.3 tons of hydrocarbons, and 33-43 tons of nitrogen oxides. These emissions would occur on the highways and not at the site itself. Total emissions from vehicles working on the site during the 7- to 10-year period would be 15-22 tons of carbon monoxide, 5.5-8.2 tons of hydrocarbons and 105-150 tons of nitrogen oxides.

It has been estimated that a maximum construction ambient noise level would be 70 dB(A). This represents a maximum increase of 7 dB(A) over current ambient noise levels. The Occupational Safety and Health Administration (OSHA) standards of noise exposure in the work place would not be violated.

Solid waste generated during construction would consist of cleared vegetation and construction rubble. Cleared vegetation would be incinerated and would consist of trees and residual crop growth such as cornstalks. Construction rubble would consist of wrapping paper, nuts and bolts, boxes and cans, and broken and leftover materials, etc. Approximately 235 tons of refuse would be generated during the 7- to 10-year construction period.

Impacts to the terrestrial ecosystem would be removal of vegetation and subsequent loss of wildlife food, cover, and habitat. Loss of habitat would force some 1700 small mammals and 1100 songbirds and gamebirds to migrate. Migrants would face increased competition for space, food, and other life requirements. The animals would be more susceptible to predation, disease, and adverse weather conditions. The site is currently under cultivation. It has been estimated that annual production losses would include 4880 bushels of corn, 95 tons of hay, and 3.6 tons of burley tobacco.

Impacts to the aquatic environment would be minor and temporary. The amount of sediment which would enter surface waters would not alter the number or kind of organisms currently inhabiting the streams nor would there be a loss in macroinvertebrates which serve as food sources for fish.

There are no known endangered or threatened species known to inhabit the proposed park site. However, the area does serve as a portion of the feeding range of the turkey vulture (listed as threatened by the Audubon Society) and its removal would have a minor impact on the turkey vulture.

2. Operation

Effects on soils during operation would depend upon whether outdoor storage of process materials is permitted. Effects on surface waters during operation would be slight. Runoff from the industrial park would contain pollutants such as suspended and organic and inorganic solids, nutrients, and oxygen-demanding materials. Runoff would be diverted to storm sewers and discharged into North Elkhorn Creek. The quantity of pollutants actually entering the waterway would depend upon the frequency and duration of rainfall events and the availability of materials to be flushed.

Liquid discharges from user-industries would be treated so as to comply with State and Federal regulations. Federal statutes require the installation of best practicable control technology. Effluent concentrations which would be achieved by this technology as designated for each industry would be well within State and Federal water quality standards.

Air emissions from the coal gasification plant would result from flaring which would occur three times per year. Particulate emissions would be 0.09 tons/year; NO_x, 0.1 tons/year; and SO_x, 0.2 tons/year. Assuming a 90 percent removal efficiency, gaseous emissions from user-industries would amount to 2467 lbs/day of particulates, 2573 lbs/day fluoride, 0.68 lbs/day carbon monoxide, 0.34 lbs/day hydrocarbons, 2.56 lbs/day nitrogen oxides, 50.4 lbs/day condensibles and 29.4 lbs/day volatiles.

The coal preparation facility would be the major noise source. The crushing and screening operations at the coal preparation facility would create noise levels of 62 dBA at 1000 feet. Noise levels at the nearest noise sensitive area (2000 ft away) would be 53 dBA. Trains bringing coal to the gasifier site twice a month would emit a sound level of 72 dBA at 50 feet during unloading. The gasification plant itself and other industries in the park would be enclosed. Outdoor noise levels from these sources would be negligible.

Solid wastes from the coal gasification plant would include dust and ashes, sulfur, and tars and oils. Approximately 2600 lbs of ash and dust would be generated each day. A permit has been granted to dispose of the ash in the Scott County landfill. The sulfur cake from the Holmes Stretford process, consisting of 50 percent water and 50 percent sulfur, may be landfilled or sold. Tars would represent those substances most hazardous to human health because several constituents may be carcinogenic. Tars would be containerized and any spills would be diked. Ultimate disposition of the tars and sulfur cake has not been determined. Facilities inhabiting the industrial park would generate solid wastes from raw material surplus, nonspecification products and sludge and oil from treatment of wastewaters. Approximately 5.3 tons of solid waste would be produced daily.

Release of the contents of the coal pile drainage retention pond or the entire volume of untreated wastewaters from the user-industries into North Elkhorn Creek or Royal Spring would result in excessive levels of iron and manganese. The effects of these constituents would be aesthetic. Both impart an objectionable taste to water and stain laundry and plumbing fixtures. Rupture of the gasification system would result in violation of all pertinent water quality standards in both water bodies. Neither could serve as a source of drinking water and extreme disruption to the ecosystems would result.

The major impact to the terrestrial ecosystem would have occurred during the construction phase. However, air emissions would have a minor effect on vegetation. Projected NO_x levels of 0.49 $\mu g/m^3$ within 50 meters of the roadway during peak traffic would cause reduced growth and leaf lesions on vegetation within that distance.

Potential impacts to the aquatic ecosystem would be directly related to water quality. Normal operation of the facilities and discharge of treated wastewaters would have no impact on the aquatic environment. In the event of an accidental spill of untreated wastewater including coal pile runoff, the impacts to the aquatic ecosystem would depend on concentration and kinds of wastewater pollutants, diluting capabilities of the receiving water body, and duration of the spill.

The major demographic impact from the proposed action would be on population size. The number of newly created primary and secondary jobs would range from 905 to 1855. Judging from current commuting patterns, approximately 1000 new jobs would be taken by Scott County residents. As of April 1977 the Scott County labor market had a total of 4056 unemployed persons. Assuming 10 percent are unemployable, the projected available labor supply totals approximately 3600 persons. This is adequate to meet labor needs.

A maximum of 150 persons would migrate into Scott County. Assuming each is a head of household and an average family size of 3.37 persons, a certain increase of 506 persons would result. This constitutes a 2.7 percent increase in the Scott County population.

The additional wage which would accrue to the community would be $17,000,000 annually. A positive impact on the local tax base would result from this increase. Approximately 170 school-age children would enter the population. The Scott Country school system presently has an excess capacity of 950 spaces. Consequently, the school system would be able to adequately accommodate the projected growth in pupils. There would likely be no adverse impact on local libraries or institutions of higher education.

There would be adverse impacts on the local fire department and housing situation. The fire department is staffed with a total of 40 volunteers. This force would not be adequate for the projected population increases. Housing is currently in short supply with less than a one percent vacancy rate in Georgetown. Any increase in local population would result in a serious housing shortage.

The water demand of the industrial park (1.1 mgd) could not be met with existing water supplies if Royal Spring were at low flow (0.5 mgd). In order to meet daily demands the flow would have to continue at approximately 3.5 mgd. However, if the Kentucky Water Co. can supply the daily needs of the park and gasifier, there would be no impact to the water treatment system of Georgetown. If industrial wastewaters were discharged to the municipal treatment system instead of surface waters, its actual treatment capacity of 2.0 mgd would be exceeded by 200,000 gpd.

The road system servicing the proposed site is comprised mainly of two-lane, wandering country roads. Lemons Mill Road which accesses the site itself is particularly narrow and winding. It is unlikely that these roads could support the additional traffic without being improved and widened. However, if the park is built the county would construct a 4-lane access road which would take the traffic burden off Lemons Mill Road.

The two historical buildings near the proposed site are Aulick House directly across from the site on Lemons Mill Road and the James Thorn House located on the parcel of land adjacent to the proposed site. Neither structure is listed in the National Register. These properties would become less desirable as private residences or for restoration due to their proximity to an industrial park.

E. Mitigation of Potential Adverse Effects of Project Implementation

1. Construction

Air emissions from vehicles would be reduced as much as possible by control devices to comply with Emission Standards for Moving Sources (42 USC 1857). Also, the Environmental Protection Agency has the authority to prescribe standards for any new vehicle which might appear.

Erosion control structures such as dams, site basins, hay bales, and mulches would be employed. Revegetation of exposed areas would begin as soon as possible. Oils and waste products would be isolated and excluded from the runoff.

2. Operation

a. Air

Impacts from air emissions would be mitigated by adherence to Federal and State regulations. The most pertinent are Kentucky law KRS Chapter 224 and the Clean Air Act Amendments of 1974 and 1977.

Air emissions would result from fugitive dust generated during coal handling and storage. To reduce these emissions the coal storage pile and conveyors would be covered, and coal crushing would be carried out in an enclosed area equipped with sub-ambient pressure controls and bag filters.

Several pollution control devices would be incorporated into the gasification process. Eighty percent of the dust and ash would be removed by the dust collector and scrubbing tower. Condensible components would be removed by reducing the temperature at various stages. Tars and oils would then be skimmed off. An electrostatic precipitator would remove any remaining dust, soot, tar, or oil. The Holmes Stretford unit would remove 98 percent of the sulfur.

The two facilities engaged in the manufacture of glass products would emit air pollutants (fluorides and particulates) from glass melting operations. These air emissions would be mitigated by installation of baghouse control devices. Ammonia emissions from the light bulb manufacturer would be eliminated by steam strippers.

Air emissions from the two clay products industries would result from grinding of raw material and from furnace exhausts and vents. Emissions would be mostly particulates and fluorides. The emission of fluorides would be reduced by operating the kilns at temperatures below 2000°F and by choosing clays of low fluoride content. Particulates and fluorides would be reduced by installation of wet cyclone scrubbers.

The primary source of air pollution from the metal heat treatment process would be oven exhaust gases. Stack gas scrubbers would be used to lessen this exhaust. The metal stamping process would contribute to the air pollution problem from fuming of plating baths. This would primarily constitute a worker safety hazard. The hazard would be mitigated by providing good ventilation in work areas.

Air emissions resulting from the wood laminator would come from resin drying and sanding operations. Impacts from condensibles (resins and wood sugars) and volatiles (terpenes and methane) would be partially mitigated by a scrubber. Particulate emissions would be negligible if baghouses were installed.

b. Water

The Federal Water Pollution Control Act as amended in 1972 (P.L. 92-500) and 1977 (P.L. 95-217) empowers the Environmental Protection Agency to regulate wastewater discharges from industrial facilities. Regulations specifying levels of treatment which must be achieved by industrial dischargers have been promulgated and technology capable of achieving these levels has been identified by the Environmental Protection Agency. It is assumed that the user-industries would install the specified technology.

Runoff from the coal storage pile would be collected and routed to a retention pond. Waste streams from the tar trap and spray tower would be biologically treated by a Peabody system and then released to the municipal system. Cooling water blowdown would be directed immediately to the municipal treatment system.

Wastewater from the glass container facility would result from cullet quenching and noncontact cooling water. In-plant control measures would do much to mitigate impacts from wastewater discharge. These measures would include spray collection of forming machine shop oil, good housekeeping, shear spray recycle, collection of oily runoff, and use of nonliquid cleaners.

The volume of water discharged would be reduced by segregating the cullet quench water from the cooling water. Noncontact water would be discharged untreated. The cullet quench water would pass through a gravity oil separator and recycle back to the process. Blowdown from the separator would be directed to a dissolved air flotation system and then to a diatomaceous earth filter.

Impacts from cullet quench water from the light bulb manufacturer would be mitigated in the same way as in the glass container facility. Acid solutions from etching light bulbs would be the greatest problem at this facility. The waste stream would first undergo precipitation, flocculation and sedimentation. This treatment would remove fluorides and suspended solids. To remove ammonia, the waste stream would undergo recarbonization and stream stripping. Further reduction of fluorides and suspended solids would occur as the wastewater is passed through the final steps of sand and activated alumina filtration.

Wastewater associated with the ceramic tile manufacturer would result from mixing of batches and glazes, cooling, clean-up, dust control, and boiler feed. Volumes discharged would be small, and the major constituent would be suspended solids. Effects of these wastewaters would be largely eliminated by evaporation/settling ponds. If sufficient reduction of suspended solids is not realized through these practices alone, chemical flocculants would be added to further reduce the suspended solids content.

Process water in porcelain products manufacture would be used for slip preparation, clean-up, glaze spray booth dust control, cooling, and boiler feed. To achieve permissible discharge limits only rudimentary control practices would have to be instituted. These would include a sump, clarifier, settling tank, and perhaps a sand bed filter.

Wastewaters from the metal heat treatment plant and the metal fabricator would be similar and treated in the same manner. They would be segregated into two streams. One stream would contain emulsified oils that would be broken by sulfuric acid and steam. The freed oil would rise to the surface and be removed by a skimmer. The second segregated stream would contain free oils and be treated directly by the skimmer. These two waste streams would be combined and fed into an equalization tank. From the equalization tank, the combined waste stream would undergo precipitation, coagulation, and clarification or filtration. These mitigating measures would be sufficient to remove 60-98 percent of the dilute oils, suspended solids, metals, fluorides, and phosphates.

Impacts from wastewaters which would be discharged from the wood laminator would be entirely mitigated because no discharge of pollutants would be achieved. This would be the case whether a wet or a dry process system became operational. In the dry process, no discharge would be achieved by recycling log wash water and using the solids as boiler feed; closing the resin system by using the wash water as make-up in the resin solution; eliminating discharge from humidification by careful in-plant controls; and neutralization of caul water and disposal by impoundment or spray irrigation.

In the wet process, no discharge of pollutants would be achieved by recycling process water as fiber dilution water after treatment by heat exchangers to reduce the temperature, gravity settling, screening, and filtration.

c. Solid Wastes

The largest volume of solid wastes created by the gasifier and industrial park would be sludges from treatment of wastewaters. The impacts existing from these substances would be mitigated by enforcing regulations enacted by the State of Kentucky in 1976 (KRS Chapter 224 and 401 KAR 2:010). These regulations cover the construction and operation of landfills and licensing of haulers. Provisions have been made for the operation of landfills to handle hazardous wastes. Also, Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA) empowers the Environmental Protection Agency to issue regulations controlling the disposal of solid wastes.

Solid wastes from the coal gasifier would be char and ash from the dust collector, oils and tars from the tar trap, spray tower and the electrostatic precipitator, and the sulfur cake and system purges from the Holmes Stretford process. The char and ash would be inert because of the high temperatures at which pyrolysis takes place. It would be acceptable material for landfilling, and a permit has been issued by the Kentucky Department of Natural Resources and Environmental Protection for disposal in the Scott County landfill. To keep the ash from becoming airborne during transit, it would be covered and the moisture content increased.

Disposal of oils and tars would present a greater problem. However, except in the case of a major spill resulting in the release of these materials, the health of the general public would not be jeopardized. The greatest hazard would be to workers at the gasifier and those involved in handling of the tar. The chance of inhalation or dermal contact has been greatly minimized by the elimination of poke holes for temperature depth readings. The Holmes Stretford process would generate approximately 645 tons of sulfur cake per year. No permit has been issued for disposal of the tars and oils or the sulfur cake.

d. Socioeconomic Environment

Adverse effects to the socioeconomic environment include lack of an adequate fire department, housing shortage, and insufficient water supply and water and wastewater treatment facilities. The fire department would have to be upgraded from volunteer to full-time and new equipment purchased. New housing units would have to be constructed. The problems associated with water supply and water treatment plant capabilities would be eliminated if IID bought water from Kentucky-American Water Company which gets its water from the Kentucky River instead of local resources. The impacts to the wastewater treatment facility would be eliminated if the user-industries operate under an NPDES (National Pollution Discharge Elimination System) permit and discharge their treated wastewaters to surface waters (North Elkhorn Creek) instead of the municipal system. This plan would cause an increase of approximately 10 percent of the daily flow of North Elkhorn Creek.

F. Unavoidable Adverse Effects

1. Construction

During the construction phase, unavoidable adverse effects would include soil disruption and displacement and slight increases in the suspended sediment load of North Elkhorn Creek, Cane Run and Royal Spring. During low flow, water quality standards would be exceeded by Royal Spring during low flow.

Air emissions from vehicle and heavy equipment exhausts and fugitive dust could not be eliminated. There would be increases in ambient noise levels, but these would not exceed OSHA work place standards. Also, 235 tons of construction refuse would be generated.

Agricultural productions from the proposed site would be lost, and wildlife inhabiting the area would be forced to relocate. A very small portion of the feeding range of the turkey vulture would be removed.

2. Operation

Operation of the gasifier and the user-industries would result in some adverse effects. Unavoidable adverse effects to surface or groundwater during normal operation would be minor. A slight loss of recharge volume to Royal Spring and increase in runoff volume to North Elkhorn Creek would result from paved areas.

Although air pollution control equipment would be installed, there would be some air emissions. These emissions would be composed of SO_x, NO_x, carbon monoxide, hydrocarbons, condensibles and volatiles. Air emissions would have a minor effect on roadside vegetation causing reduced growth and leaf lesions. There would be a minor increase in ambient sound levels. There would be potentially significant adverse effects from the tars and oils generated if no means of disposal is found.

G. Alternatives to the Proposed Action and the Tradeoff Analysis

Reasonably available alternatives which have been identified are no action, implementing the proposed action at another site in the Georgetown area, implementing the proposed action nearer the source of coal, constructing only the gasifier in an existing industrial park, and developing only the industrial park in the Georgetown area.

The no action alternative means that neither the gasifier nor industrial park would be built. All potential environmental impacts would be eliminated. If this alternative were implemented, the greatest impacts would be to the developer and the Department of Energy.

Construction of the gasifier and industrial park in the area north of Lemons Mill Road and on either side of Interstate 75 would result in elimination of impacts to the aquifer and prime farmlands. However, impacts to North Elkhorn Creek and Little Eagle Creek would be greatly increased.

Construction of the gasifier and the industrial park in an area nearer the source of coal would eliminate having to transport the coal over such a long distance. Proper siting would greatly reduce impacts to surface waters, groundwater, and prime farmland.

If the gasifier were built in an existing industrial park, many of the impacts would be eliminated or greatly decreased in magnitude because the effort would be on a much smaller scale. However, it would be necessary to retrofit existing manufacturers to burn low-Btu gas.

The final alternative of construction of only the industrial park would probably be implemented if the gasifier facility is not approved. The acreage under consideration has been zoned industrial since 1973 and was purchased by Industrial Development, Inc. for that use. Impacts would not change if the industrial occupants remain the same type. However, IID estimates that the nature of the industries would become more employee intensive. If this were the case, socioeconomic impacts would be heightened.

H. Short-Term and Long-Term Effects

Implementation of the proposed action would remove 144 acres of prime farmland, as designated by the Soil Conservation Service, from agricultural purposes. This would be a long-term effect and last at least for the lifetime of the park (50 years). That landfill taken by the solid wastes could not be used for other purposes.

More than 1,000,000 gallons of water would be required by the park daily. This volume of water would not be available for agricultural, industrial, commercial, or residential uses for the lifetime of the park. However, most of this water would not be consumed by the industrial processes and would be returned to the hydrosphere. Consequently, its use by the industrial park represents only a short-term effect to the natural environment in the question of water availability.

Some degradation of surface and groundwater quality would occur. This degradation would continue over the lifetime of the park. Even if all discharges were to cease, that mass of pollutants already emitted would still be in the system. The period of time required for the hydrosphere to return to its pristine condition is unknown. This represents a long-term effect.

Some degradation of air quality would occur. Some damage to plants is certain. However, of the possible compounds that would be emitted, only carbon monoxide would remain in the atmosphere for a long period of time. Return of other constituents to the earth's surface through precipitation precludes any long-term effects.

Conversion of the site to an industrial setting would foreclose the use of this acreage by wildlife species currently inhabiting the area. Adverse effects to the species forced to relocate would be short-term.

None of the anticipated effects to the socioeconomic environment would be long-term or irreparable. The population would increase with or without the proposed action, and inadequate social services would have to be upgraded anyway. Any loss in social ambience would be short-term and would drop off after an initial period of stabilization and integration of the newcomers into the community.

I. Irreversible and Irretrievable Commitment of Resources

Construction materials which would be committed to the facility include concrete, electrical wire, glass, asphalt paving, rubber and mastic caulking, light fixtures, paint, plumbing supplies, etc.

The major nonrenewable resource which would be consumed is coal. Annual consumption by the gasifiers would be 26,280 tons of coal, 0.0005 percent of the total national recoverable reserve. Also, raw materials required by each manufacturing process would be consumed.

Construction of the gasifier and industrial park would require 35 persons working 7 to 10 years. The total number of employees required for the operation of the park would be between 426 and 532. If the lifetime of the park is 50 years, this amounts to 22,000 to 27,300 man-years expended.

One hundred forty-four acres on the site have been declared prime farmland. Construction of the gasifier and the park would remove this acreage from agricultural uses. Approximate annual crop and forage production losses from the site would be 4880 bushels of corn, 95 tons of hay, and 3.6 tons of burley tobacco. This would amount to 244,000 bushels of corn, 4800 tons of hay, and 180 tons of burley tobacco over the lifetime of the industrial park (50 years).

I. References

Lykins, B. W. and J. M. Smith, 1976, Interim Report on the Impact of Public Law 92-500 on Municipal Pollution Control Technology: Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA 600 2-76-018.

CHAPTER I

PURPOSE AND STRUCTURE

A. Purpose

This Draft Environmental Impact Statement (DEIS) is in response to the requirements of the National Environmental Policy Act (NEPA) of 1969 and in accordance with the guidance and requirements of "Guidelines for Environmental Review," U.S. Department of Energy (DOE). It addresses the potential environmental consequences of the installation of a low-Btu gasification system and the attendant development of an industrial park in Georgetown, Scott County, Kentucky.

The goals of this document are to:

a. Provide for agency and other decision-makers and the public a full and objective disclosure of the potential environmental effects of the proposed action;

b. Evaluate the implications of the action to man and his physical and social surroundings; and

c. Explore, develop, and describe alternative actions that may avoid, minimize, or compensate for adverse environmental impacts caused by the proposed action.

The proposed action, i.e., the installation of a low-Btu gasifier system, is analyzed as a separate entity. This is a joint Federal, State, and industry action. The consequent and attendant development of an industrial park, an industry action, is also analyzed, on the basis of its likely eventual composition and structure, to determine the cumulative effects of the proposed action.

B. Organization

Chapter II--Description of the Proposed Action.

A brief discussion of the DOE low-Btu gasification program, the technical details of the proposed gasifier, and the development of the industrial park are presented.

Chapter III--Existing Environmental Setting.

This chapter describes the physical, biological, and socioeconomic environments in the vicinity of the proposed action.

Chapter IV--Land Use Relationships.

Land use plans, policies, and regulations, as applicable to the proposed action, are reviewed.

Chapter V--Potential Environmental Impacts of the Proposed Action.

This chapter presents potential physical, ecological, and socioeconomic impacts of the construction and operation of the proposed gasifier system and the industrial park.

Chapter VI--Mitigating Measures.

In consideration of the impacts described in Chapter V, means, both technological and social, are discussed that would reduce or eliminate significant impacts.

Chapter VII--Unavoidable Adverse Effects.

This chapter itemizes those adverse effects that are seen to be probable in spite of efforts to ameliorate them.

Chapter VIII--Alternatives to the Proposed Action.

Reasonably available alternatives such as no action, the development of the industrial park without the gasifier and relocation of the proposed action are addressed.

Chapter IX--Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity.

This chapter provides a comparison of the short-term and long-term benefits and detriments which would occur as a result of the proposed action.

Chapter X--Irreversible and Irretrievable Commitments of Resources That Would Occur as a Result of the Proposed Action.

This chapter identifies and quantifies those resources, i.e., manpower, materials, land, and fuel, which would be lost and those options which would be foreclosed as a result of the proposed action.

Chapter XI--Environmental Trade-Off Analysis.

This chapter contains an analysis of the trade-offs associated with the proposed action and the reasonably available alternatives discussed in Chapter VIII.

Chapter XII--Consultation and Coordination With Others.

This chapter identifies parties involved or consulted in the preparation of this document.

CHAPTER II
DESCRIPTION OF THE PROPOSED ACTION

A. Purpose

This chapter provides background information concerning the development of low-Btu coal gasification as a subject of interest to the United States Department of Energy (DOE). In particular it traces the proposed development of a low-Btu coal gasification facility and adjacent industrial park currently planned for Georgetown, Kentucky. The description provides technical information concerning the construction and operation of the low-Btu coal gasification unit, the development of the attendant industrial park, and methods of waste treatment.

B. Methodology

Information concerning the proposed action was extracted from several sources, including the proposal submitted to the former Energy Research and Development Administration (ERDA) by Irvin Industrial Development, Inc., (IID), Coal Gasification Plant for Georgetown, Kentucky (June, 1976) and Mason and Hanger-Silas Mason Company, Inc's., Environmental Assessment for the Kentucky - Federal Energy Park at Georgetown, Kentucky (February, 1977). However, most descriptive information was derived from a document entitled Environmental Report Kentucky - Federal Energy Park, Georgetown, Kentucky for Irvin Industrial Development, Inc., September, 1977, prepared by Dames and Moore, Inc. Requisite information not contained in these sources was obtained from other literature, by visiting the proposed site, and by speaking with involved and interested individuals.

Although the industrial park would not receive Department of Energy funding and its development probably would proceed without the gasifier to meet energy needs, it has been decided that impacts from construction and operation of the industries that would occupy the industrial park must be evaluated. The actual identities of the occupants are not known. However, IID has provided a list of probable tenants. This list is very general, and in order to identify potential impacts, it was necessary to choose manufacturing processes within those industries listed. Industrial processes were chosen on the basis of presence in the geographical area, prevalence within the industry, or as a worst possible case in terms of pollutant emissions. A scenario has been constructed using this list which characterizes the chronology and technical aspects of construction and operation as well as sources and kinds of pollutants associated with each industry. From this, expected environmental impacts are drawn. This approach has certain drawbacks. To the extent that the actual occupants are different from those projected, the situation depicted by the scenario will not present a true-to-life situation. Also, the list provided by IID includes only those industries scheduled to utilize the gas. Nonusers will also contribute environmental impacts, but these cannot be characterized quantitatively or qualitatively.

C. Organization

Section D of the chapter provides a brief review of the chain of events leading up to the preparation of this Draft Environmental Impact Statement (DEIS) and DOE's involvement in the conceptual progress of the low-Btu coal gasifier planned for Georgetown, Kentucky. Section E gives a brief description of the geographic location of the site. Section F provides technical information on the construction and operation of the gasifier and the treatment of wastes associated with the gasifier. Section G provides technical information on the construction and operation of projected facilities in the industrial park and treatment of wastes from these facilities.

D. Background and Objectives

The Fossil Energy (FE) Research, Development and Demonstration (RD&D) Programs of the Department of Energy are rapidly growing in response to the Nation's need to acquire sufficient amounts of fossil fuel from domestic sources. Overall program goals are (ERDA, 1977):

- "To develop the technology needed to make fossil fuels available in form and quantity needed;
- To assure that the Nation's fossil fuels resources are developed at acceptable economic, social and environmental costs."

One possible avenue of providing a portion of this needed energy is low-Btu coal gasification. Consequently, on March 30, 1976, ERDA issued a Program Opportunity Notice (PON) under Fossil Energy Program No. 4 (FE-4). The purpose of this notice was to stimulate interest in the integration and evaluation of low-Btu coal gasification technology in operational environments. Irvin Industrial Development, Inc. responded to the PON offering to participate in the action described below.

Under the PON arrangement for funding, DOE and the Commonwealth of Kentucky would share with IID the cost of all phases of the coal gasification program including the gasifier site development, gasifier site utilities, building construction, operation of the gasification facility, and performance evaluation. Development of the industrial park would be entirely the responsibility of IID.

Under the National Environmental Policy Act of 1969 (NEPA), an environmental impact statement (EIS) was required to describe the potential environmental impacts of the proposed gasifier installation. Because the industrial park is so closely related to the gasifier, it was decided that the impact statement must include the effects of the development of the industrial park as well. Consequently, a scenario was constructed which describes the manufacturing process of projected user-industries, their pollutant emissions, and pollution treatment facilities.

E. Project Location

Irvin Industrial Development, Inc. has proposed to construct a low-Btu coal gasification plant in Georgetown, Scott County, Kentucky (see Figure II-1). The plant would be located in an industrially zoned area off Lemons Mill Road in the southeast corner of Georgetown (see Figure II-2). This industrial park containing 173.6 acres is being developed by Irvin Industrial Development, Inc. and should be fully occupied in 7- to 10-years. The gasification facility would be located on a 7.1 acre site in the southern end of the park (see Figure II-3). The remainder of the park area would be divided into 26 lots ranging in size from 3.5 acres to 10.1 acres. The Scott County Master Development Plan shows that this area has been industrial property for more than 13 years and has been zoned by the Scott County Planning and Zoning Commission as an industrial park since 1971. Changing the zoning from agricultural to industrial was approved by the Scott County Fiscal Court on July 13, 1973.

Of the sites considered, this one was chosen due to its proximity to transportation facilities and the ready availability of customers. The park is convenient to rail, air, and interstate highway transportation. Bluegrass Air Field is less than 20 miles from the park. As shown in Figure II-2, Southern Railway has a line leading directly into the park and adjacent to the proposed gasifier site. The park itself is adjacent to Interstate 75.

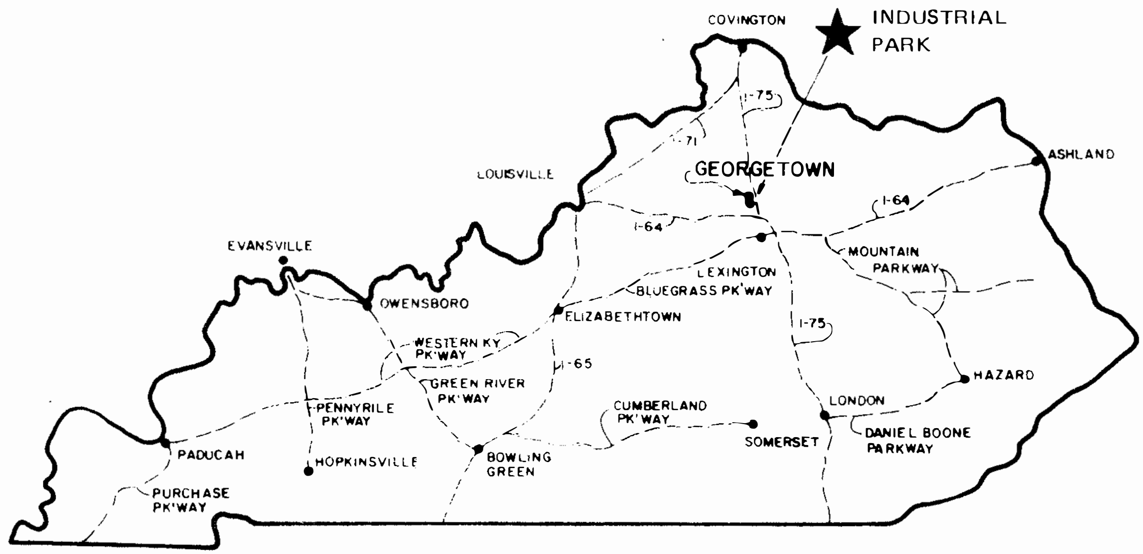
It is anticipated that the plant would demonstrate the technical and economic feasibility of low-Btu coal gasification by producing commercially usable fuel gas with a heat value of 150-165 British thermal units per cubic foot (Btu/cu.ft.). Approximately 480 billion Btus would be produced each year. The gasification facility would provide energy for industrial needs and space heating to all the occupants of the industrial park. [Hoover Ball and Bearing and Johnson Controls, Inc., existing industrial facilities bordering the proposed industrial park, and two nearby elementary schools could be supplied with the product gas (Lohr, 1977). Neither the industrial facilities nor the schools, however, are addressed in this statement.] It would also serve as a data gathering center for the University of Kentucky, Institute for Mining and Minerals Research (IMMR) for testing and research to advance the state-of-the-art.

The coal used in the gasifier would come primarily from southeastern Kentucky from the seam known as Elkhorn #3. However, some coal from western Kentucky and other sites would be used during experimentation to provide a diversity of operating data (Lohr, 1977). Coal consumption during the first year would be approximately 5800 tons. When the system becomes fully operational, 26,280 tons of coal would be used per year (Mason Hanger-Silas Mason, 1976).

F. Project Description

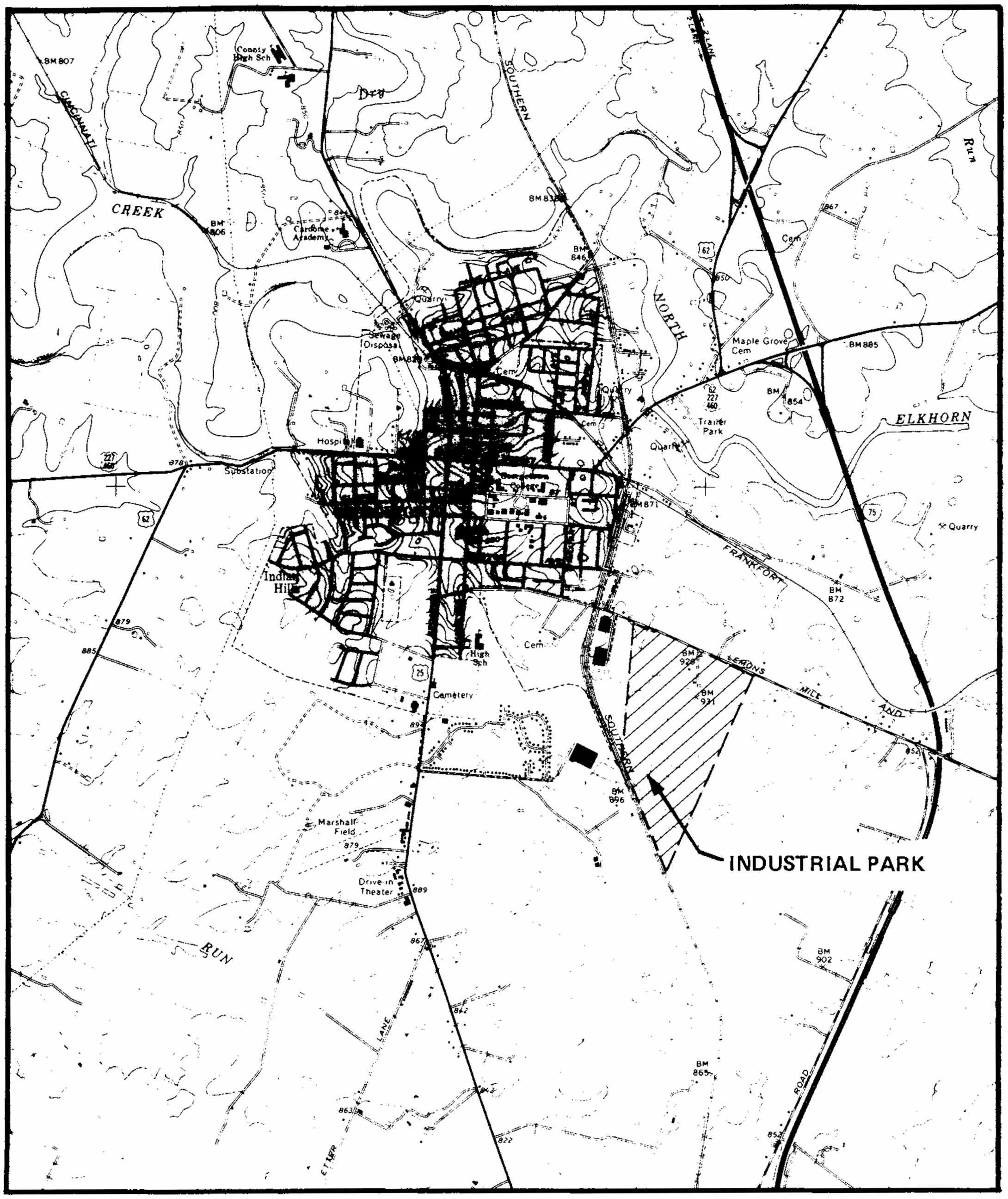
1. Construction and Technical Assistance

Design and construction of the proposed facility would be performed over 22-27 months by Irvin Industrial Development, Inc. Preliminary design of the system has been completed by Mason and Hanger-Silas



SOURCE: Mason and Hanger, 1976

FIGURE II-1
SITE LOCATION MAP



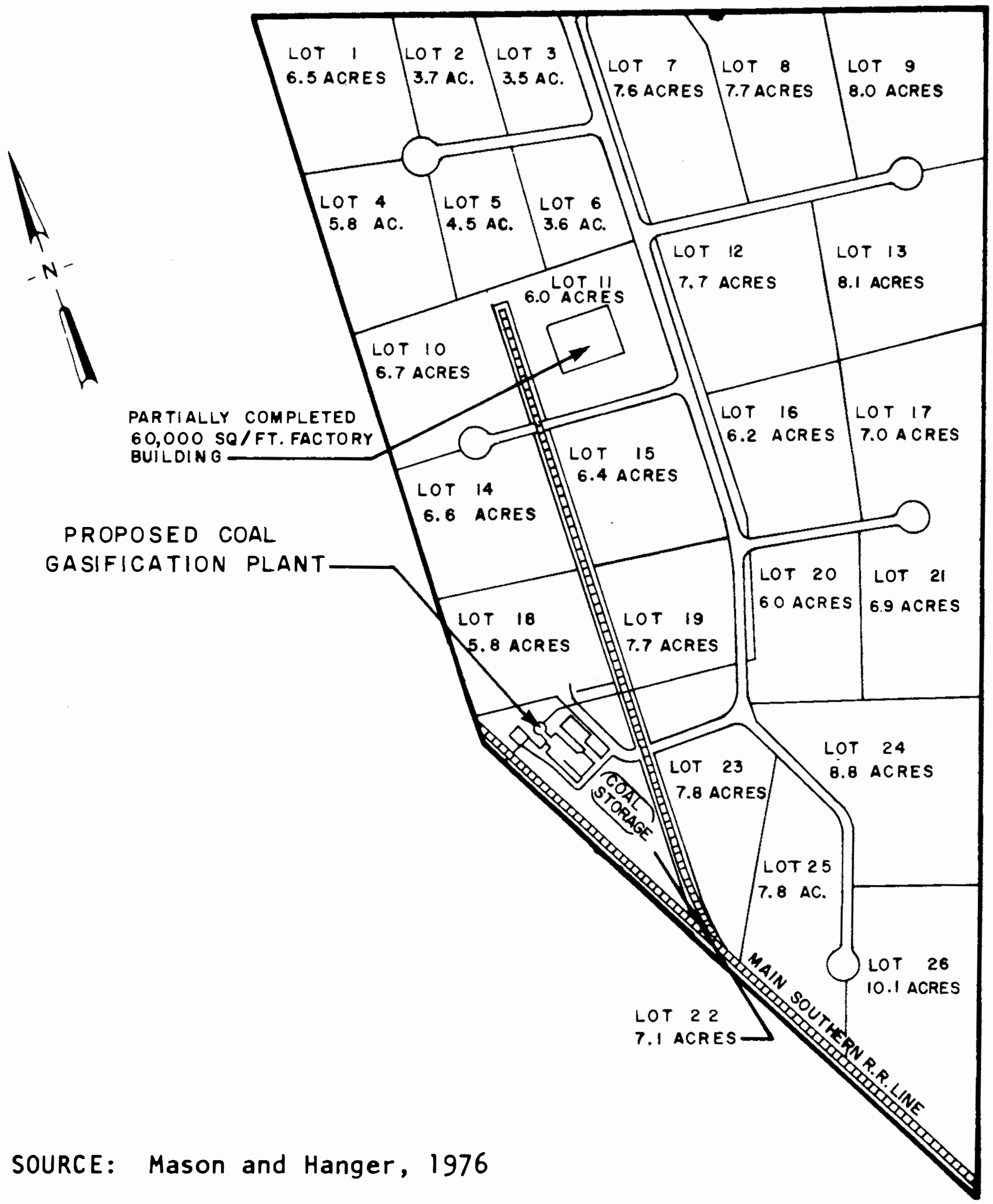
SOURCE: Mason and Hanger, 1976

N

2000 0 2000

SCALE IN FEET

FIGURE II-2
PROJECT AREA MAP



SOURCE: Mason and Hanger, 1976

FIGURE II-3
INDUSTRIAL PARK
PROPOSED SITE LAYOUT

Mason Co., Inc. The same firm would also be responsible for project management and engineering. The Institute of Mining and Minerals Research (IMMR) would assume the responsibility for data collection and reporting to DOE. Peabody, Inc. has been retained by IID to design the biological waste treatment facility (IID, 1976).

The paved area at the gasifier site would amount to 7400 square feet including a parking lot and turn-around area at the coal storage pile. It is anticipated that approximately 180 feet of paved access roads would be required. Access to the park itself would be provided by the railroad, Lemons Mill Road and an access road. Southern Railroad would engineer the needed spur line into the site but the cost of construction would be borne by IID (Geer, 1977). The county has agreed to construct a 4-lane interconnecting road between the proposed park and Interstate 75 (IID, 1976).

The initial 4- to 6-month period would be devoted to site shaping and excavation. Site work, grading and trenching would be performed by graders, dozers, front end loaders and trucks. Concrete work would begin a month or two prior to completion of excavation and would continue over a 4- to 6-month period. Equipment involved would include a derrick to handle forms, reinforcing steel and concrete chutes, concrete mixer trucks to deliver and place the concrete, and a finishing machine for slab surface finishing (Lohr, 1977).

Equipment placement would occur over a 6- to 7-month period and would require derricks, blocking, jacks and hoists. Building erection would require about 2 to 3 months and would require derricks and scaffolds. The gasifier system would be housed entirely under a single roof except for the coal storage pile, product gas storage, and the distribution system. The floor area of this building would be 7200 sq. ft. The building would be constructed of steel and have 60-foot high metal panel walls. Backfill, site dressing, and painting would require 2 to 3 months and would require graders, front end loaders, trucks, and paving machines and rollers. Painting would require scaffolds and ladders (Lohr, 1977).

Construction materials required would be steel in shapes, bars, plate and pipe. Concrete, both cast in place and precast; electrical wire and switch gear; instruments; glass for windows and doors; asphalt paving and dump-proof material; rubber caulking; mastic caulking; light fixtures; and interior and exterior paint would also be required (Lohr, 1977).

Normal construction hours would be from 7 or 8 a.m. to 5 or 6 p.m. Some night construction would be required at times of large concrete pours (Lohr, 1977).

2. Material Feedstocks and Feedrates

An estimated 26,280 tons of coal would be consumed by the gasification system each year. Feedrate of coal to each gasifier would be approximately 1.5 tons/hr. Raw materials required by the gasification process would be 10-11 tons/year of soda ash, 0.5-0.75 tons/year of H-5 chemicals (glycerine type inhibitors to reduce scaling) and 114 gal/hr of make-up water.

The coal chosen for use would be Elkhorn #3 from Breathitt County in eastern Kentucky. The ultimate analysis (IID, 1977) on an as-received basis of this coal is as follows:

Constituent	Percentage
H_2	5.11
C	78.99
N_2	1.44
O_2	7.98
S	0.77
Ash	3.89
Chlorine	0.08
Moisture	1.74
Total	100.00
Heating Value	14,200.00 Btu/lb

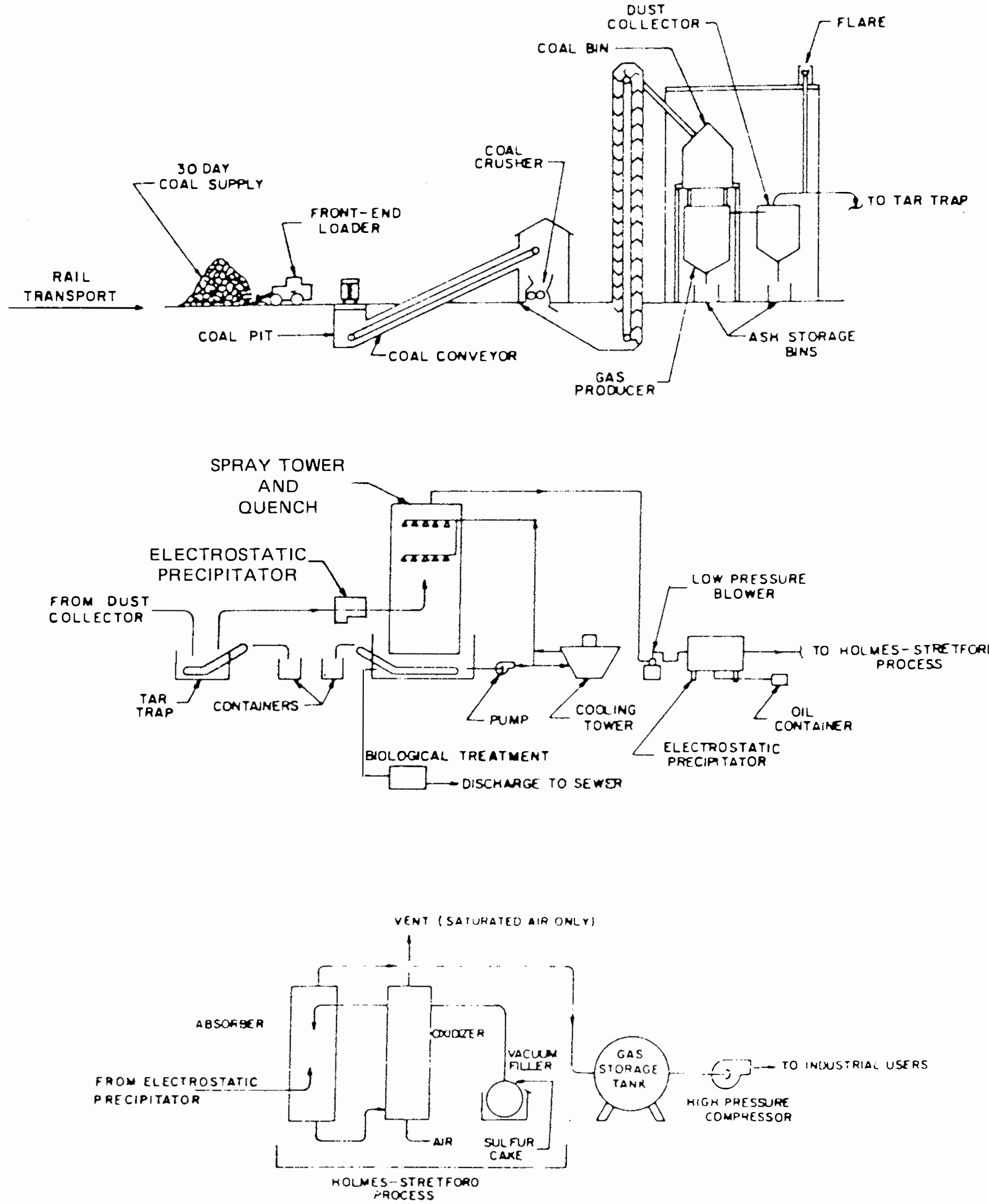
3. Operation of and Environmental Controls Associated with the Low-Btu Coal Gasifier

The low-Btu coal gasification facility would consist of a coal storage area, a coal handling unit, the gasifier, a cyclone, a heat exchanger with tar drainage unit, a spray tower, an electrostatic precipitator, a Holmes Stretford unit for sulfur removal, a gas storage tank, and a distribution system. Figure II-4 provides a flow diagram of the system. In the following discussion, the fate of the fuel from coal storage to gas distribution is followed through each of the facility segments shown in Figure II-4. A detailed description of each technology is included.

a. Coal Storage and Handling

Approximately 70 tons of coal would be coming via truck or rail to the site daily. A thirty-day supply of coal would be stored on a 50' x 50' concrete slab under cover with 3' walls on three sides (IID, 1976).

Coal would be transferred from storage to the coal pit by a front end loader. The coal would pass through a grizzly (screen) capable of accommodating a maximum of 3-inch lumps. Any coal larger than three inches would be diverted to the crusher or broken by a hammer and then redirected through the grizzly to the pit. The coal would then move by bucket to dual overhead bins--one for experimental coal, one for production coal. At capacity one storage bin would hold an 8-hour supply of coal (Dames and Moore, 1977).



SOURCE: Mason and Hanger, 1976

FIGURE II-4
FLOW DIAGRAM OF LOW-BTU COAL GASIFICATION SYSTEM AND POLLUTION CONTROL SYSTEM

b. Coal Gasification System

The coal would then feed from one of the bins to the gasification system. The system has been developed based on the use of two gasifiers of the air-blown, fixed-bed Wellman-Galusha type. Each would have a diameter of 6.5 feet and rotating agitators of standard design. Each gasifier would have a maximum capacity of approximately 3000 lbs of coal per hour, and it is expected that this would be the average feed rate. General properties of Wellman-Galusha gasifiers are shown in Table II-1.

Table II-1. General Properties of Wellman-Galusha Gasifier (Coal Feed Rate 3000 lbs/hr/gasifier (max))

Gas Production Rate (at about 65 ft^3 per lb of coal and 144 Btu/ft^3)	204,750 ft^3/hr/gasifier (max)
Ash Production Rate	180-300 lbs/hr/gasifier
Sulfur Removal Rate	40-80 lbs/hr/gasifier
Tar Production Rate	12-25 gallons/hr/gasifier

Source: Hahn, O.J., 1977

Coal would be introduced into the gasifier by opening the top feed pipe coal valves to fill the feed pipes. The top valves would then close to prevent gas from escaping through feed valves. Bottom feed valves would then open, and coal would feed into the pyrolysis chamber. Coal would be fed periodically to keep the large diameter coal pipes at least partially full. The pyrolysis chamber would be completely surrounded by a water jacket. The inner wall would be composed of 1-inch steel plate and would require no refractory lining and no external steam source (Dames and Moore, 1977).

An overflow on the water jacket would maintain a water level of several inches with an air space above the water level. An air blower would be provided which is capable of supplying the required air at up to 30 inches water gauge (W.G.) for the producer. The air would be introduced at one side of the water jacket air space. As the air moves through this air space, it would pick up vapor from the water as required for optimum operation.

This water-saturated air would then pass into the upper zone of a cone-shaped hopper and be forced upward through the ash of the rotating grate. The ash zone would vary in depth but would usually be 8-12 inches deep. Saturation would be controlled by regulating the rate of jacket water supply to maintain desired saturation temperature. The saturated air, in passing through, would pick up sensible

Table II-2. Composition of Gas Before Entering Clean-Up System

Constituent		ACFH[1]	Volume %[2]	Pounds[1] Per Hour	Weight[2] %
Carbon monoxide	(CO)	159,219	22.70	3,684.9	19-26
Methane	(CH_4)	22,380	3.20	296.0	1-2
Hydrogen gas	(H_2)	74,888	10.70	123.8	14-19
Carbon dioxide	(CO_2)	16,496	2.30	600.0	6-1
Oxygen gas	(O_2)	1,061	0.10	28.1	
Nitrogen gas	N_2	341,293	48.70	7,898.6	50
Hydrogen cyanide	(HCN)	350	0.05	8.1	
Ammonia	(NH_3)	350	0.05	5.1	
Carbonyl sulfide	(COS)	350	0.05	18.0	
Hydrogen sulfide	(H_2S)	1,089	1.10	30.4	0.3-3
Water	H_2O	81,749	11.70	1,215.0	
Tar		2,108	0.30	348.0	
Carbon Sulfide	(CS_2)		0.016[b]		
Thiophene			0.010[b]		
Mercaptans			0.003[b]		
Pyridine Bases			0.004[b]		
Nitrogen Oxide	(NO)		0.0001[b]		
TOTAL		701,327			

[1]Hahn, O. J., 1977
[2]Dames and Moore, 1977

heat and at the same time cool the grate and ashes (Dames and Moore, 1977). The air would increase in heat content and move from the oxidation zone into the reduction zone where CO_2 + C 2CO. It would continue into the pyrolysis zone where fresh coal would combine with volatiles from the heated fuel. Then through a series of chemical reactions, gas would be produced.

The product gas from the gasifier would be at temperatures of 1050-1200° Fahrenheit (°F). It would be composed mainly of carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), hydrogen gas (H_2), nitrogen gas (N_2), trace amounts of metals, hydrogen sulfide gas (H_2S), and tars. The rate of production of the gas would be 207,862 standard cubic feet per hour (scf/hr). It would have a heating value of 150-165 Btu/scf of gas (Mason Hanger-Silas Mason, 1976). Approximate gaseous composition before it enters the clean-up system is shown in Table II-2.

The product gas would then be fed into a series of pollution treatment devices including a dust collector, tar trap, spray tower, Peabody biological treatment system, electrostatic precipitator, and Holmes Stretford process for sulfur control.

c. Dust Removal

The gas leaving the producer would then be introduced into the dust cyclone. Approximately 14.5 pounds of coal dust and ash particles per hour (80 percent) would be removed. The gas producer and dust cyclone would be coupled to operate as a single system.

Should over-production of gas require flaring, a vent pipe would be provided in the main gas-flow piping. Flaring would occur approximately three times per year immediately after the gas leaves the dust cyclone. The vent pipe for the flare would be located in the main gasifier chamber. The burn would occur at 1600°F which is sufficient to destroy any organic material. To prevent visibility of flame and promote complete combustion, a refractory-lined shroud would be placed around the burner. The coal ash and cyclone dust would be disposed of in a sanitary landfill located five miles from proposed gasifier site (Dames and Moore, 1977). The present site has one year's capacity remaining, but an additional adjacent 10 acres has been acquired. Irvin Industries has submitted an approximate chemical analysis of the ash to the Solid Waste Department of Kentucky and has received approval to dispose of the ash in the Scott County sanitary landfill. No other site in the state has been approved as a receptacle of the ash. It is anticipated that Factory Services of Lexington, Kentucky would be the waste hauling agent. One 40-cubic yard load/day of ash would be collected at the gasifier by the contract hauler. During transit, the ash would be covered by a solid nylon tarp. Upon arrival at the landfill site, it would be wetted down to prevent dust formation.

As the product gas leaves the cyclone dust collector through a refractory-lined flue at 1 to 2 inches W.G., it would flow downward through a heat recovery section to remove and utilize the sensible heat. The gas temperature would be reduced in this section to about 500°F by heat transfer into a heat recovery tube bank. Heat absorbed by this tube bank would be removed by forced circulation of Dowtherm A (ethylene glycol) through the tubes and transferred to a second heat exchanger to produce about 200 pounds of steam per hour which could be used for space heating (Dames and Moore, 1977).

d. Oil, Tar, and Particulate Removal

From the dust cyclone, the gas would move to the tar trap where the condensible components would be removed. The quantity of condensible materials would vary depending on the characteristics of the coal used but would average 12 to 15 gallons per ton of coal. The condensible materials would appear in three different fractions. The first would comprise approximately 62 percent of the total and would appear at temperatures between 660 and 950°F. The constituents would be heavy oil, tar, pitch, wax, and carbon (soot). The material would have a low viscosity and would flow easily at the above temperatures. The next fraction to condense out would be anthracene and heavy oils. This would occur at temperatures between 485 and 660°F and amount to approximately 16 percent of the total condensibles. The components of this fraction would consist of fluorene, phenanthrene, anthracene, carbozole, methylnaphthalene, dimethylnapthalene, acetanaphthalene and anthracene oil. These materials would have a low viscosity in the 485 to 660°F temperature range and would flow easily. The down-flowing gas would assist in sweeping the condensed materials from the heat recovery tube bank to the tar and heavy oil trap. The trapped material would remain fluid at the 480 to 500°F temperature range found in the tar trap and would be bled off as required. The remaining condensible materials would remain in the vapor phase at temperatures above about 485°F. This final fraction would condense later in the system as the gas temperature is reduced to 115°F (Dames and Moore, 1977).

e. Hot Electrostatic Precipitator

The gas stream would leave the dust collector at about 500°F and enter a hot electrostatic precipitator for tar and oil removal. The gas would leave the hot precipitator at 480-490°F to enter the quencher and spray tower for further removal.

f. Open Scrubbing Tower

From the hot electrostatic precipitator, the gas stream would enter a quencher and a scrubbing tower for further cooling to temperatures of 300°F and 115°F respectively. The scrubbing tower would be a vertical vessel with an open bottom set vertically in a tank of water and aromatic oil, which would be circulated through spray nozzles arranged at various levels within the tower. The system is designed to have alarms and to be tied to an emergency water supply so that the bottom end of the spray tower would always be submerged.

Here, cooling would cause the final fraction to condense. Those products with a specific gravity greater than the specific gravity of water would fall to the floor of the tank where they would be removed by raking or by a conveyor apron. Lighter condensible material such as phenols, creosols, xylenols, and higher tar acid, pyridine and heavy tar bases, naphthalene, benzene, toluene, xylene, and heavy solvents would be decanted or skimmed off for containerization and disposal.

The fluid circulated through the spray tower unit would be circulated through a heat exchanger connected to a cooling tower water circuit for dissipating sensible heat gain in the circulating fluid. A demister would be located at the outlet. Saturated gases leaving the spray tower at 115°F would have the characteristics shown in Table II-3.

Table II-3. Composition of Gas Leaving Spray Tower

Constituent	ACFH	Volume %	Pounds Per Hour
CO	55,088	23.54	3,684.9
CH_4	7,743	2.30	296.0
H_2	25,911	11.07	123.8
CO_2	5,708	2.43	600.0
O_2	367	0.16	28.1
N_2	118,087	50.47	7,898.6
HCN	121	0.05	8.1
NH_3	121	0.05	5.1
COS	121	0.05	18.0
H_2S	377	0.20	30.4
H_2O	20,297	8.68	870.7
Total	233,941	100.00	13,563.7

Source: Dames and Moore, 1977

g. Cold Electrostatic Precipitator

As the product gas leaves the scrubber, a blower would force the gas through the electrostatic precipitator to remove any aerosol particles, entrained dust, condensed tar and oil droplets, and soot from the gas stream. Gases would enter and leave the electrostatic precipitator at temperatures of about 100-110°F. There would be no change in the gas composition except for those materials removed by the precipitator. Ash and tar products would be periodically removed and stored in metal containers for subsequent disposition as a by-product (Dames and Moore, 1977).

h. Sulfur Removal

From the electrostatic precipitator the gas would be vented to the Holmes Stretford unit for removal of sulfur compounds, NH_3, and HCN. The gas would be treated with a water solution containing sodium carbonate, sodium vanadate, anthraquinone disulfonic acid (ADA), citric acid, and traces of chelated iron at 80°F and a pH of 8.5. The H_2S would be oxidized to elemental sulfur by the vanadate ion. The vanadium which would be reduced by the sulfur would then be reoxidized by the ADA to the pentavalent state. This reaction would use air as the oxidizer and would take place in the absorber. The liquid containing the elemental sulfur would pass to an oxidizer where ADA would be reoxidized by air. The elemental sulfur froth would overflow to a holding tank and the reoxidized solution would be cycled back to the absorber (EPA, 1976). The froth would pass through a vacuum filter and be removed as a cake with a moisture content of 50 percent. It would have a purity as elemental sulfur in excess of 99 percent. The fluid in circulation would pick up a certain amount of water vapor from the saturated product gas and be passed through an evaporator-cooler for regeneration. The bleed liquor would be cracked by incineration into a gas stream containing H_2S and CO_2 along with a liquid stream containing reduced vanadium salts. This liquid stream may then be used as a regenerant (Vason, 1978).

It is estimated that the H_2S removal system would remove 38.2 pounds of sulfur per hour (42.6 percent by weight), 6.6 pounds of reduced vanadium salts per hour (7.4 percent by weight), and 44.8 pounds of water per hour (50 percent by weight). The gas as it leaves the absorber, would be between 70 and 130°F and would have the composition shown in Table II-4. Removal efficiencies of COS and CS_2 vary depending upon the design of the system. Operating parameters such as temperature, residence time and pH may be varied to achieve fifty to eighty percent removal of these compounds. COS is hydrolyzed to H_2S and CO_2 by excessive steam and sodium carbonate. Resulting levels of emission would be below existing air quality standards (Vason, 1978).

Table II-4. Composition of Gas Leaving Absorber

Constituent	ACFH	Volume %	Pounds Per Hour
CO	53,777	24.41	3,684.9
CH_4	7,542	3.42	296.0
H_2	25,722	11.67	125.9
CO_2	5,560	2.52	600.0
O_2	357	0.16	28.1
N_2	115,017	52.20	7,898.6
H_2O	12,359	5.62	557.9
COS[1]			
Total	220,334	100.00	13,191.4

Source: Dames and Moore, 1977

[1]Cannot be determined until final design specifications of system known.

i. Biological Treatment

A Peabody biological treatment system would be used to treat liquid effluent from traps, spray towers, and cooling tower blowdown. It would be an anaerobic digestion, trickling filter design. This kind of system has been successfully installed on a coke oven operation which has much higher levels of raw wasteload constituents. Anticipated treated influent and effluent levels are shown below:

Characteristic	Gasification Plant Wastewater Characteristics	Wastewater After Pretreatment
Flow Rate	10 to 20 gpm	
Phenols and Polynuclear Aromatics	2500 ppm	1-5 ppm
Cyanide	10 ppm	4 ppm
Ammonia	250 ppm	40 ppm
pH	8.9	6-9

Source: Vason, 1978a.
Drake, 1978.

The Kentucky Environmental Protection Water Quality Office will permit discharge to the municipal wastewater treatment system if the following standards are met: pH = 6-9; Phenols, 15 ppm; cyanide, 4 ppm; ammonia, 40 ppm.

j. Compression, Storage and Distribution

After treatment, the gas would be fed into a refrigerated cooling coil section and desiccant to remove entrained vapor at a dewpoint of 40°F. A blower would then force the gas to a spherical gas holder for an eight-hour storage period. The actual time of storage would depend upon demand. The gas would then be compressed for distribution into the 1000-linear-foot system. Present plans for the gas distribution system include a primary gas line extending from the compressor building adjacent to the main park service road. Secondary gas lines with shutoff valves would be provided from the main line to each park occupant requiring gas. All gas lines would be located underground and would be marked above ground for exact location.

4. Evaluation and Environmental Monitoring to be Performed by IMMR

The Institute for Mining and Minerals Research (IMMR) of the University of Kentucky would carry out the three-year data collection program for the Department of Energy. Additional technical support would be provided by the Kentucky Center for Energy Research. Besides the DOE program monitoring, IMMR would conduct tests on the stability of the production gasifier, effectiveness of waste treatment technology, and several bench scale programs. The environmental, health and safety aspects of each experiment and research program would be evaluated prior to any action. No program would be started without Department of Energy approval.

a. Production Gasifier Tests

One of the Wellman-Galusha gasifiers would be used for production purposes and the second would be used initially for testing and research and then converted to production at a later date. Research would be conducted by the Institute of Mining and Minerals Research, University of Kentucky. The production gasifier would always run on coal with little or no compositional variations (Elkhorn #3). The operation of the production gasifier would provide a basis for observation of system stability and the effect of load variations on the gasifier and waste treatment facility (IID, 1976).

The start-up test of the system would last approximately two months and would monitor component and system performance under major demand reductions ranging from 20 to 90 percent. The parameters which would be monitored during this time are gas composition, heating value, and particulate, tar and sulfur removal efficiencies (IID, 1976).

After the start-up test period, gathering of operational data as per DOE instruction would continue. Parameters to be varied during this time would be coal composition, feed rates of air, steam and coal, tar, dust and sulfur removal rates, cooling rates, and product gas composition. Data would be recorded as a function of gas demand and total Btu demand (IID, 1976).

b. Research Gasifier Tests

The research gasifier would operate on coal of varying composition and source. Other variables would be coal size distribution, carbon/steam ratio, carbon/air ratio, and feed rate. The effect of coal size distribution on the gasification rate would be the first test performed. In the past, fixed bed gasifiers have run on coal averaging 2" x 1-1/2". This size would be varied over a period of four to six months (IID, 1976).

The second series of tests would evaluate the effect of variable feed stock composition. Also, changes in the feed rate and stirrer rotation would be made to determine optimum output. These tests would continue for a period of six to ten months.

c. Waste Treatment Technology Tests

The first goal of these tests would be to evaluate the cleanup system as a function of dust loading, tar loading, and sulfur and nitrogen content of the coal. Variations in the operating conditions of the gasification system would be explored. These variables would include exit gas temperature from the gasifier, free space between coal bed, temperature of heat exchanger, scrubber temperature, voltage of the electrostatic precipitators, and nitrogen and sulfur content of the gas stream before entering the Holmes Stretford process.

The second phase of the gas cleanup test would involve modifications of the cleanup system to improve or reoptimize the cleanup process. At present IMMR has a process under development using a high-temperature ash bed to remove sulfur and catalyze the cracking of tar. Testing of this and other high-temperature cleanup systems would occur (IID, 1976).

d. Research Programs

It is also anticipated that the test gasifier and the associated small laboratory would be involved in many research programs. The present plans include work on testing of gas cleanup technology, direct uses of low-Btu gas, combustion of low-Btu gases, and control technology of gasification systems. Specific tests that would be conducted include evaluations of high-temperature removal of tars and particulates; regeneration of solvents used during sulfur removal, direct use of gas in reduction of iron ore, behavior of trace elements, nitrogen compounds, and particulates during combustion, and testing of on-line monitors.

5. Project Schedule

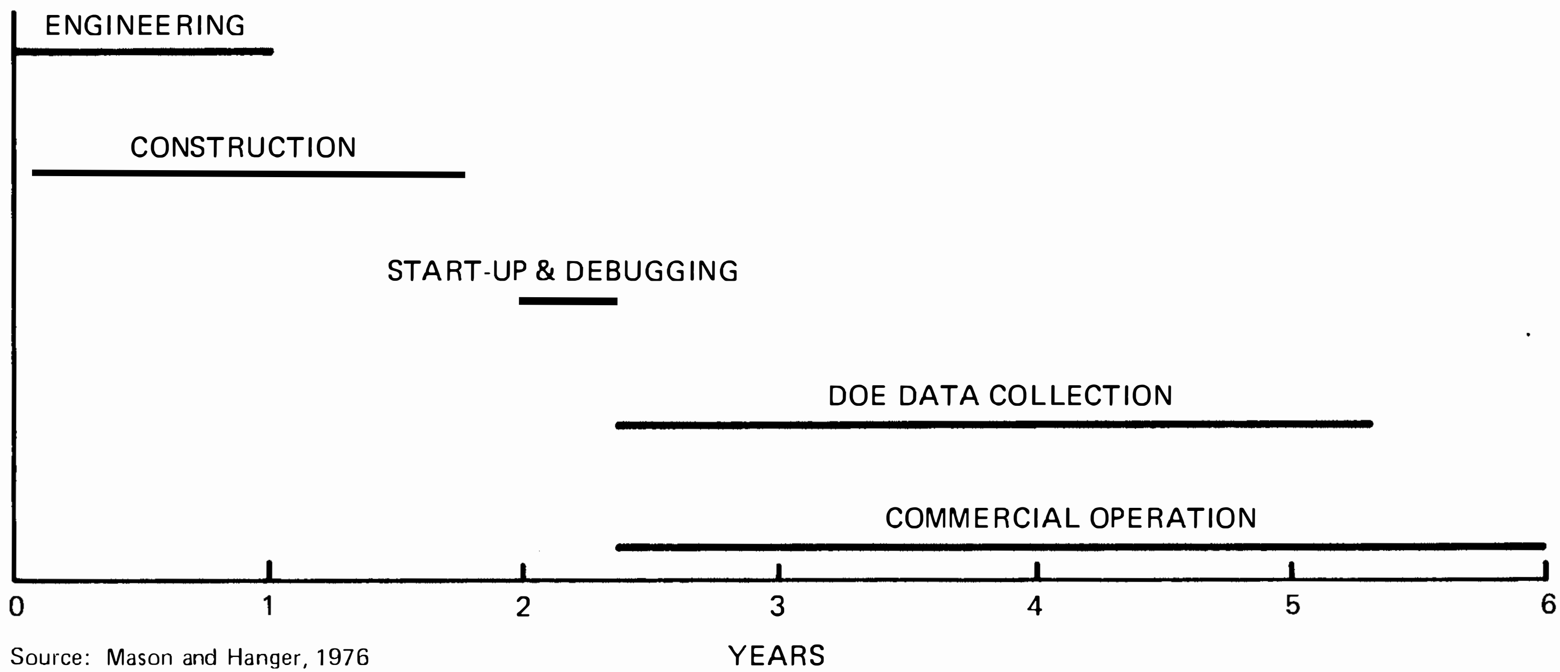
The schedule for construction and completion of the gasifier and its concomitant facilities is shown in Figure II-5. Design and construction would require approximately 25 months. Data collection and commercial operations would commence subsequent to the start-up and debugging period. The former would continue for a period of three years. A planned timetable for the research and monitoring program to be carried out by the Institute of Mining and Minerals Research, University of Kentucky is shown in Figure II-6.

G. Development of Industrial Park

IID has compiled a list of probable occupants of the industrial park. Table II-5 presents the statistics for these industries. Approximately 720,000 sq. ft. of floor area would be necessary. The number of employees would range from 426-532. These seven operations would utilize approximately 13 lots to house adequate grounds for landscaping, parking, and outside storage. Adding the energy requirements of Hoover Ball and Bearing and Johnson Controls (77 billion Btu/yr) to the 500 billion Btu/yr required by the listed industries would result in approximately 85 percent utilization of the synthetic gas. The remaining 12 lots would be sold for warehousing, commercial or light manufacturing operations not requiring gas and employing 300 to 350 additional people. This would give a total of 726 to 882 employees. The location of industrial facilities in the park as constructed in the scenario is shown in Figure II-7. The building schedule for the user-industries is shown in Figure II-8.

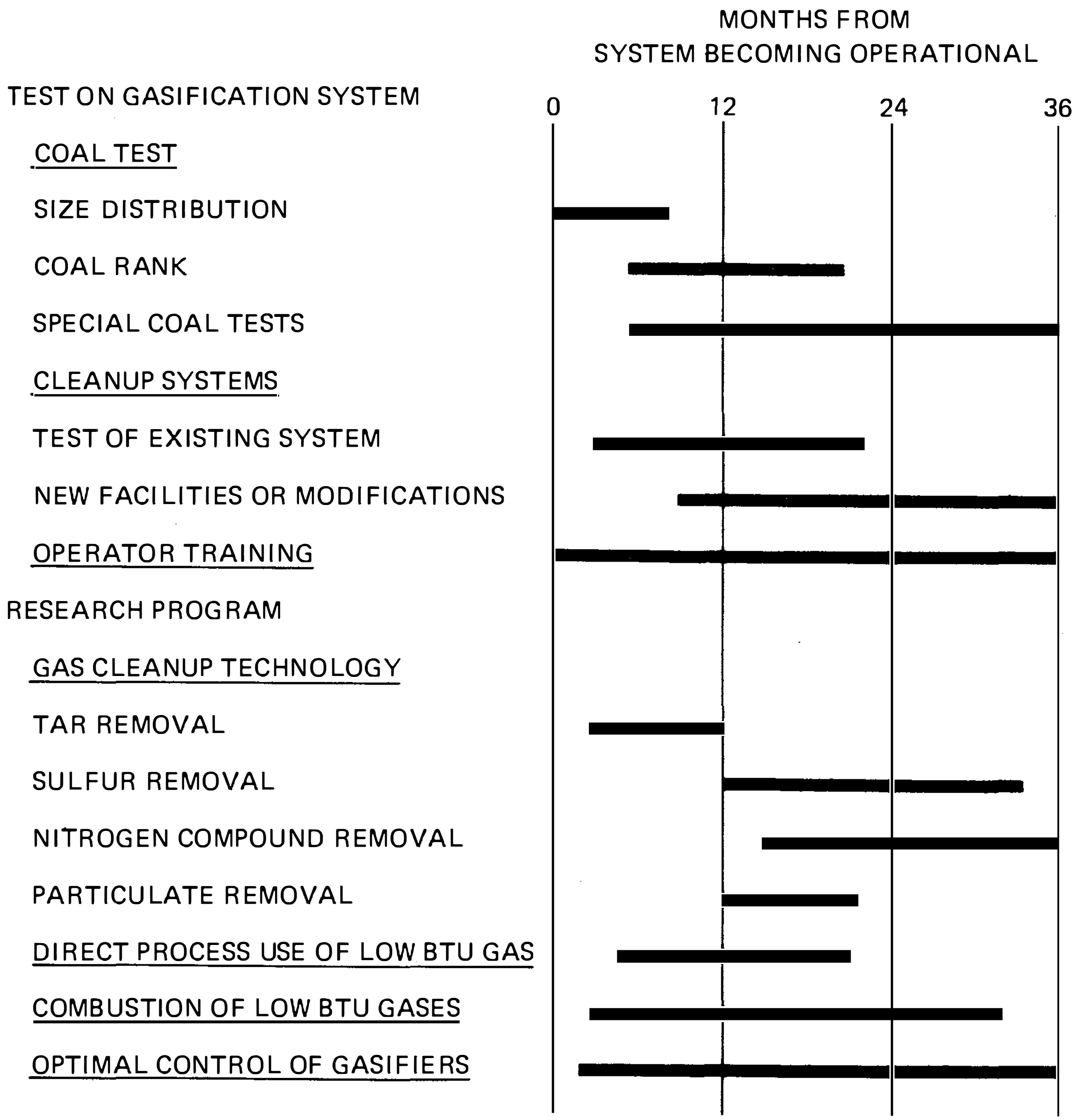
The following assumptions were made in the construction of the scenario:

1. The park would populate progressively outward from the gasifier site.
2. Each industry would occupy two lots.
3. The size of the lot would be proportional to the building floor area given in Table II-5.
4. Half of the nonenergy consuming operations would be warehouses and half would be commercial operations. From these facilities only sanitary wastes and runoff from parking lot areas would be generated.
5. Construction would proceed at a constant rate and be completed in 7-10 years.



Source: Mason and Hanger, 1976

FIGURE II-5
INDUSTRIAL PARK
PROPOSED PROGRAM SCHEDULE



SOURCE: IID, 1976

FIGURE II-6
RESEARCH TIME TABLE

Table II-5. Potential User-Industries to Occupy Industrial Park

Typical Company	Building Area Requirements (sq.ft.)	Employees	Energy Requirements
Commercial Heat Treat	35,000	16 - 22	Electric for office air conditioning, lighting, some equipment product gas - 35 Billion Btu per year.
Miniature Light Bulb Manufacturer	125,000	75 - 100	Electric for air conditioning, lighting, and power equipment product gas for heating and processing. 80-100 Billion Btu/year.
Glass Products Manufacturer	100,000	50 - 75	Same as Commercial Heat Treat product gas Requirements: 80-100 Billion Btu/year.
Wood Laminator	50,000 - 60,000	20 - 25	Electric for lighting, air conditioning, and power tools product gas for heating and wood kilns 15-20 Billion Btu/year.
Ceramic Tile Manufacturer	100,000	50 - 75	Same as Commercial Heat Treat product gas: 80 Billion Btu/ year.
Stamping and Metal Fabricator	100,000	80 - 100	Electric for air conditioning, lighting, and power; Syngas for heating and annealing product gas: 20-30 Billion Btu/year
Porcelainized Products Manufacturer	200,000	125	Same as Commercial Heat Treat product gas: 100 Billion Btu/ year.
TOTAL	720,000	426 - 532	a. Electric: Undefined b. Product gas: 410-542 Billion Btu/year

Source: T. E. Lohr, IID, 1977.

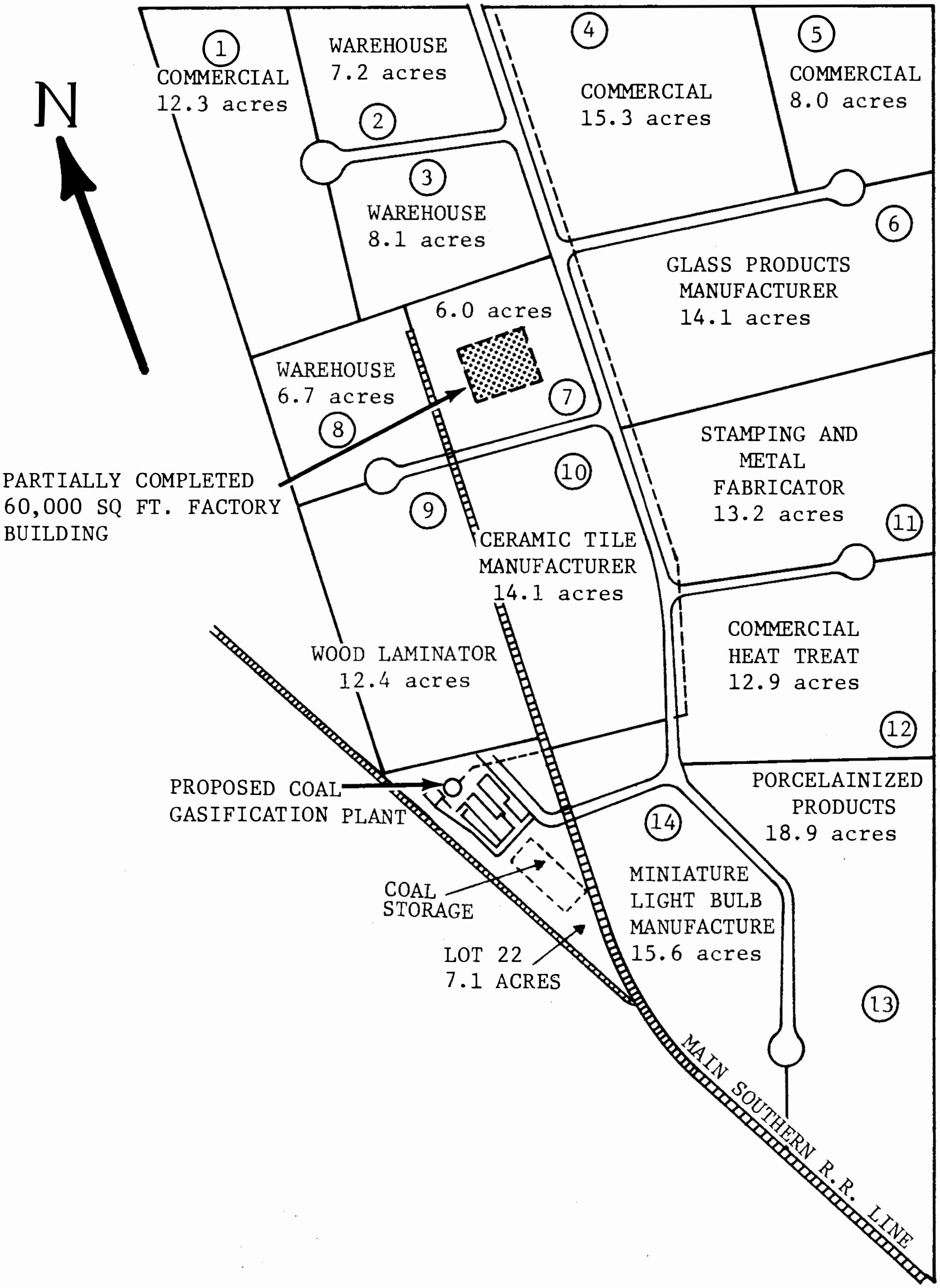


FIGURE II-7
LOCATION OF USER-INDUSTRIES
IN INDUSTRIAL PARK

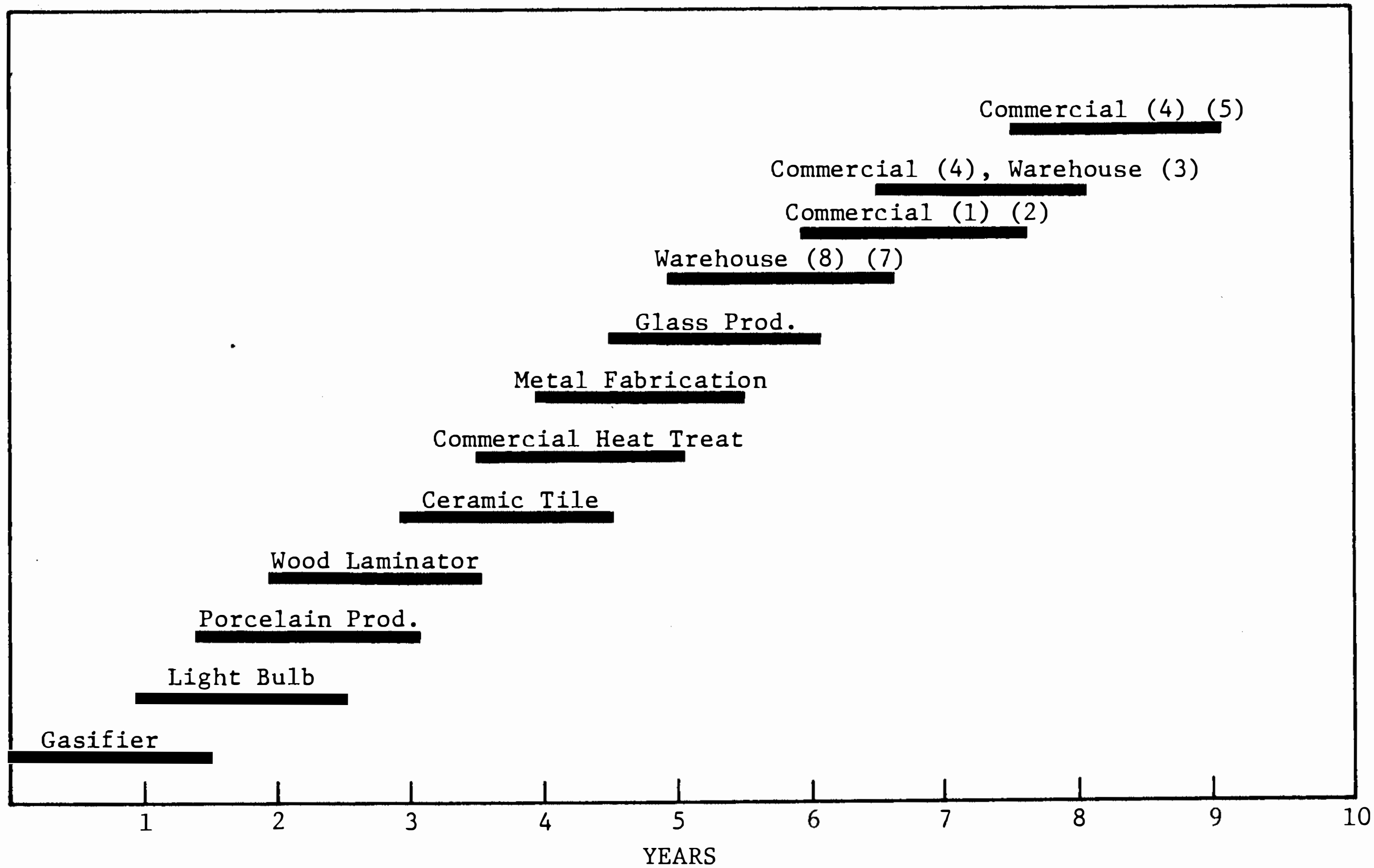


FIGURE II-8
CONSTRUCTION SCHEDULE FOR USER-INDUSTRIES

1. Glass Manufacturing

Two of the manufacturers proposed for the industrial site are related to the glass industry and fall into SIC Code 3229. These are the glass products and miniature light bulb manufacturers which would occupy lots 6 and 14, respectively. All glass manufacturing involves the high temperature conversion of raw materials into a homogenous melt and fabrication from that melt into useful articles. The basic raw materials are glass, sand, soda ash, limestone, and feldspar with minor additives for specific purposes such as coloring.

a. Raw Materials

Soda-lime glass would be used by both the glass products manufacturer and the incandescent light bulb manufacturer. Sand (silica) and sodium oxide would be the primary components and would account for 70 percent and 15 percent of the ingredients, respectively. Sodium oxide and possibly potassium oxide would be added as fluxing agents to reduce the viscosity of the mixture. This would allow lower melting temperatures and would improve removal efficiencies of undissolved gases. Calcium oxide, aluminum oxide, and magnesium oxide would be added to improve chemical durability of the glass. Iron or other agents may be added for coloring. Also, each batch would contain 10 to 50 percent cullet (waste glass from product rejects and breakage) (Dellinger, 1975).

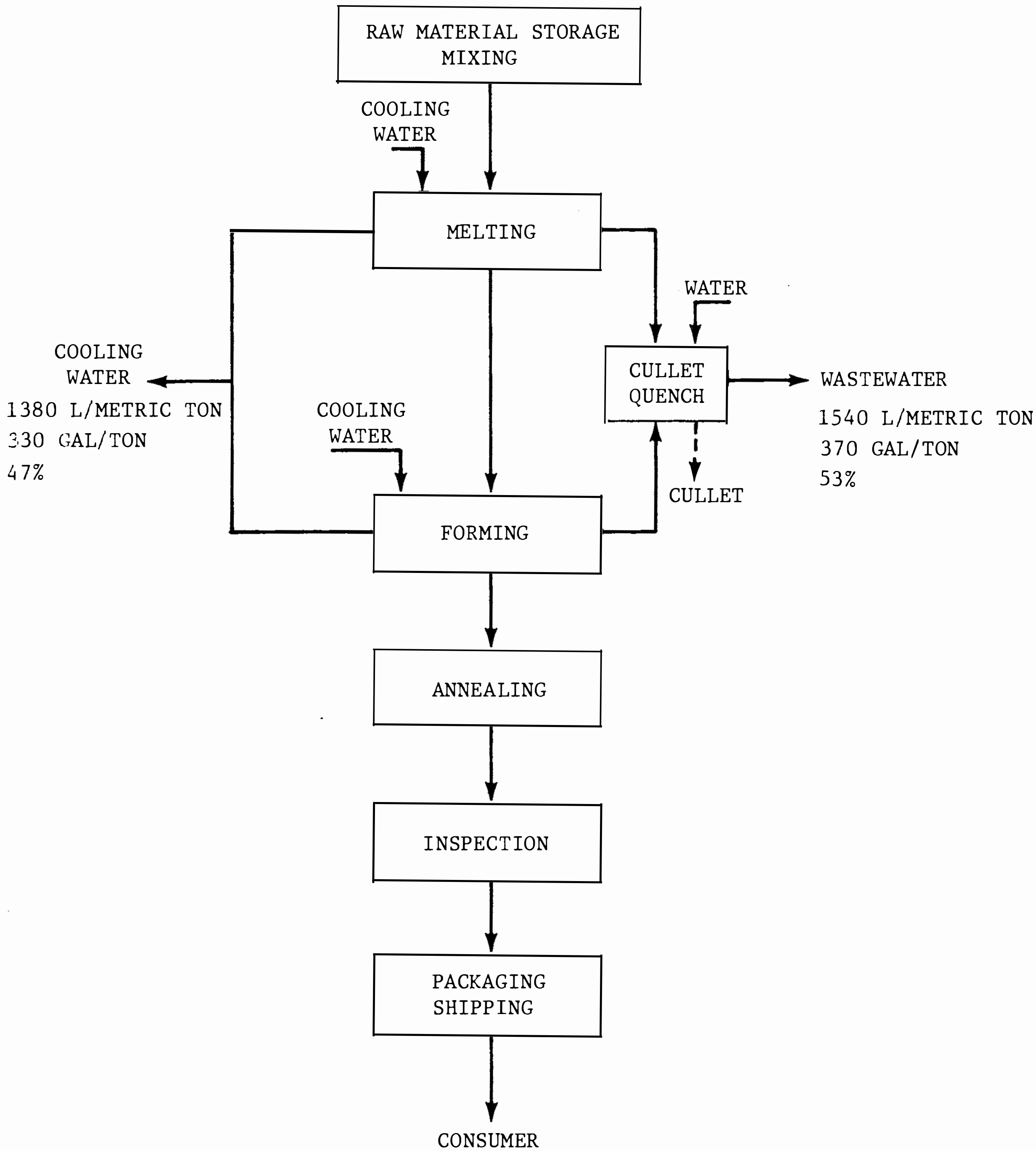
It is possible, if lead-alkali silicate glass or borosilicate glass were produced, that lead oxide and boric oxide would be used as the fluxing agents. Borosilicate glass is used in incand escent lamp envelopes because of its lower coefficient of expansion and greater resistance to the corrosive effect of acids.

b. Glass Products Industry

(1) Manufacturing Process

There are four or five steps basic to the pressed and blown glass industry. These are weighing and mixing of raw materials, melting of raw materials, forming of molten glass, and annealing of formed glass products. Forming methods vary substantially depending on the final product. Following forming and annealing, the glass may be prepared for shipping.

It is assumed that Lot 6 would be occupied by a glass container manufacturer. Figure II-9 is a typical flow diagram for glass container manufacturing. Raw materials would be received in bulk and stored in segregated bins or silos. Batch weighing and mixing would be mostly automatic, thus reducing operator error. Large mixers with a 1000-3000 lb capacity would be used to ensure uniformity. To reduce segregation and dusting, some water (up to 4%) would be added to the batch mix. The mixer would discharge into unit containers from which the batch would automatically and continuously discharge into the furnace through screw or pusher type feeders (Dellinger, 1975).



SOURCE: Dellinger, 1975.

FIGURE II-9
FLOW DIAGRAM FOR GLASS CONTAINER MANUFACTURING

In glass container manufacturing, continuous tanks would be used to melt and fine (remove bubbles from the glass). A glass tank that would have an output of 10-150 tons/day would be 20-50 feet long, 10-25 feet wide, and have a holding capacity of 50-300 tons of glass. The tank would be divided into two sections, the melting chamber and the working and fining chamber. The temperature within these molds would be controlled very carefully in order to ensure production of uniform ware. The final step in the manufacturing process would be to cool the product. All cooling would be carried out by forced air.

(2) Water Usage and Characteristics

Process water would be used for cullet quenching and noncontact cooling of the batch feeders, melting furnaces and forming machines. The discharge volume would depend on quantity of once-through cooling water and water conservation practices in the plant. Water may also be added to the batch for dust suppression at the rate of 2.75 gal/ton. This small volume is nonrecoverable. Noncontact cooling water flows would be approximately 330 gal/ton. Cullet quench water would be required to dissipate the heat of molten glass, and average flows would be approximately 370 gal/ton. Typical characteristics of the combined noncontact cooling and cullet quench water streams are shown in Table II-6. The above quoted flows represent wide ranges of discharges. These flows are known to range from practically nothing to 1500 gal/ton (Dellinger, 1975).

Table II-6. Raw Wastewater
Glass Container Manufacturing

Flow	700 gal/ton	
pH	7.5	
BOD	0.029 lb/ton	5 mg/l
COD	0.29 lb/ton	50 mg/l
Suspended Solids	0.14 lb/ton	24 mg/l
Oil	0.06 lb/ton	10 mg/l

Source: Dellinger, 1975

Small amounts of biological oxygen demand (BOD) and chemical oxygen demand (COD) would be added to the wastewater from shear spray (an emulsion used to cool shears and cullets) or lubricating oil. Suspended solids are composed mostly of glass particles. Oil is added in the form of shear spray oil and leaking lubricants. The average increase in temperature over plant influent water is 6°C. The typical pH of the wastewater is 7.5 (Dellinger, 1975).

(3) Pollutant Control Technology

Some existing glass container manufacturers have achieved low effluent levels with only in-plant measures, and final treatment systems have not been required. These kinds of practices have included improved spray collection of forming machine shop oil, improved housekeeping, recycle of shear spray, collection of oily runoff from forming machines, and use of nonliquid cleaners (Dellinger, 1975).

However, to achieve optimum control, both in-plant and end-of-pipe control measures would be practiced by this facility. A possible configuration of a treatment system is shown in Figure II-10. Effluent levels can further be reduced by segregating the cullet quench water from the cooling water system, recycling the cullet quench water through a gravity separator, and treating the blowdown using dissolved air flotation.

Segregation of the noncontact cooling water and recycling with a 5 percent blowdown would reduce the typical contact water discharge to 18.5 gal/ton. Blowdown from the recycle system can be treated to 0.004 lb/ton using dissolved air flotation. COD would be reduced in proportion to the oil removed. The sludge production would be approximately 500 gal/day at 3 percent solids (Dellinger, 1975).

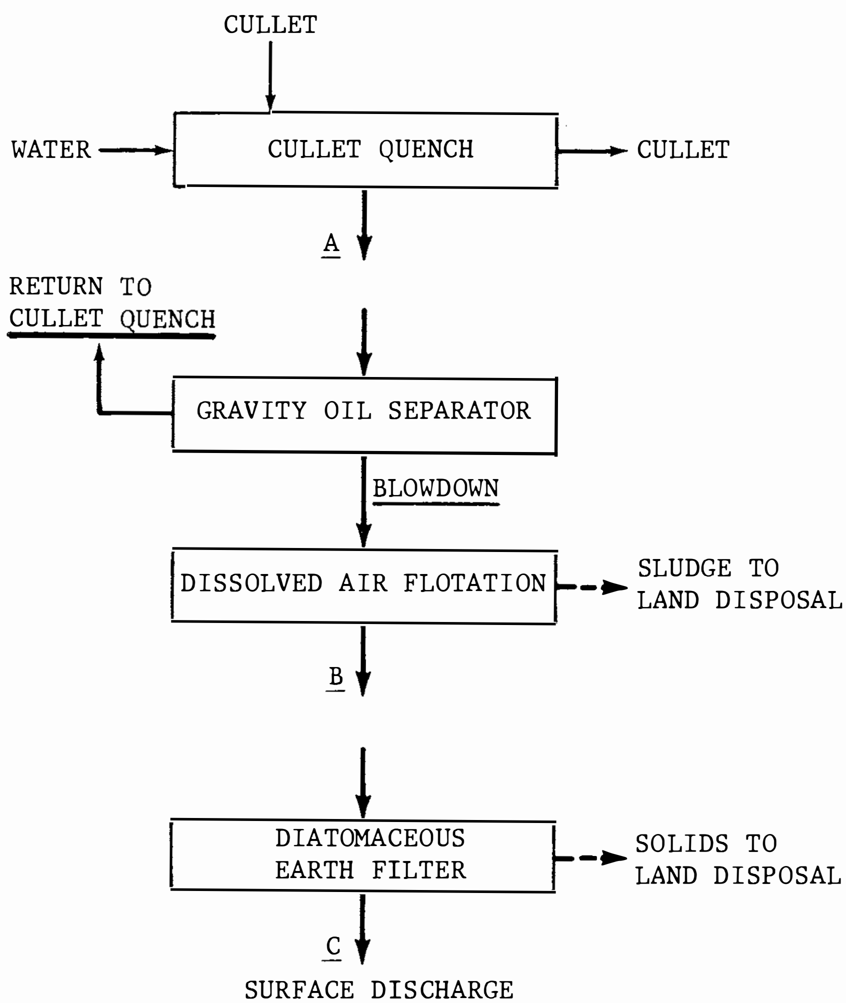
Diatomaceous earth filtration may be used to further reduce the oil and suspended solids in the dissolved air flotation discharge stream to less than 0.016 lb/ton. Approximately 13 gal/day of 15 percent solids sludge would be produced (Dellinger, 1975).

c. Incandescent Light Bulb Blanks

(1) Manufacturing Process

Site 14 would be occupied by a miniature glass bulb manufacturer. Figure II-11 depicts a typical flow diagram for incandescent bulb manufacturing. The light bulb blanks would be produced on a Corning ribbon machine. The glass would be supplied to the machine through a feeder in a continuous stream which would flow from a 1-inch opening and be passed between two counter-rotating water-cooled rollers. The ribbon, 3 inches wide and 1/8 inch thick, would then be redirected to a horizontal flow and placed on a plate belt. Every plate would have an opening through which the pill-shaped glass would sag under gravity. The sag would be aided by blowheads and timed compressed air impulses. The blowheads would be fastened to a continuous rotating chain belt. They would be placed above on the premolded glass and move at the same speed as the glass ribbon. After the glass has been premolded, it would be enclosed by blow molds and then blown out to finished bulbs through the blowheads. The blow molds would be rotated around their axes to obtain smooth seamless surfaces. The finished bulbs would then be separated from the ribbon. A light blow with a hammer-like device and a puff of compressed air would knock each bulb off the ribbon.

Frosting would be the final step in the process. The blank bulbs would be set in a rack which holds approximately one hundred blanks open end down. Jets of "white acid" (mixture of hydrofluoric acid and ammonium fluoride) would be sprayed into the bulbs momentarily. This would produce a rough or matt surface. The rack would then move to a second tank where water would be sprayed into the bulbs to rinse out the acid and reaction products. Over a third tank the bulbs would receive jets of clear



SOURCE: Dellinger, 1975.

FIGURE II-10
POSSIBLE WASTEWATER TREATMENT SYSTEM
FOR GLASS CONTAINER MANUFACTURING

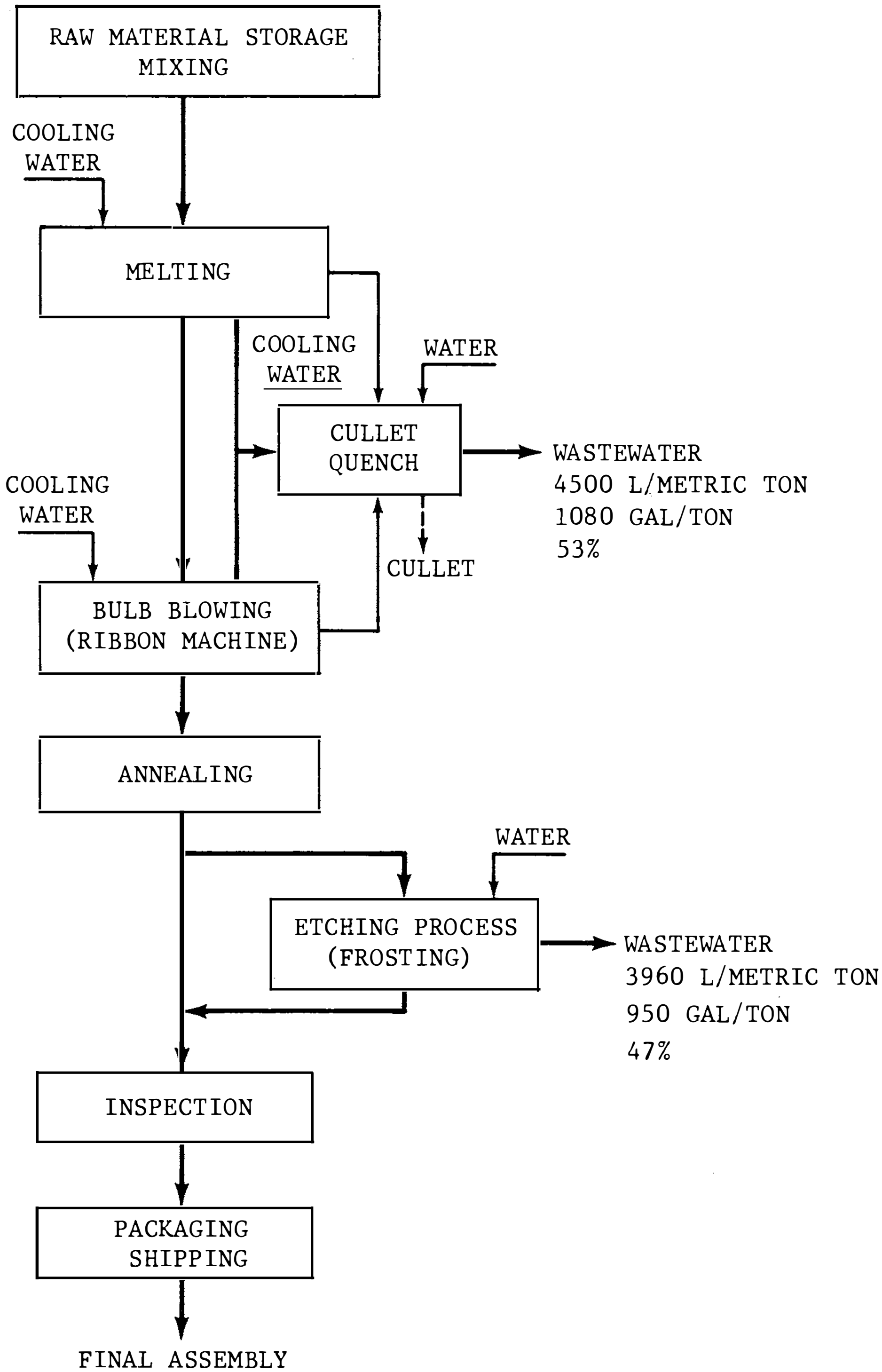


FIGURE II-11
FLOW DIAGRAM FOR INCANDESCENT LAMP GLASS MANUFACTURING

hydrofluoric acid which would round off the angularities of the tiny grooves formed by the action of the white acid.

(2) Water Usage and Characteristics

Process water would be used in the production of incandescent lamp envelopes for cullet quenching and rinsing frosted bulbs. The frosting wastewater stream would be the major source of pollutants and would contain high concentrations of fluoride and ammonia. Flows would average 950 gal/ton. Non-contact cooling water could double for quench waters. Additional wastewater would be contributed by the emulsified oil solution that would be sprayed on the ribbon machine blowpipes and bulb molds. These combined flows would amount to approximately 1080 gal/ton.

Typical characteristics of the cullet quench waters and the frosting waters are shown in Table II-7. Suspended solids would consist of fine particles of glass and substances from the frosting process. Oil in the cullet quench water would result mostly from the emulsified oil used to spray the ribbon machine blow tips and from lubricating oil leaks.

Table II-7. Raw Wastewater Incandescent Lamp Envelope Manufacturing

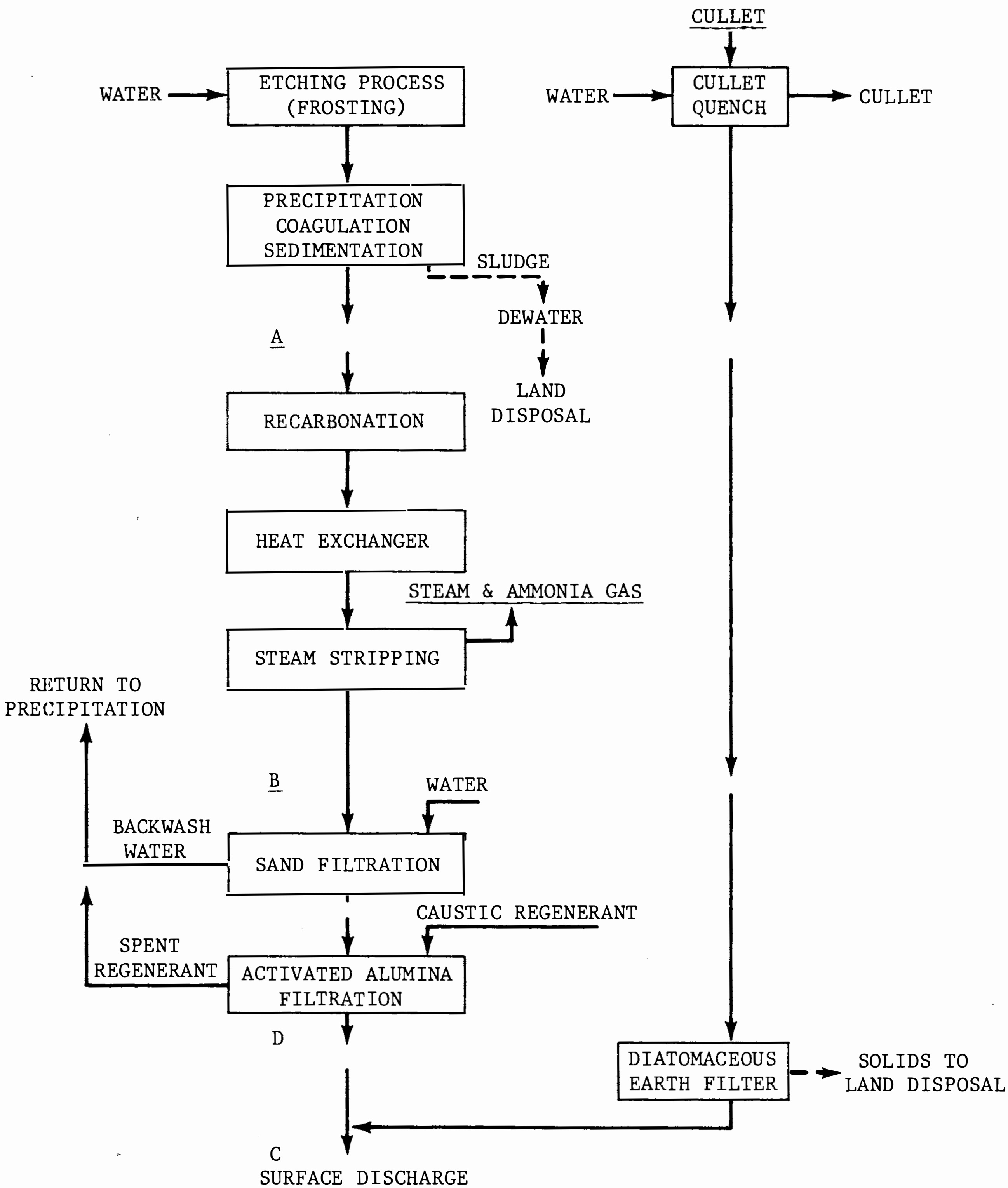
	Cullet Quenching	
Flow	1080 gal/ton	
pH	8.6	
COD	0.23 lb/ton	25 mg/l
Suspended Solids	0.23 lb/ton	25 mg/l
Oil	0.23 lb/ton	25 mg/l
	Frosting	
Flow	950 gal/ton	
pH	3.0	
COD	0.20 lb/ton	25 mg/l
Suspended Solids	0.79 lb/ton	100 mg/l
Fluoride	22.2 lb/ton	2800 mg/l
Ammonia	5.1 lb/ton	650 mg/l

Source: Dellinger, 1975

Fluoride and ammonia would be contributed to the wastewater by the frosting solution and by the discharge of fume scrubbing equipment. Spent frosting solution would be regenerated and reused or disposed of separately and would not be discharged to the wastewater stream.

(3) Pollutant Control Technology

A possible wastewater treatment system for incandescent light bulb manufacture is shown in Figure II-12. The most significant water control problem would be treatment of the acid solutions used in frosting. Frosting wastewaters would be treated using lime precipitation for fluoride and suspended solids removal. However, this system would not remove ammonia. This treatment followed by flocculation



SOURCE: Dellinger, 1975.

FIGURE II-12
POSSIBLE WASTEWATER TREATMENT SYSTEM FOR INCANDESCENT LAMP GLASS MANUFACTURING

and sedimentation would reduce the fluoride concentration to about 30 mg/l and suspended solids to about 60 mg/l. Ammonia concentrations would be about 276 mg/l. Some ammonia discharge could be eliminated by separate disposal of the concentrated etching solution. It would be possible to recover the salts from the etching solution by evaporating most of the water and allowing the sludge to air dry. Fluoride and suspended solids in the frosting wastewaters would be reduced further to approximately 10 mg/l and 13 mg/l, respectively, through sand filtration. Ammonia levels could be reduced to approximately 30 mg/l by steam stripping. Recarbonization would stabilize the excess calcium and consequently control pH which would in turn cause better ammonia removal. Activated alumina filtration would serve to further reduce the fluoride content. If the activated alumina regenerant is sodium hydroxide, it can be returned to the lime precipitation system for treatment. This method should reduce fluoride to approximately 2 mg/l (Dellinger, 1975).

Cullet quench waters have historically been discharged untreated or oil skimmers have been used to remove free oil. Good housekeeping measures would reduce the suspended solids and oil content of the quench water to approximately 25 mg/l. Most of the oil and suspended solids would originate in the ribbon machine area. Monitoring of coolant spray and lubrication techniques and collection of highly contaminated clean-up waters would do much to reduce the loads. The oil and suspended solids in the cullet quench water would be reduced by filtration through an oil adsorptive diatomaceous earth medium. The resulting filter cake would be about 15 percent solids. The oil and suspended solids content of the filtrate would be approximately 10 mg/l (Dellinger, 1975).

d. Air Pollution

Most of the air emissions from the glass container facility and the miniature light bulb manufacturer would result from the glass melting operation. Emissions would consist primarily of particulates and fluorides. Particles would be only a few microns in diameter. Consequently, cyclones and centrifugal scrubbers would not be as effective as baghouses or filters in collecting particulate matter. Emission factors for melting of soda lime glass are 2 lb of particulates per/ton of glass produced and 4x the weight percent of fluoride in the glass in lb/ton (EPA, 1976). The incandescent light bulb facility might also have a problem from steam stripping of the ammonia. If the ammonia were vented through the furnace exhaust stack, the combined concentration would probably not exceed 35 mg/cu m. This is the threshold odor limit for ammonia (Dellinger, 1975).

e. Solid Wastes

Three types of solid wastes would be generated. These would be oil skimmings from the dissolved air flotation, spent diatomaceous earth, and lime precipitation sludges. The oil skimmings have a 3 percent solids content and would be in the range of 200-400 gallons per day. These skimmings may be disposed of by an oil reclamation firm, used as road oil, or incinerated (Dellinger, 1975).

Spent diatomaceous earth has an estimated moisture content of approximately 85 percent and does not flow. Somewhere between 2-20 cu. ft. per day would be generated. This material would be stable and should be suitable for landfill (Dellinger, 1975).

The lime precipitation process would produce the greatest volume of sludge. It may reach several tons per day and would be disposed of as landfill (Dellinger, 1975).

2. Ceramic Products Industries

Two of the industries which would inhabit the park fall into this classification. These are the ceramic tile and porcelain products manufacturers. They would occupy lots 10 and 13, respectively.

a. Raw Materials

The raw materials that would be needed encompass a wide variety of minerals and inorganic chemicals. The most common are listed below (Versar, 1975):

Borax	Lithium carbonate	Copper oxide
Boric acid	Spodumene	Iron oxide
Silica	Magnesium carbonate	Lead monoxide
Soda ash	Calcium carbonate	Manganese dioxide
China clay	Barium carbonate	Nickel oxide
Feldspar	Potassium carbonate	Titanium dioxide
Nepheline syenite	Potassium nitrate	Zinc oxide
Fluorspar	Sodium nitrate	Monosodium phosphate
Potassium silicofluoride	Antimony oxide	Zircon
Sodium silicofluoride	Hydrated alumina	Whiting
	Cobalt oxide	Wollastonite

b. Ceramic Tile Industry

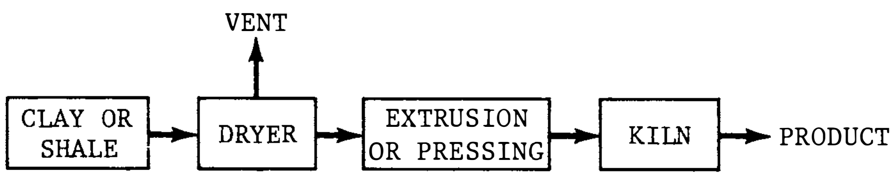
(1) Manufacturing Process

Figure II-13 shows a typical flow diagram for ceramic tile manufacture. Raw materials would be blended together or batched as the first step in the production of ceramic tiles. These raw materials would be talc, ball clay, and kaolin and may include soapstone, feldspar, silica, pyrophyllite, nepheline syenite, wollastonite, dolomite, whiting, and stratite. During batching some water would be added to increase plasticity.

The next step would be to press the mixture to the desired configuration. After pressing, the "green" tiles would be processed differently depending on the product. Final tiles may be glazed or unglazed. Unglazed tiles would be fired directly after pressing. Glazed tiles may be glazed and then fired or fired, glazed and refired. After air cooling, the tiles would be inspected and packaged (Versar, 1975).

(2) Water Usage and Characteristics

Water usage would vary greatly depending on whether the tiles would be glazed or unglazed. The average water use (excluding sanitary) for existing plants producing glazed tile is 260 gal/ton. The unglazed plants have an average water use of 20 gal/ton and many use no process water. Water usages would include process water in mixing of batches and glazes, cooling, clean-up, dust control, and boiler



SOURCE: Versar, 1975.

FIGURE II-13
FLOW DIAGRAM FOR MANUFACTURE OF CERAMIC TILE

feed. Very small volumes of water are discharged and the major constituent would be suspended solids. Small amounts of mineral raw materials and glaze ingredients may also be found.

(3) Pollution Control Technology

If the tile facility produces unglazed tile, it would be possible to have no discharge of water except for sanitary wastes. Effluent from glazing operations would enter an evaporation/settling pond to reduce suspended solids. Chemical flocculants may also be used. Probable ranges of effluent concentrations are shown in Table II-8. Lead and zinc would create the greatest problems and further treatment to remove these constituents would be necessary.

Table II-8. Possible Effluent Concentrations
Glazed Tile Manufacture

Constituent	Concentration mg/l
pH	5-12
COD	30-150
TSS	500-1000
TDS	20-320
Ba	300-500
Cd	<0.01-0.03
Cr	<0.05
Cu	<0.05-0.15
Fe	0.04-0.87
Pb	0.55-12.0
Mn	<0.02-0.07
Mo	<0.5
Ni	0.08-0.35
Sr	0.06-0.35
Zn	2.0-400

Source: Versar, 1975

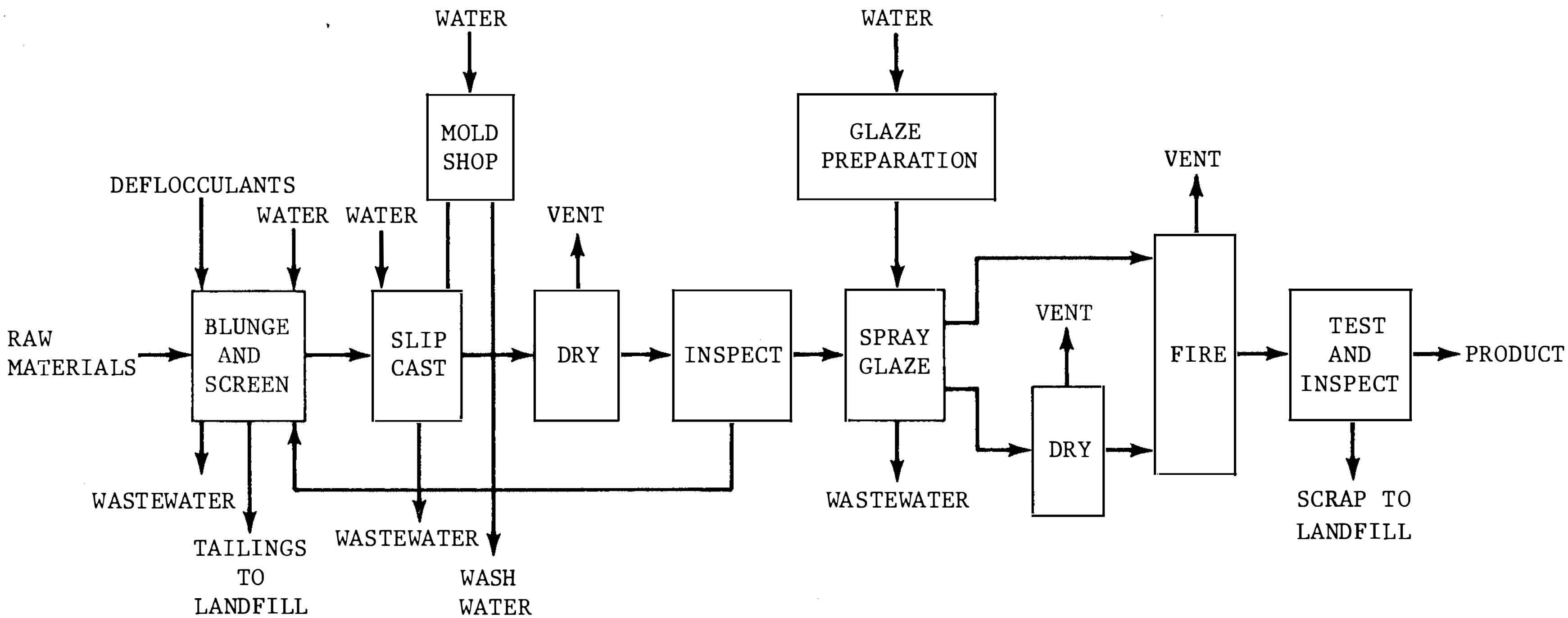
c. Porcelain Products Manufacture

(1) Manufacturing Process

Figure II-14 presents a generalized flow diagram for production of porcelain products. Raw materials would be mixed with water to create a suspension. This suspension would be screened, passed through a magnetic separator, and then fed into plaster-of-paris molds. The "green" ware would be partially dried, removed from the mold, hand rubbed, sponged, and inspected. After aging in a warm drying room for several days, the green ware would be sprayed with a glaze consisting of silica, feldspar with fluxes, opacifiers and dyes in an aqueous medium. Glazed ware would then be air dried, stacked on kiln cars, and fired.

(2) Water Usage and Characteristics

Process water would be used for slip preparation, cleanup, and glaze spray booth dust control. Auxiliary uses would be cooling and boiler feeding. Total process water flows would range from 70-750



SOURCE: Versar, 1975.

FIGURE II-14
FLOW DIAGRAM FOR MANUFACTURE OF PORCELAIN PRODUCTS

gal/ton with an average of 320 gal/ton. Cooling water flows would range from 1-230 gal/ton with an average of 90 gal/ton. Boiler water flows would range from 1-57 gal/ton with an average of 23 gal/ton. Glaze spray booth dust control uses would range from 9-200 gal/ton with an average of 70 gal/ton (Versar, 1975).

Wastes may also be generated from slurry preparation and glaze cleanup and dust control. Recycling of glaze wastes would be possible only if there are no color changes. Total suspended solids of untreated wastes would be 500-1000 mg/l. Other constituents would be lead (0.2-3 mg/l), zinc (1-15 mg/l), and barium (0.1-12 mg/l).

(3) Pollution Control Technology

The porcelain products facility would install a sump, clarifier, settling tank, and perhaps a sand bed filter for treatment of its wastewaters. It may be necessary to acid treat the raw waste to decrease settling times and then after settling to pH adjust the stream (Versar, 1975). Some plants have been able to achieve no discharge through evaporation of ponded wastewaters. Although these techniques may seem rudimentary, they appear to be satisfactory in removing pollutants. Existing plants practicing these technologies are able to recycle their wastewater for washdown in the casting and finishing areas and for slip make-up water. Using these techniques effluent discharges would be approximately 100 mg/l suspended solids, 0.5 mg/l lead, 0.5 mg/l zinc, and 0.5 mg/l barium.

(4) Air Pollution

Possible sources of air pollution from these two ceramic products industries would be from grinding of raw materials and from furnace exhausts and vent emissions. Grinding of materials would result in dust from clay and shale. The constituents of this dust would be mostly silica and aluminum oxide. Emission factors have been developed for manufacture of bricks. It is assumed that similar emissions would occur from tile and porcelain products manufacture. The emission factor from grinding and drying raw materials is 96 lb/ton of product. For storing, it is 34 lb/ton (EPA, 1976).

For curing and firing, the following emissions factors have been computed: 0.04 lb/ton of particulates, negligible lb/ton of SO_x, 0.04 lb/ton of CO, 0.02 lb/ton of hydrocarbons, 0.15 lb/ton NO_x and 1.0 lb/ton fluoride. These figures assume gas-fired tunnel kilns. Tunnel kilns were chosen over periodic kilns because of greater fuel efficiency (EPA, 1976).

A variety of control systems may be used to reduce particulate and gaseous emissions. The emission of fluorides can be reduced by operating the kiln at temperatures below 2000°F and by choosing clays of low fluoride content. Satisfactory control can be achieved by scrubbing kiln gases with water. Wet cyclone scrubbers can remove fluorides with an efficiency of 95 percent.

(5) Solid Wastes

Solid raw wastes from this kind of operation would consist of raw materials and frits (glass which contains fluxing material and is used as a constituent in a glaze, body, or other ceramic composition). Other solid raw wastes would consist of firebrick and frit of various composition generated from rebuilding of smelters. The quantity of solid wastes generated in this way would be approximately 8.0 kg of raw materials and frit per kkg of product and 3.0 kg of firebrick per kkg of product (Versar, 1975).

3. Commercial Heat Treating

A commercial heat treating operation would occupy lot 12. A wide range of metal heat treating methods exist. This is because of the differing properties of materials treated. In general, heat treating is accomplished by raising the metal to a desired temperature at a controlled or uncontrolled rate, followed by quenching in air, oil, brine, or water. A typical process flow diagram for heat treating type processes is shown in Figure II-15. Process water, which constitutes 39 percent of the gross water used in the industry is used mainly for rinsing subsequent to quenching and washing. Possible contaminants would include alkali, phosphates, detergents, cyanides, and oils (EPA, 1975).

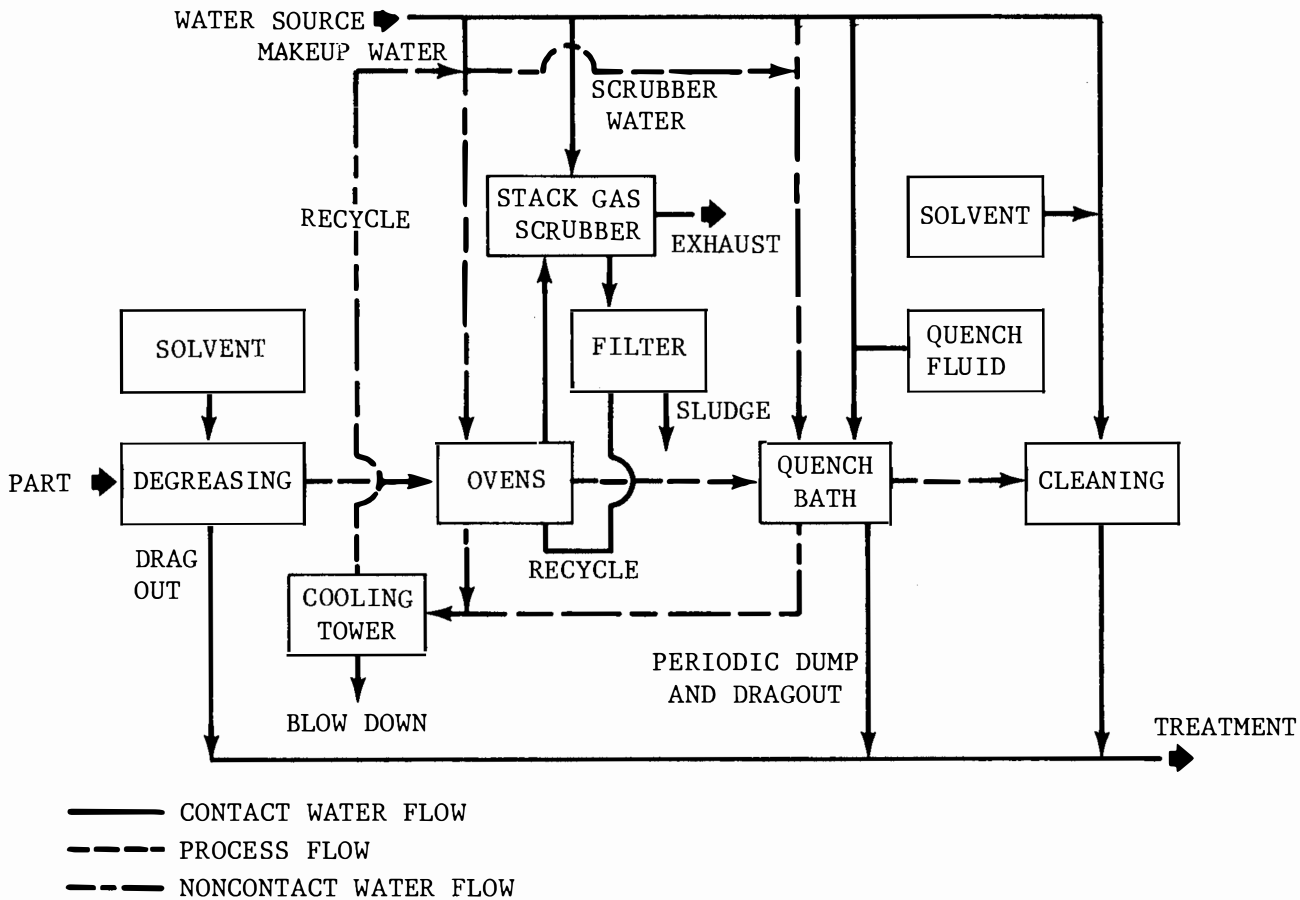
a. Manufacturing Process

Carbonitriding is a typical heat treating process and is assumed to be the process performed in the establishment located in the industrial park. A typical flow diagram is shown in Figure II-16. Carbonitriding would be carried out in a gas fired furnace with an endothermic atmosphere at 790°C. After exposure to this atmosphere for 5-10 minutes, ammonia and natural gas would be introduced for 15 minutes. The carbon and nitrogen would be absorbed by the metal surface and would harden it. The metal would then be quenched in oil and washed to remove the oil (EPA, 1975). It is possible that carbonitriding would also be done using a molten cyanide salt bath.

b. Water Use and Characteristics

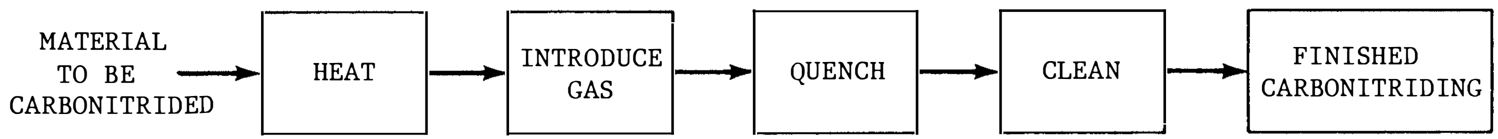
As evident from Figure II-15, water would be used for noncontact cooling of furnace doors and for heating or cooling of quench baths. The major contact liquid would be water used in the cleaning of parts and for quench baths. Water used in quench baths would probably be held in tanks and dumped periodically when sufficiently contaminated to make it unusable. Since contact water would be used only once, it would comprise the greatest discharge volume. Other uses of water include air pollution control of stack gases from furnaces (EPA, 1975). Total discharge of water would be approximately 100,000 gal/day.

Probable concentrations of constituents in the raw waste streams are given in Table II-9. The most significant constituents would be cyanide, oil and grease, suspended solids, and COD. Also, significant quantities of chlorides, potassium, and sodium would be present.



SOURCE: EPA, 1975.

FIGURE II-15
FLOW DIAGRAM FOR HEAT TREATMENT PROCESSES



SOURCE: EPA, 1975.

FIGURE II-16
FLOW DIAGRAM FOR CARBONITRIDING

Table II-9. Average Concentrations of Wastewater Constituents Heat Treatment Process

Parameter	mg/l
pH, Acidic	4.347
pH, Alkaline	9.003
Turbidity	349.148
Temperature (°C)	23.826
Dissolved Oxygen	6.979
Residual Chlorine	2.667
Acidity	375.412
Alkalinity	1367.551
Ammonia	3.630
BOD 5	322.439
Color	196.756
Sulfide	0.565
Cyanide, Total	67.186
Cyanide Amn. to Chlor	0.010
Kjeldahl Nitrogen	7.293
Phenols	0.390
Conductance	2689.780
Total Solids	2016.146
Total Suspended Solids	715.887
Settleable Solids	6.353
Aluminum	2.129
Barium	0.987
Cadmium	0.006
Calcium	56.344
Chloride	245.842
Chloride, Total	0.008
Chromium, Hexavalent	0.005
Copper	0.434
Fluoride	3.200
Iron, Total	14.502
Iron, Dissolved	5.945
Lead	2.768
Magnesium	14.705
Manganese	0.224
Molybdenum	0.292
Oil, Grease	681.392
Hardness	298.628
COD	2356.958
Total Phosphates	0.600
PCB	12.842
Potassium	189.820
Silica	16.372
Sodium	674.203
Sulfate	482.165
Sulfite	33.784
Titanium	0.139
Zinc	1.182
Arsenic	0.010
Boron	1.487
Mercury	0.010
Nickel	1.261
Nitrate	37.350
Nitrite	0.759
Selenium	0.010
Silver	0.003
Strontium	1.409
Cobalt	0.010
Thallium	0.020
Tin	0.072

Source: EPA, 1975

Cyanide would result from the washing of parts which have been treated with cyanide. Oil and grease would come from oil quench baths and from degreasing operations before and after treatment. The sodium, potassium, and chloride would result from cleaning after salt bath quench operations.

c. Pollution Control Technology

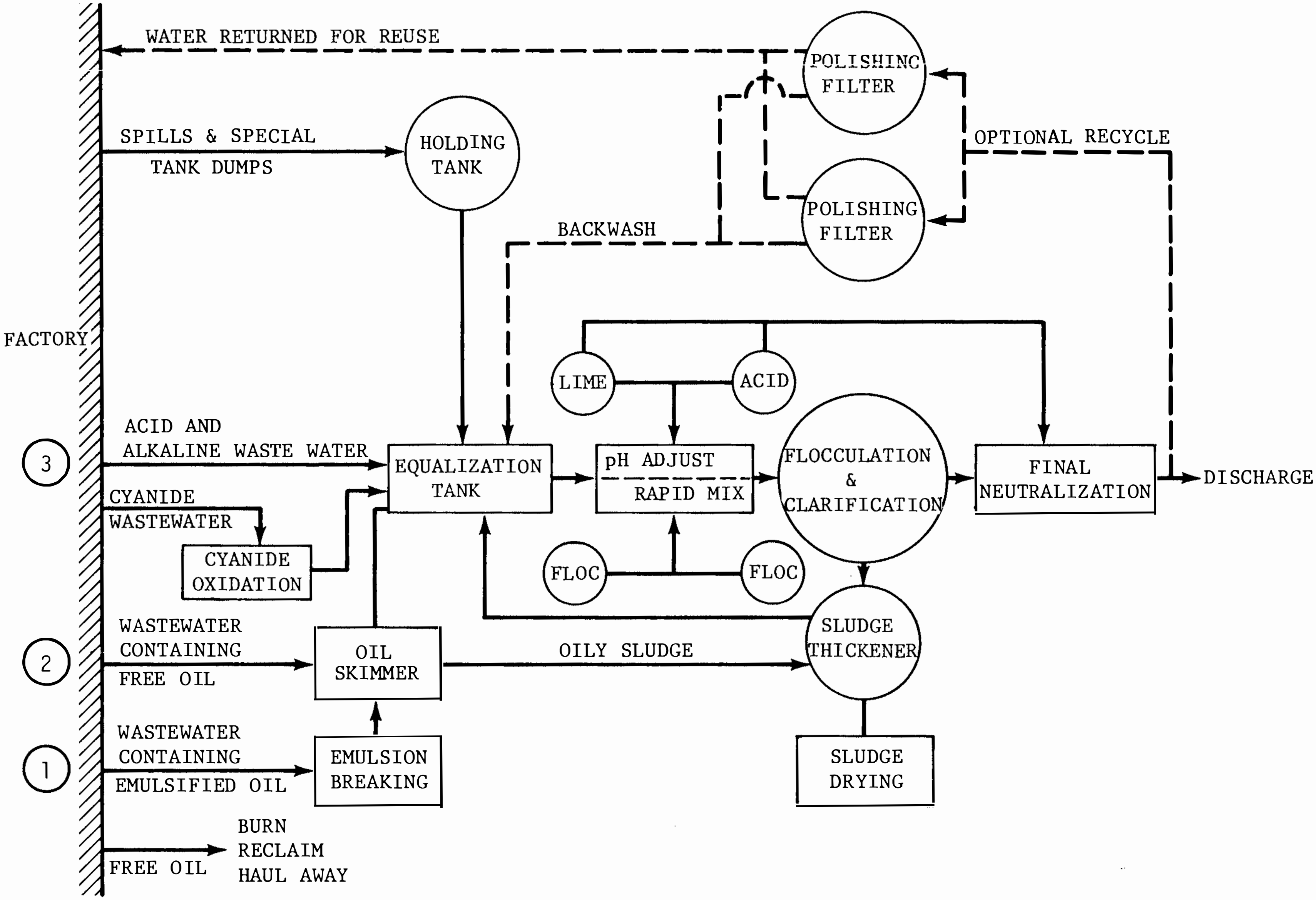
The waste treatment system that would be most likely to adequately remove the pollutants is shown in Figure II-17. Stream 1 would contain segregated emulsified oils that would enter the emulsion breaking tank. Emulsion breaking would be accomplished by adding sulfuric acid and steam. This would reduce the miscibility of oil and water, and the oil would rise to the surface and be separated by a skimmer.

If the oils have the same specific gravity as the water, lime, alum, ferrous sulfate, soda ash, or ferric chloride would be used as flocculants. Air flotation would then be used to bring the floc and oil to the surface. Oil removal efficiencies would be about 60-90 percent and would be governed by optimum pH adjustment.

Stream 2 would consist of segregated wastes containing free oils. It would be treated directly by the oil skimmer. The oil/water mixture from the emulsion breaking tank would also enter the skimmer. The free oil would rise to the surface and be swept into a receiving channel and pumped to an oil holding tank to await ultimate disposal. Water in the skimmer would be discharged to the equalization tank.

Stream 3 would consist of the dilute segregated acid and/or alkali waters and the suspended and dissolved solids. It would enter directly into the equalization tank from the plant. The equalization tank would provide a mixing basin for the oily waste stream and the dilute acid/alkali wastes. Also, any spills or batch dumps would be metered into the waste stream at a rate whereby it could be treated properly.

From the equalization tank, the combined waste stream would enter the chemical treatment section of the facility. Coagulation and precipitation would occur, removing 60-98 percent of the dilute oils and grease, suspended solids, metals, fluorides, and phosphates. Those wastewaters containing cyanide must be segregated and oxidized prior to combining them with the rest of the waste stream. Table II-10 lists the expected pollutants, raw waste load concentrations, and concentrations after treatment.



SOURCE: EPA, 1975.

FIGURE II-17
POSSIBLE WASTEWATER TREATMENT SCHEME
FOR HEAT TREATMENT PROCESSES

Table II-10. Concentrations of Wastewater Constituents After Treatment-Heat Treatment Process

Parameter	Raw Waste mg/l	Treated Waste mg/l	Percent Reduction	Remarks
Flow (l/hr)	15,771	15,771	N/A	Equivalent to 100,000 gal/day.
pH	9.0	8.5	N/A	
Suspended Solids	716	15	98	
Cyanide	67.2	0.05	99+	
Iron	14.5	0.5	97	
Lead	2.8	0.1	96	
Nickel	1.3	0.2	85	
Oil and Grease	681.0	5.5	99	
COD	2360.0	70.8	97	

Source: EPA, 1975

d. Air Pollution

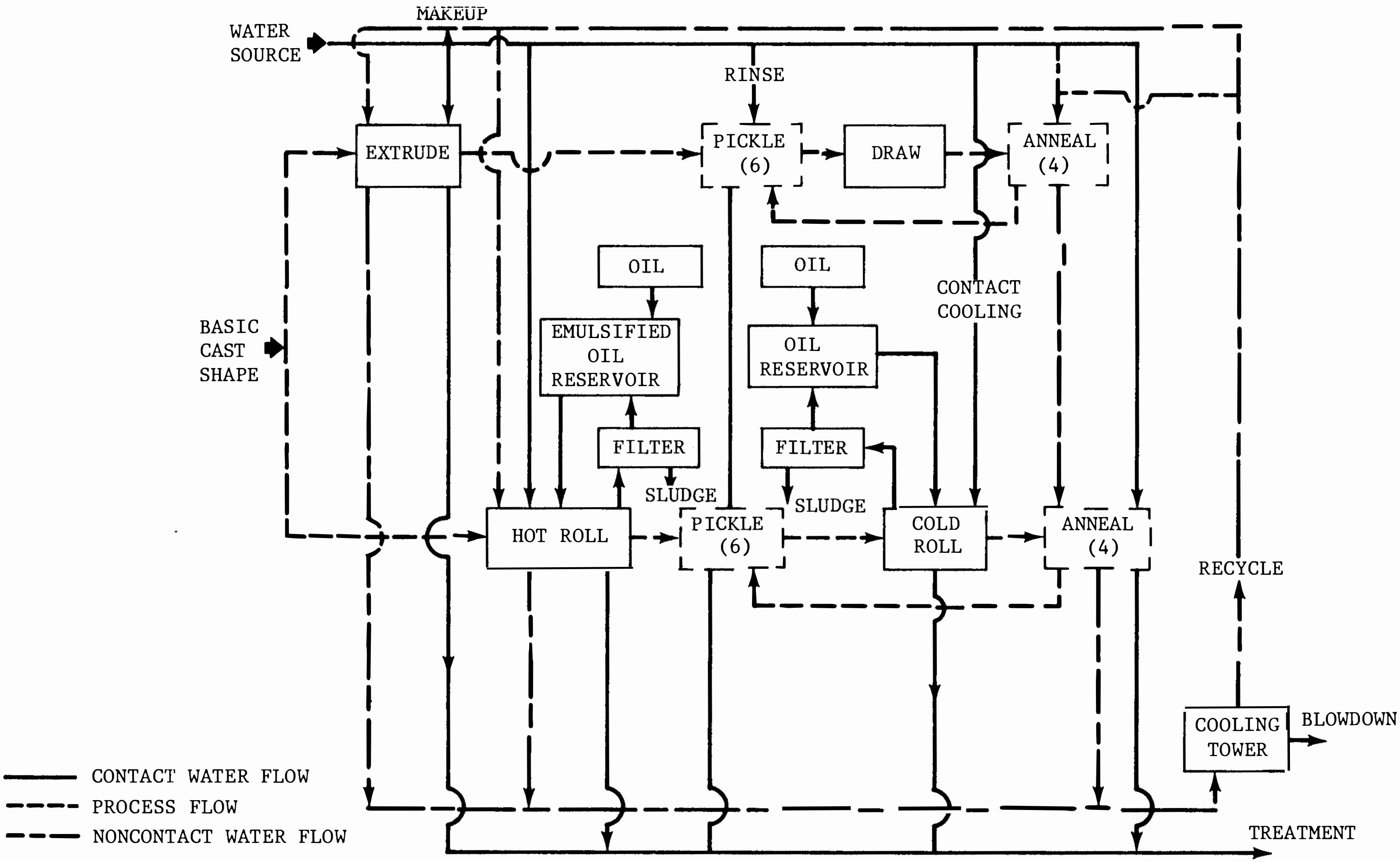
The primary source of air pollution would be the oven exhaust gas. Stack gas scrubbers would be employed to clean up this exhaust. Resulting effluent would be filtered and recycled through the process as shown in Figure II-17. During carbonitriding the molten cyanide salt bath would produce alkali carbonate dust which is an irritant. It can be removed through a scrubber (EPA, 1975).

e. Solid Wastes

The major sources of solid wastes would be oils from skimmers and sludge from the clarifier. Emulsified oils would be fed to the sludge thickener (see Figure II-17) and then sent to the sludge drying bed. These oils would become part of the sludge which would be disposed of as landfill. Free oils would be burned or reclaimed by a contract hauler.

4. Metal Stamping and Fabricating

The principal manufacturing operations in this facility would be material forming and material coating. A generalized process diagram is shown in Figure II-18. The major raw materials would be steel, copper and aluminum.



SOURCE: EPA, 1975.

FIGURE II-18
FLOW DIAGRAM FOR METAL FORMING PROCESS

Metal stampings would be made by cutting stock and stamping it into the desired shape. After stamping, the excess metal would be trimmed off and the surface would be cleaned and finished. Process water would constitute approximately 10 percent of the gross water used. It would be used mainly for washing and rinsing of the pieces after stamping to remove waxes and lubricants that would be used in the dies in the stamping process (EPA, 1975).

a. Manufacturing Process

The manufacture of bottle openers and similar kitchen utensils is representative of the metal stamping industry. This type of process would be housed on Lot 11. Figure II-19 is a flow diagram of this process. Raw sheet stock would first be sheared to the approximate size. Then the shape of the raw utensil would be formed in a blanking operation. The ornamental work and sections such as tongs on a fork would then be stamped. Curves would be formed by bending. The final piece would be cleaned to remove any lubricants from the forming operation. Finally, the item would be plated with chrome or nickel.

b. Water Usage and Characteristics

Water would be used for contact and noncontact cooling water, lubrication, and emulsion make-up. Emulsified oil may be used as the coolant-lubricant used in hot rolling and the majority of this stream would be recirculated. However, spilling and wasting of spent emulsions could result in a waste stream. Average concentrations of raw waste stream constituents are shown in Table II-11. The major pollutants would be oil and grease, COD, suspended solids, and metals.

c. Pollution Control Technology

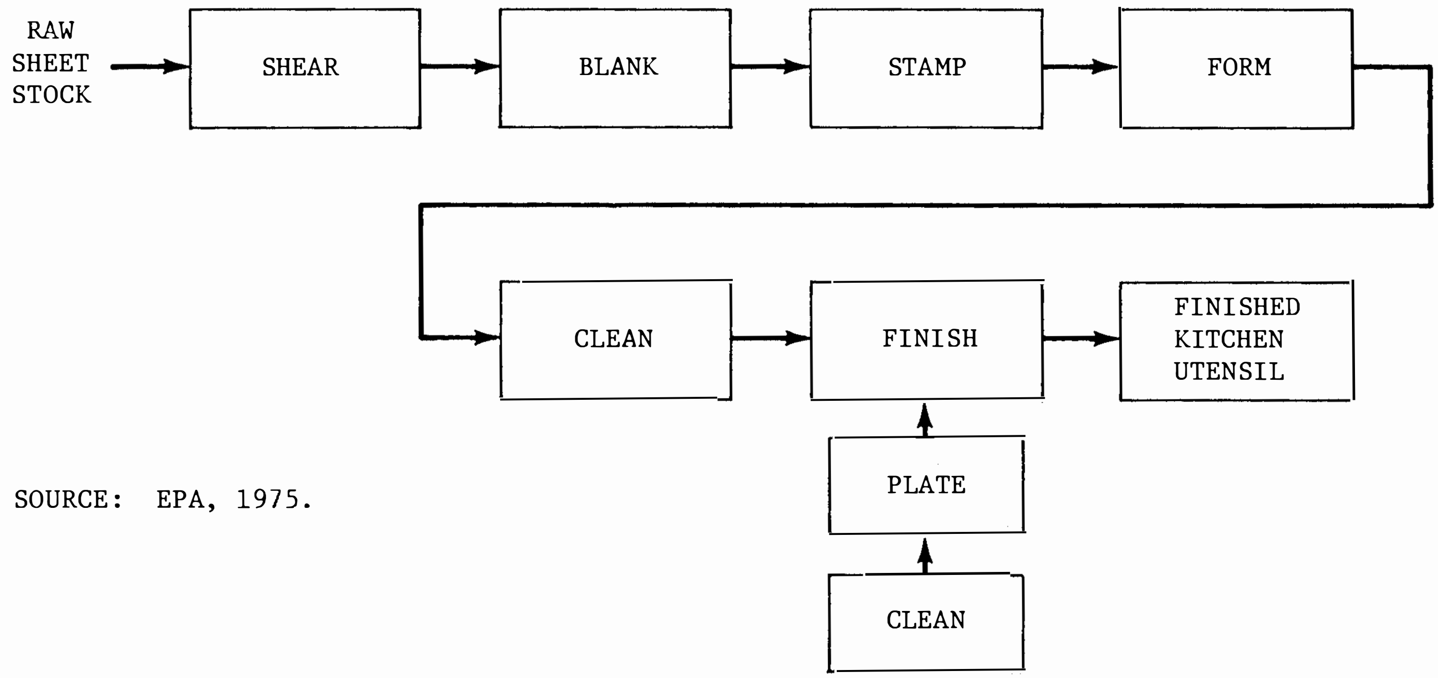
The treatment system best suited to this kind of operation is the same as that discussed for heat treating processes (see Figure II-17). The expected raw waste loads, treated waste loads, and percent reduction are shown in Table II-12.

(d) Air Pollution

The major source of air pollution would be fuming of the plating baths if these were part of the production process. Good ventilation must be present in order to ensure worker safety. It may be necessary to install a scrubber to treat these fumes.

(e) Solid Wastes

Solid wastes generated and means of disposition would be the same as those discussed in Section II-G.-3.e. In addition to these solid wastes, there would also be waste metal trimmings. These trimmings would be sent out to be remelted and recycled in other operations.



SOURCE: EPA, 1975.

FIGURE II-19
FLOW DIAGRAM FOR MANUFACTURE OF KITCHEN UTENSILS

Table II-11. Average Concentrations of Wastewater Constituents Metal Fabrication Process

Parameter	mg/l
pH, Acidic	4.718
pH, Alkaline	8.772
Turbidity	472.400
Temperature	24.117
Dissolved Oxygen	5.671
Residual Chlorine	2.333
Acidity	14096.344
Alkalinity	650.356
Ammonia	5.403
B.O.D. 5	448.921
Color	224.710
Sulfide	0.645
Cyanide, Total	0.523
Cyanide Amn. to Chlor	0.518
Kjeldahl Nitrogen	17.608
Phenols	0.473
Conductance	6772.312
Total Solids	5294.062
Total Suspended Solids	1034.100
Settleable Solids	8.485
Aluminum	13.269
Barium	0.836
Cadmium	0.064
Calcium	34.574
Chloride	154.730
Chloride, Total	0.085
Chromium, Hexavalent	0.011
Copper	8.471
Fluoride	0.727
Iron, Total	29.348
Iron, Dissolved	14.309
Lead	2.751
Magnesium	16.348
Manganese	1.164
Molybdenum	0.073
Oil, Grease	599.668
Hardness	5304.152
C.O.D.	2826.503
Total Phosphates	6.455
P.C.B.'s	9.867
Potassium	18.219
Silica	15.387
Sodium	305.670
Sulfate	304.493
Sulfite	7.967
Titanium	0.107
Zinc	10.766
Arsenic	0.010
Boron	1.509
Mercury	0.002
Nickel	5.797
Nitrate	7.080
Nitrite	0.582
Selenium	0.010
Silver	0.005
Strontium	1.186
Chlorinated Hydrocarbons	0.008
Cobalt	0.010
Thallium	0.020
Tin	0.083

Source: EPA, 1975

Table II-12. Levels of Reduction of Wastewater Constituents After Treatment Metal Fabrication Process

Parameter	Raw Waste mg/1	Treated Waste mg/1	Percent Reduction	Remarks
Flow (1/hr)	15,771	15,771	N/A	Equivalent to 100,000 gal/day
pH	8.8	8.5	N/A	
Suspended Solids	1,030.0	15.0	98	
Copper	8.5	0.2	98	
Iron	29.3	0.6	98	
Lead	2.8	0.1	90	
Nickel	5.8	0.2	96	
Oil and Grease	600	5.4	99	
CCD	2,830	84.9	97	
Phosphates	6.5	1.7	69	
Silver	0.01	0.01	0	No reduction due to low raw waste values found as an average for this sub-category.
Zinc	10.8	0.5	95	

Source: EPA, 1975

5. Wood Lamination

Lot 9 would be occupied by a company engaged in wood lamination. For the purposes of the scenario, it has been assumed that this facility would be engaged in the manufacture of hardboard. Hardboard is a generic term for a panel manufactured from interfelted ligno-cellulosic fibers consolidated under heat and pressure in a hot press to a density of 31 lb/cu ft or more. Other materials may be added to improve certain properties such as stiffness, hardness, finishing properties, resistance to abrasion and moisture, and to increase strength, durability, and utility (Williams, 1975).

a. Manufacturing Process

Raw material for hardboard production would be wood in the form of round wood, wood chips or other sources of wood fiber. There are two major hardboard manufacturing processes based upon the manner in which the board is formed. These are the wet process and the dry process. In the wet process water is used as the medium for carrying the fibers and distributing them to the forming machine (see Figure II-20). Air serves that function in the dry process (see Figure II-21).

In general, the first step would be fiber preparation, accomplished by a combination of thermal and mechanical pulping. This would involve a preliminary treatment of the raw material with heat (approximately 350°F) followed by passing the material through a disc refiner to further reduce it (Williams, 1974).

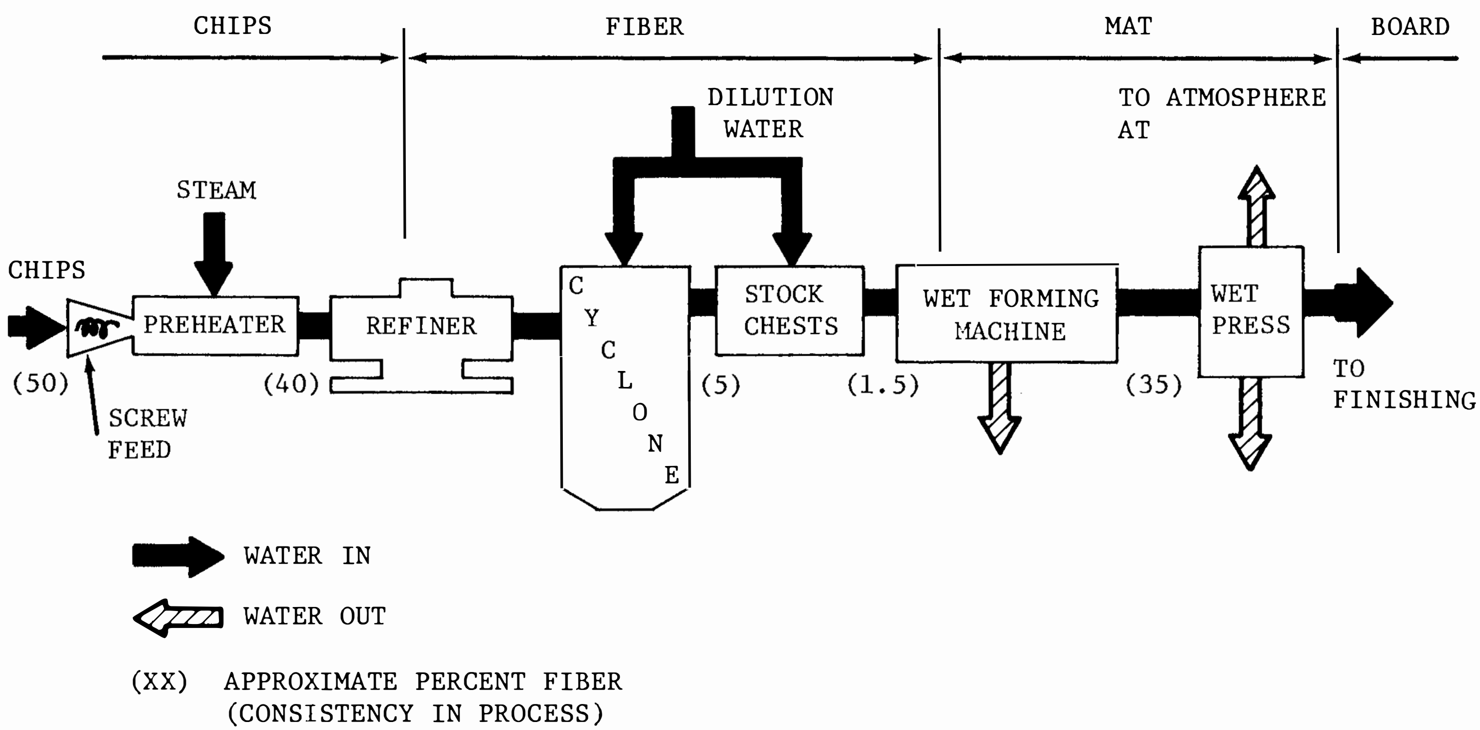
The pulp would then be formed into a mat either by the wet or dry process. Fibers would be welded together into a tough, durable, grainless board by a massive press. High pressure steam circulating within the press would provide the necessary heat to bond the fibers together. At the same time pressures between 35 and 130 atmospheres would be applied. The combination of heat and pressure applied to the mats would weld the fibers together (Williams, 1974).

After being ejected from the press, the boards would be tempered. This process would consist of impregnating the sheets of hardboard with drying oils or resins. This would increase the hardness, strength, and weather resistance of the board. The board would be finally humidified to increase moisture content and reduce warping (Williams, 1974).

b. Water Use and Characteristics

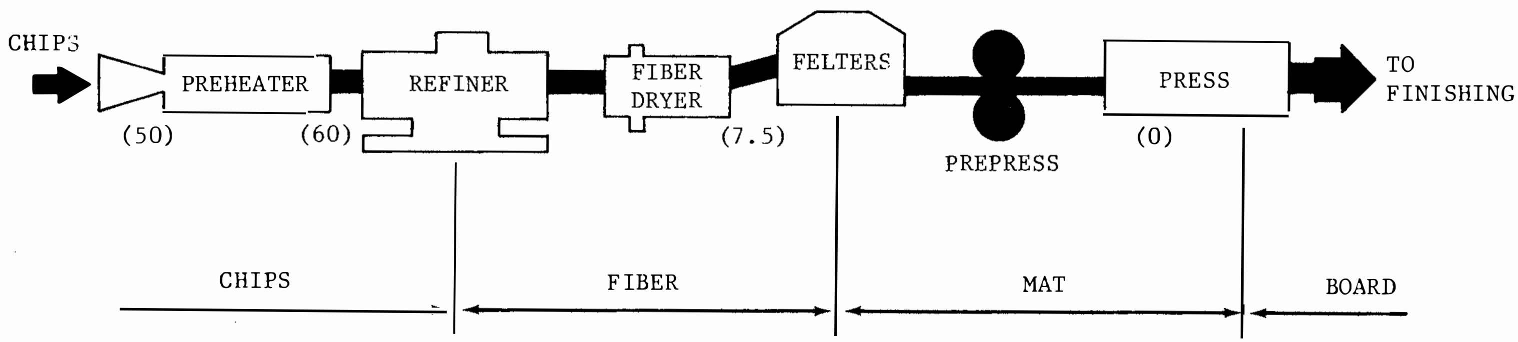
(1) Dry Process

In dry process hardboard production, the major water uses would be for log and chip washing, for the resin system, caul washing, humidification, and cooling water. Ranges of these flows in gallons/day are shown in Table II-13.



SOURCE: Williams, 1974.

FIGURE II-20
TYPICAL WET PROCESS HARDBOARD MILL



(XX) APPROXIMATE PERCENT MOISTURE

SOURCE: Williams, 1974.

FIGURE II-21
TYPICAL DRY PROCESS HARDBOARD MILL

Table II-13. Water Usages Introduction of Dry Process Hardboard

Operation	Water Use (gal/day)
Log and Chip Wash[1]	0 - 2,000
Resin Wash[2]	0 - 1,500
Caul Wash	0 - 170
Housekeeping[3]	0 - 5,000
Cooling Water	22,000 - 83,000
Humidification[4]	0 - 4,340

[1] Nine out of ten plants report 0 gal/day.
[2] Seven out of ten plants report 0 gal/day.
Second highest use is 150 gal/day.
[3] Six out of eight plants report 0 gal/day.
Second highest use is 100 gal/day.
[4] Ten out of eleven plants report 0 gal/day.

Source: EPA, 1975

Washing of raw materials to eliminate sand, dirt and debris is not widely practiced. Both fresh water and cooling water from mat formation may be used for log washing, and quantities of water would range from 105 to 330 gal/ton.

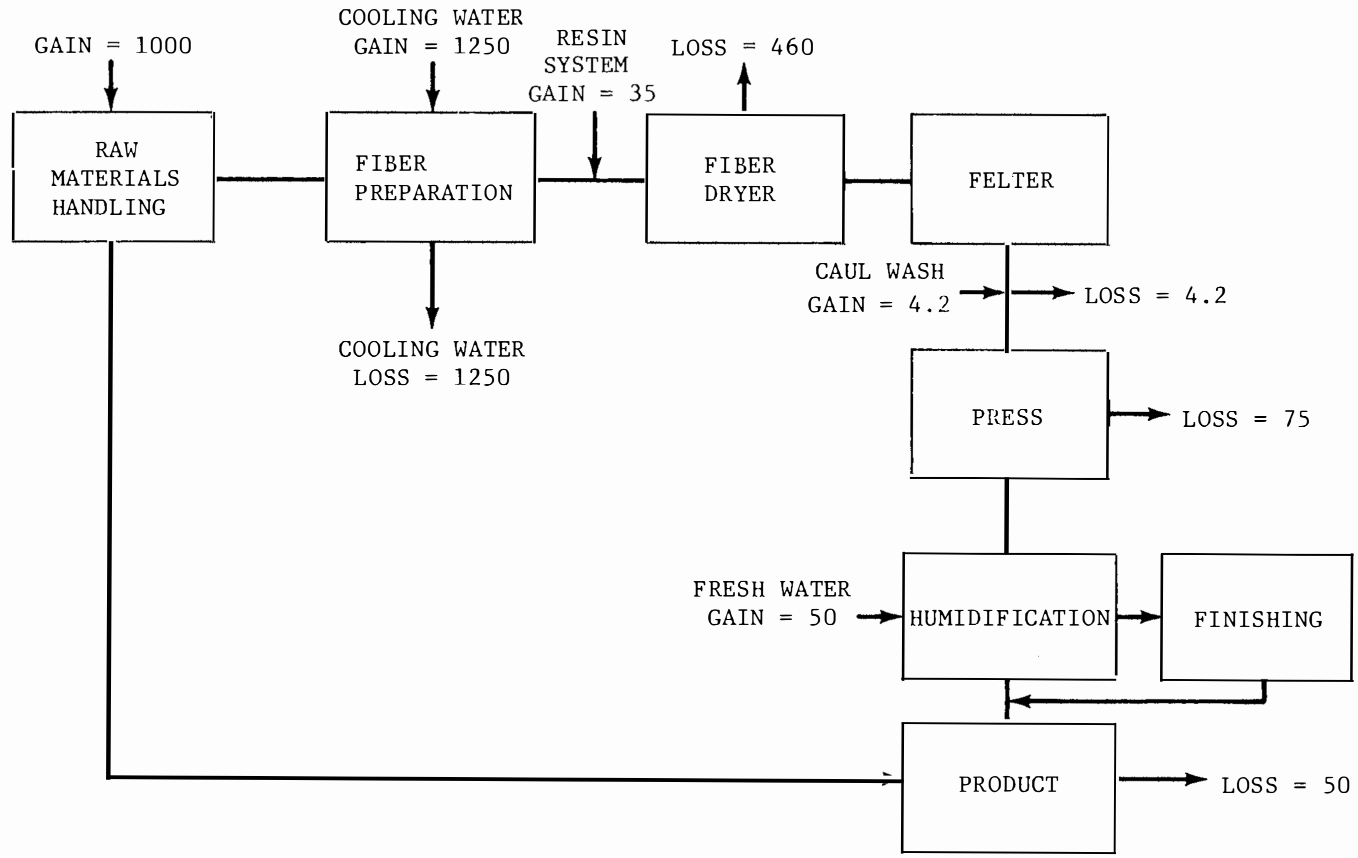
Water would also be used to make up the resins which are added as binders for hardboard. This water would evaporate in the press. Periodic cleaning of the resin system would result in discharge of chemical components of the resin. This discharge would include BOD, COD, TOC, phosphate, phenols, suspended solids, and dissolved solids.

Another cleaning operation which would generate wastes from time to time is the cleaning of press plates. These would be cleaned in place with caustic solution. They would then be rinsed off. Typical volumes would be 100-250 gal/day or 1.0 gal/ton of product.

The largest volume of water would be noncontact cooling water for refineries and air compressors. Cooling water would range from 5,000-75,000 gal/day (average = 50,000 gal/day). This cooling water may become contaminated with lubricating oil. A minor source of water would be from housekeeping procedures. A water balance diagram for a dry process facility is shown in Figure II-22.

(2) Wet Process

Wet process facilities have similar overall water requirements as dry process facilities. There are, however, variations in water use in fiber preparation and in mat formation and pressing. The only water used in fiber preparation is the addition of steam to the cooker. This quantity of steam is approximately equal to one-half the weight of dry chips processed (Williams, 1974).



*GAINS AND LOSSES SHOWN IN LITERS/TON DRY PRODUCT

TOTAL GAIN	= 2339.2
TOTAL LOSS	= 2339.2

SOURCE: Williams, 1975.

FIGURE II-22
WATER BALANCE FOR TYPICAL DRY PROCESS HARDBOARD MILL

The main reason for significant wastewater flows and concentrations from the wet process is that the fiber is diluted from 40 percent consistency to 1.5 percent consistency. Water removed from mat formation would be recycled as process water, evaporated, or discharged directly as wastewater. Process water recycle in a typical wet process production is shown in Figure II-23.

c. Pollution Control

(1) Water Pollution

In the dry process no discharge of pollutants would be possible by recycling log wash and chip wash water and disposing of the solids by landfill or use as boiler fuel; operating the resin system as a closed system, with wash water being recycled as make-up in the resin solution; neutralizing caul water, and disposing of it by impoundment or spray irrigation; and eliminating discharge from humidification by the implementation of in-plant control, including reasonable operating and process management processes (Williams, 1974).

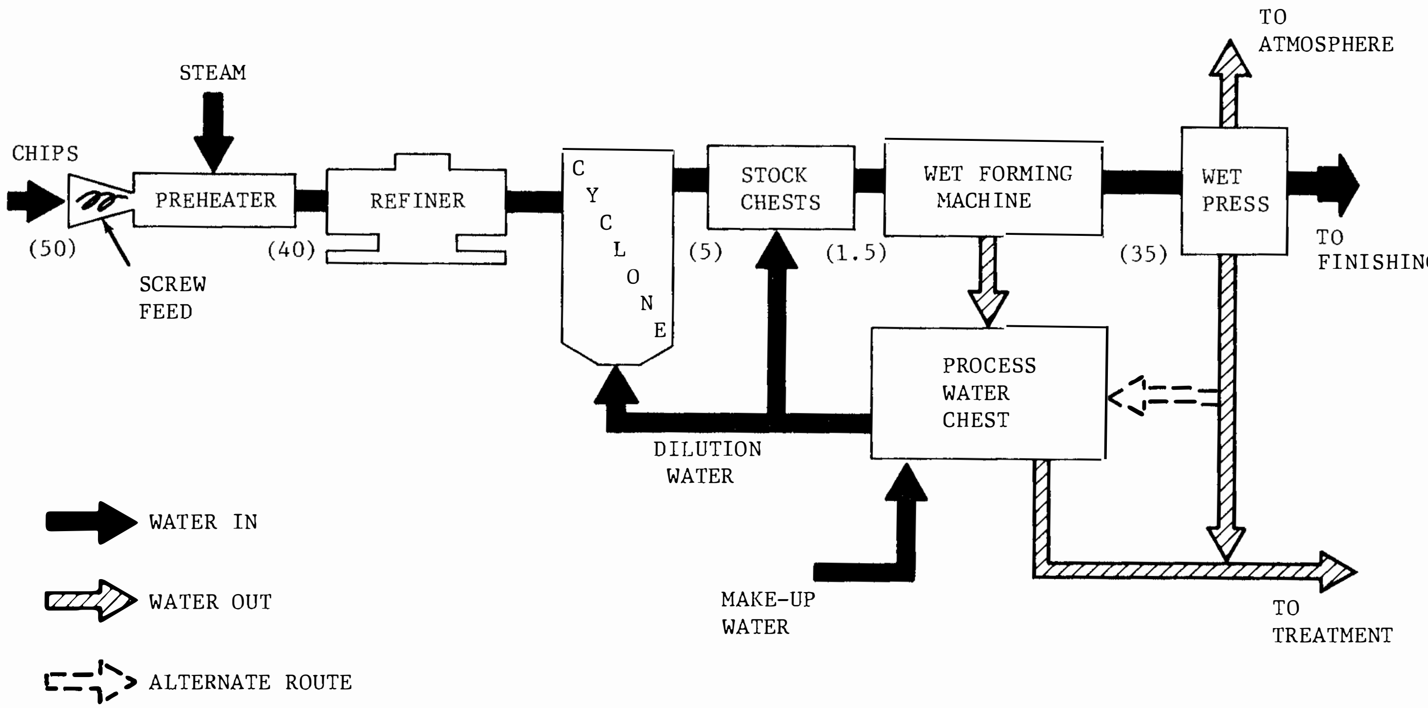
In the wet process no discharge of pollutants would be possible by recycling process water as dilution water, utilization of heat exchangers to reduce temperature, and gravity settling, screening, filtration, or flotation to reduce suspended solids; treating total wastewater flow by primary settling combined with screening, and followed by aerated lagoons or activated sludge or both, with probable pH adjustment prior to biological treatment; and disposal of sludge by aerobic digestion in sludge lagoons, or as landfill (Williams, 1974).

(2) Air Pollution

Air emissions would be similar to those generated during plywood manufacture. Major sources of emissions would be from drying of resins and sanding operations. A very minor source would be the pressing operation. The major pollutants would be organics. Two fractions would be present, condensibles and volatiles. The condensible fraction would consist of wood resins, resin acids, and wood sugars. Volatiles would consist of terpenes and unburned methane. Emission factors are 3.6 lbs per 10,000 sq. ft. of 3/8 in. board product for condensibles and 2.1 lbs per 10,000 sq. ft. of 3/8 in. board product for volatiles. Emission factors for sanding operations are 0.55 lb/hr for particulates for large diameter cyclones. If baghouses are used particulate emissions will be negligible (EPA, 1976).

(3) Solid Wastes

Sources of solid wastes would be debris and sediment generated from wasting of raw wood material, oils from the cooling water, and sludges. The debris and sediment would settle out during treatment and become part of the sludge. This sludge would be suitable for disposal as landfill. The oils could be sold or incinerated.



(XX) APPROXIMATE PERCENT FIBER (CONSISTENCY IN PROCESS)

SOURCE: Williams, 1975.

FIGURE II-23
PROCESS WATER RECYCLE IN A TYPICAL WET PROCESS HARDBOARD MILL

H. References

Dames and Moore, 1977, Environmental Report, Kentucky Federal Energy Park, Georgetown, Kentucky for Irvin Industrial Development, Inc., Job No. 10391-001-21.

Dellinger, Robert, 1975, Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Pressed and Blown Glass Segment of the Glass Manufacturing Paint Source Category, EPA 440/1-751034-a.

Drake, Robert, 1978, Irvin Industrial Development, Inc., Correspondence, February 7.

Environmental Research and Development Administration, 1977, Fossil Energy Research Program of the Energy Research and Development Administration.

Environmental Research and Development Administration, 1976, Program Opportunity Notice (PON FE-4), March 30.

Geer, Robert, 1977, Southern Railway Company, Personal Communication, September 26.

Hahn, O.J., 1977, Comments and Supplements to the Environmental Assessment for the Kentucky-Federal Energy. Park at Georgetown, Kentucky, Mason Hangar-Silas Mason, Inc., February.

Hughes, E.E., Dickson, E.M., Schmidt, R.A., 1974, Control of Environmental Impacts from Advanced Energy Sources, EPA-600/2-74-002.

Irvin Industrial Development Inc., 1976, Technical Proposal to ERDA for Coal Gasification Demonstration Plant for Georgetown, Kentucky.

Lohr, T.E., 1977, Irvin Industrial Development, Inc., Correspondence, October 11.

Lohr, T.E., Holbrook, K., 1977, Irvin Industrial Development, Inc., Personal Communication, September 20.

Mason Hangar-Silas Mason Co., Inc., 1976, Environmental Assessment for the Kentucky-Federal Energy Park, Georgetown, Kentucky, January.

MITRE Corporation, 1976, Respondent Worksheet, Work Site Data Worksheet, Gasifier Demonstration Program, Georgetown, Kentucky.

Snyder, J.R., 1977, Scott County - Georgetown Planning and Zoning Commission, Correspondence, February 3.

U.S. Environmental Protection Agency, 1975, Draft Development Document for Effluent Limitations Guidelines and Standards of Performance for the Machinery and Mechanical Products Manufacturing Paint Source Category, Vols. I, II, III. Contract No. 68-01-2914.

U.S. Environmental Protection Agency, 1976, Quality Criteria for Water, Washington, D.C.

Versar, Inc., 1975, Draft Development Document for Effluent Limitations Guidelines and Standards of Performance--The Clay Gypsum, Refractory and Ceramic Products Industries, Contract No. 68-01-2633.

Vason, Srini, 1978, "Holmes Stretford Process Offers Economic H_2O Removal," the Oil and Gas Journal, January 2.

__________, 1978a, personal communication, February 15.

CHAPTER III
EXISTING ENVIRONMENTAL SETTING

A. Purpose

This chapter provides information describing the existing physical, biological, and socioeconomic environments present in and around the study area. This information serves as the basis from which the environmental impacts are derived.

B. Methodology

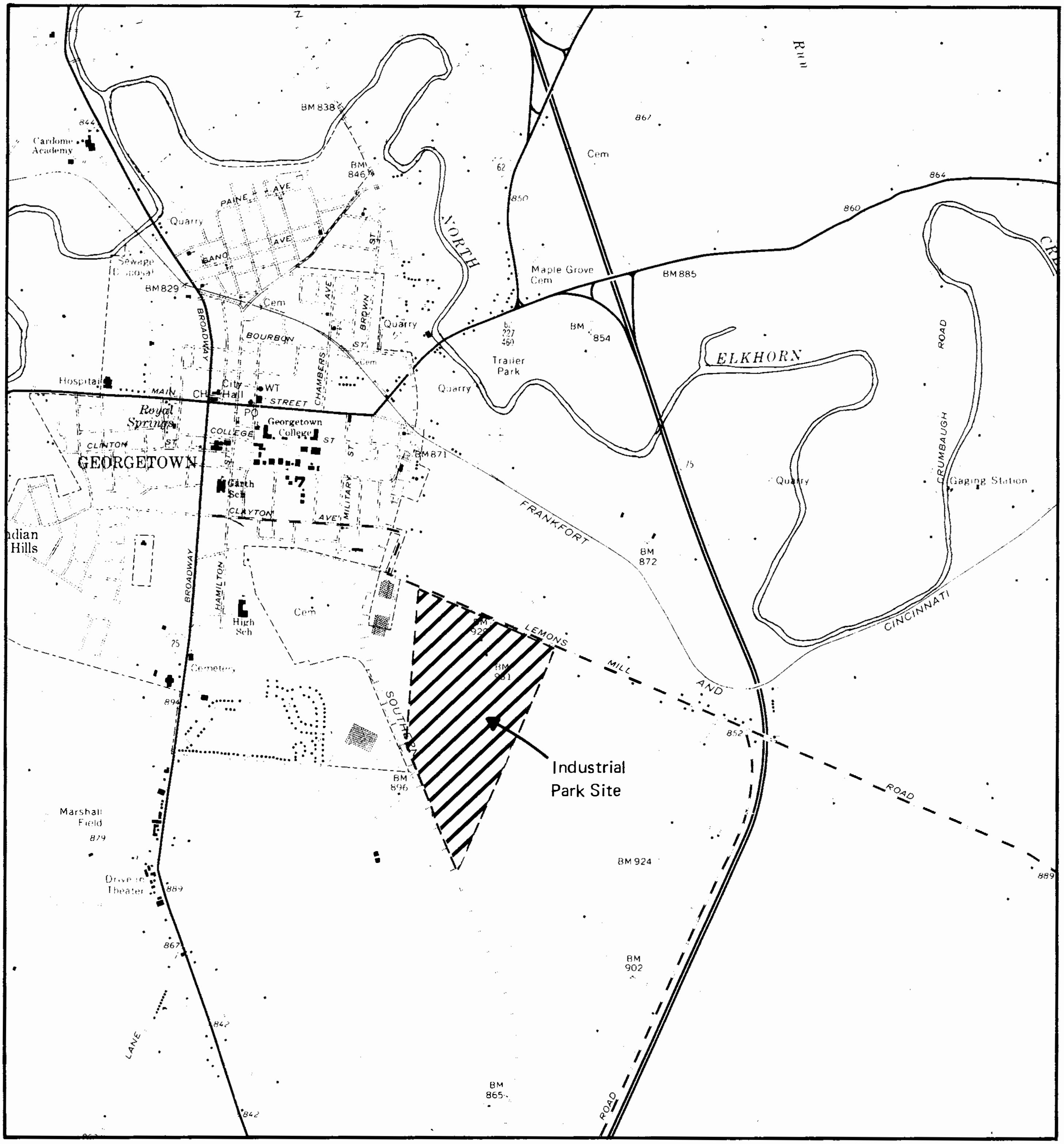
In order to provide workable and reasonable boundaries, the study area was defined as the area encompassed by the Georgetown quadrangle as designated by the U. S. Geological Survey (USGS). This quadrangle lies between latitude 84°37'30" and 84°30' and longitude 38°07'30" and 38°15' (see Figure III-1). The city of Georgetown and the proposed industrial park are centrally located in this quadrangle. The proposed industrial park will be known as the site, and acreage to be occupied by the gasifier will be known as the gasifier site. In those areas where an impact may extend beyond the study area or where no natural boundaries exist, such as in air quality, it may be necessary to extend the study area. In these instances, the study area will be defined on a case-by-case basis.

The description of the physiography, topography, geology, mineral resources, soils, hydrology, vegetation, and wildlife was prepared based upon an extensive literature search. Data were accumulated from published and unpublished sources including environmental impact statements, United States Geological Survey and Commonwealth of Kentucky Geological Survey publications, and data supplied by Irvin Industrial Development, Inc.

Several field studies were conducted by Dames and Moore to better characterize the study area. In an effort to establish the location of the major conduit to Royal Spring, a field study was conducted during June, August, and December, 1977. Dye was injected into several sinkholes at appropriate intervals and its appearance monitored at Royal Spring and North Elkhorn Creek.

In order to define the air quality, the climatology, ambient air conditions, and existing major air pollution sources of the study area (20-mile radius), existing data were analyzed. Governmental agencies, utilities, and other potential data sources were contacted and all available ambient air quality monitoring data within a 20-mile radius of the site were collected from all existing monitoring stations.

Vegetation and wildlife present at the site were determined by field sampling during the summer of 1977. Individual plant species from the overstory, understory, and groundcover strata were recorded as they were observed. Significant animals surveyed included birds, mammals, amphibians, and reptiles. In addition, notes on ecological relationships within the various communities at the site were recorded.



Source: USGS, 1965

FIGURE III-1
STUDY AREA IN AND AROUND GEORGETOWN, KENTUCKY

The aquatic ecosystem was defined by literature review and field sampling. Fish and benthic macroinvertebrates were collected and identified. Water samples were collected along the North Elkhorn Creek and analyzed.

The archeological survey of the industrial park site was conducted in compliance with provisions contained in the National Historic Preservation Act of 1966 (P.O. 89-665; 80 Stat. 915; 16USC4700), the National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42USC4321-4327), and Executive Order 11593 of May 13, 1971 (36FR821, 16USC470). Also, the provisions of the Kentucky Antiquities Act (K.R.S. Ann. 164.705-735; 1970) were adhered to.

The socioeconomic environment was defined by examining and analyzing land use and social and economic conditions. These were examined on the following three levels:

- a local impact area, consisting of the acreage within a 1-mile radius of the industrial park site;
- an intermediate impact area, consisting of Scott County; and
- a regional impact area, consisting of the Scott County labor market area (Bourbon, Fayette, Franklin, Grant, Harrison, Owen, Scott, and Woodford Counties).

Factors such as topography, existence of natural or man-made barriers, local and regional transportation networks, commercial and industrial ties, cultural unity, distribution of labor force, and the location of urban centers were taken into consideration in an attempt to delineate the study area.

C. Existing Environmental Setting

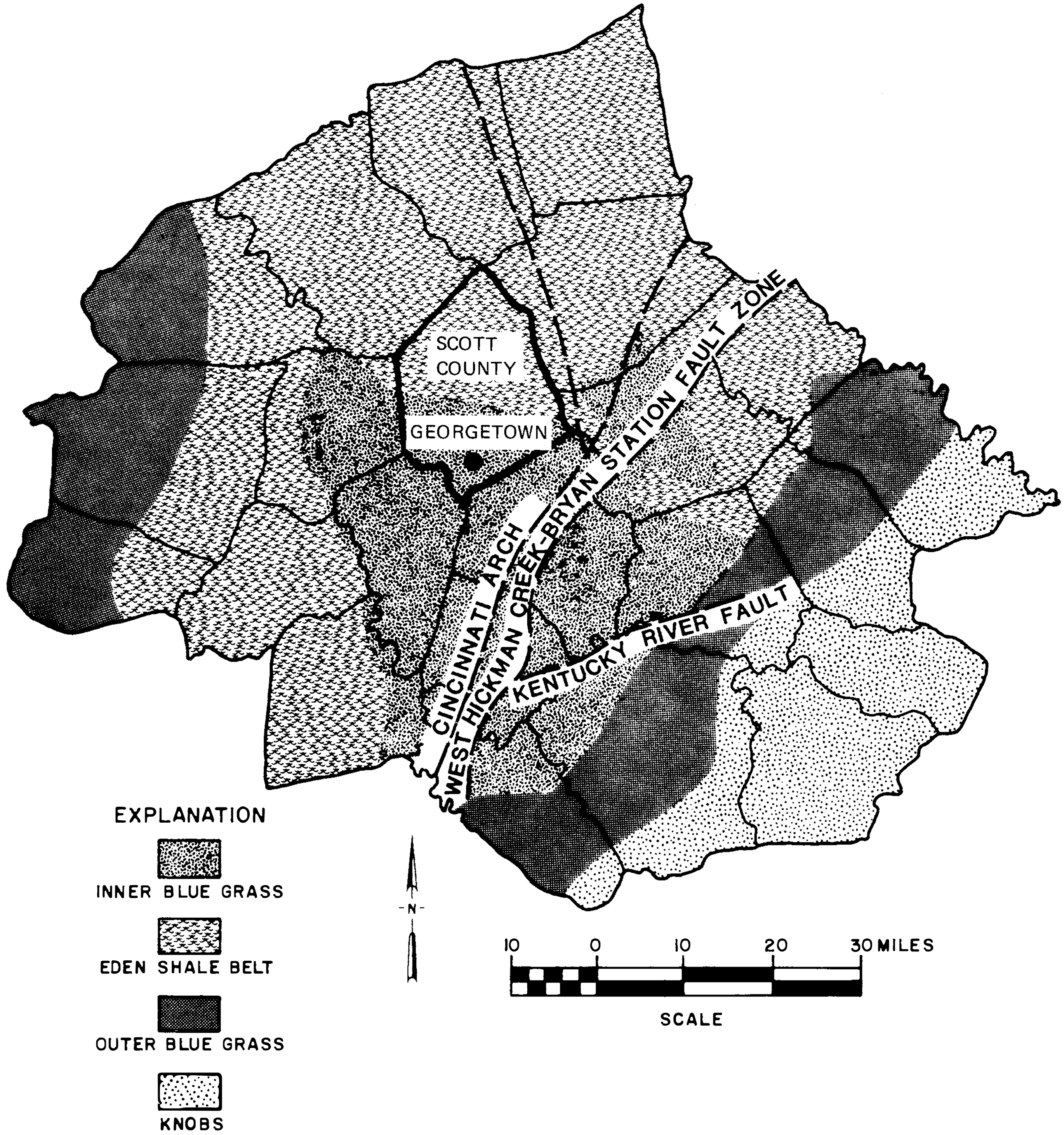
1. Physical Environment

a. Physiography

Georgetown and the industrial park site lie within the northern part of the Lexington Plain, or the Inner Blue Grass Region, of the interior Low Plateau Physiographic Province (Fenneman, 1938) (see Figure III-2). Surrounding the Inner Blue Grass are concentric belts of the Eden Shale Belt, Outer Blue Grass, and the Knobs physiographic subdivisions.

The Inner Blue Grass is a gently rolling upland, marked with numerous sinkholes and underlain by soluble limestone. Due to an extensive subsurface drainage system in the area, the small surface streams are not extensively developed. Large streams, such as the Kentucky River, however, are entrenched 200 to 500 feet.

The Eden Shale Belt, which surrounds the Inner Blue Grass, is characterized by narrow valleys and steep-sided hills and is underlain by interbedded shales and limestones. The subsurface drainage is not well developed, and this area contains fewer sinkholes than the Inner Blue Grass. There are few perennial streams, and drainage lines are closely spaced.



SOURCE: Faust, 1977

FIGURE III-2
PHYSIOGRAPHY OF
THE BLUE GRASS REGION

The Outer Blue Grass is also characterized by narrow valleys and steep-sided hills. There are very few sinkholes, and the underlying rocks are limestones and interbedded shales. The Knobs are remnant hills of Devonian shales capped by sandstone and limestone. They are erosional features and mark the boundary between the Blue Grass and Mississippian Plateau regions.

b. Topography

The Inner Blue Grass Region is typical of karst topography. It is characterized by gently rolling upland in which the Kentucky River and some of its tributaries are entrenched approximately 300 feet. Most of the rock underlying the area is limestone which has been subjected to considerable solution by surface and groundwaters. Consequently much of the drainage is underground. Frequently this drainage appears at the surface in the form of springs. Sinkholes are scattered throughout the area. Some are as much as 60 feet deep and 1 mile square (Palmquist and Hall, 1961).

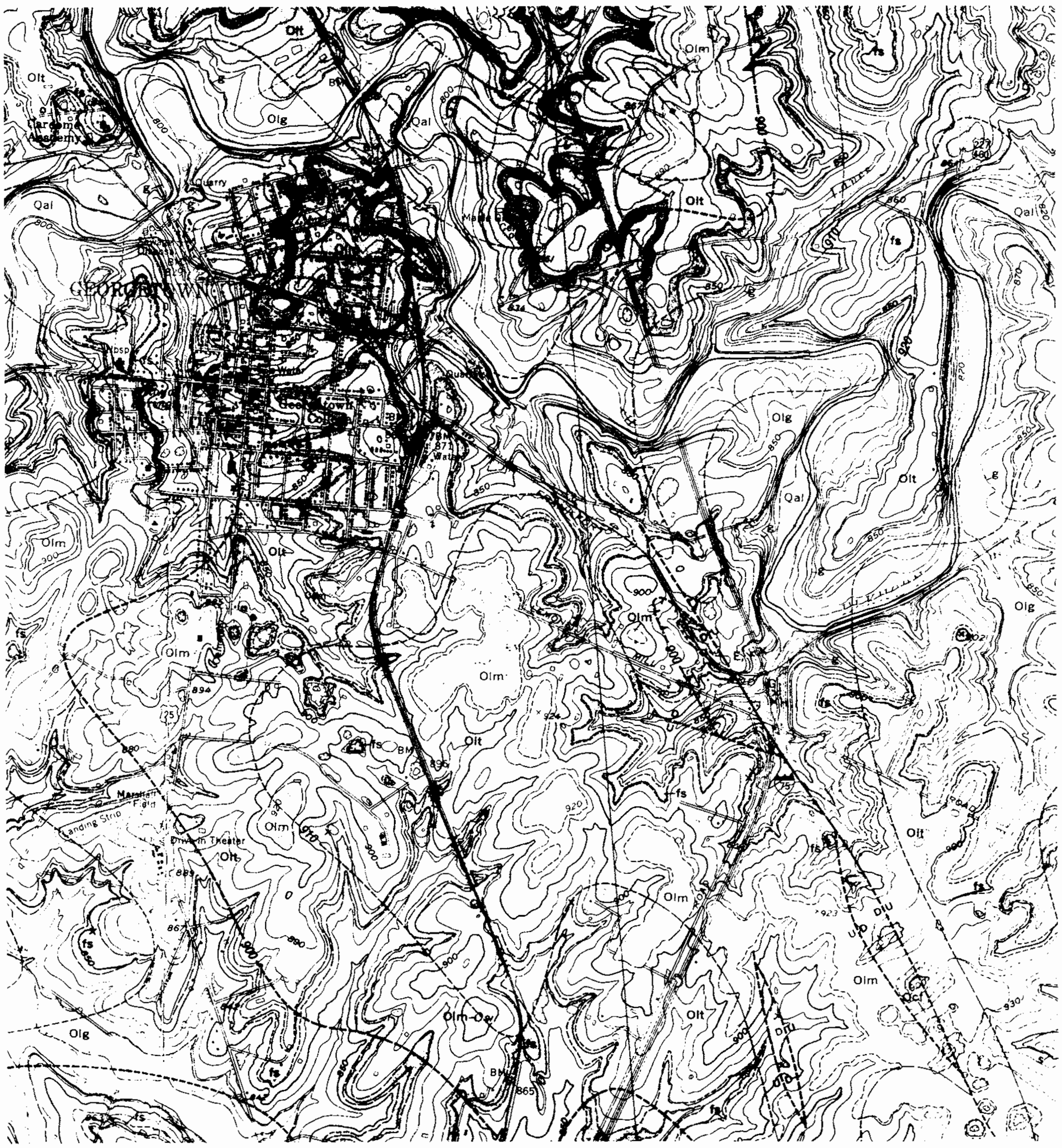
The general altitude is between 800 and 1000 feet above sea level in the Blue Grass Region with an extreme of 1400 feet. The transition from one level to another is usually abrupt. Land elevation in the vicinity of the proposed site ranges from approximately 770 feet above sea level at the junction of Cane Run and North Elkhorn Creeks, west of Georgetown, to a maximum of 950 feet above sea level on localized hills.

c. Geology

The physiographic subdivisions are directly linked to the surficial geology. A geologic map of a portion of the Georgetown Quadrangle including the area in the vicinity of the proposed site is shown in Figure III-3.

The rocks which underlie the Blue Grass Region comprise formations belonging to the earliest periods of geologic history. (See Figure III-4 for an explanation of the geologic time scale.) The oldest rocks exposed in this region are of lower middle Ordovician age and form the lower part of the High Bridge Group. The High Bridge Group is dense, fine-grained limestone containing many seams of dolomite (Matson and Palmer, 1909). It is approximately 550 to 700 feet thick and composed of three formations, the Camp Nelson Limestone, the Oregon Formation, and the Tyrone Limestone Formation (Cressman and Noger, 1976). The High Bridge Group is overlain disconformably by the Lexington Limestone Formation. A series of Cambrian and Ordovician limestone, dolomite, and sandstone units lie between the lower part of the High Bridge Group and the Precambrian basement. Although these units are not exposed, well log data indicate that the basement is at least 5000 feet below the High Bridge Group (Freeman, 1953).

Georgetown and the proposed site are underlain by the Lexington Limestone of middle Ordovician age. The northern line of the Lexington Limestone passes across Harrison, Bourbon, Scott, and Franklin



LEGEND:

Ordovician Period

- Qal = Alluvium of the Quaternary period
- Olt = Tanglewood Limestone Member
- Olm = Millersburg Member
- fs = Fossiliferous limestone and shale
- Olg = Grier Limestone Member
- g = Top of Gastropod beds

Source: USGS, 1967

FIGURE III-3
GEOLOGIC MAP OF THE STUDY AREA

ERAS	Duration of periods	PERIODS	Epochs	Duration of epochs
CENOZOIC 70 million years duration	1	Quaternary	Recent	
			Pleistocene	1
	69	Tertiary	Pliocene	10
			Miocene	15
			Oligocene	10
			Eocene	19
			Paleocene	15
MESOZOIC 130 million years duration	60	Cretaceous		
	35	Jurassic		
	35	Triassic		
PALEOZOIC 300 million years duration	30	Permian		
	25	Pennsylvanian		
	25	Mississippian		
	40	Devonian		
	30	Silurian		
	70	Ordovician		
	80	Cambrian		

FIGURE III-4
GEOLOGIC TIME SCALE

Counties; the western line lies a few miles west of the Kentucky River from Franklin County to Boule County; the southern line crosses northern Gerrard and Madison counties; and the eastern line extends through Clark and Bourbon Counties. The Lexington Limestone includes approximately 200 feet of strata, consisting of coarse-grained blue or gray limestone containing thin beds of shale. The upper 50-75 feet of the formation contain nodules and lenses of chert (Matson and Palmer, 1909). The formation is generally considered to be responsible for the fine blue grass soils of the region.

(1) Stratigraphy

A descriptive stratigraphic column of the Georgetown Quadrangle is shown on Figure III-5. As evident from the geologic map, the surficial formations in the immediate vicinity of the study area are the Grier Limestone Member and the Millersburg and Tanglewood Limestone members of the Lexington Limestone Formation.

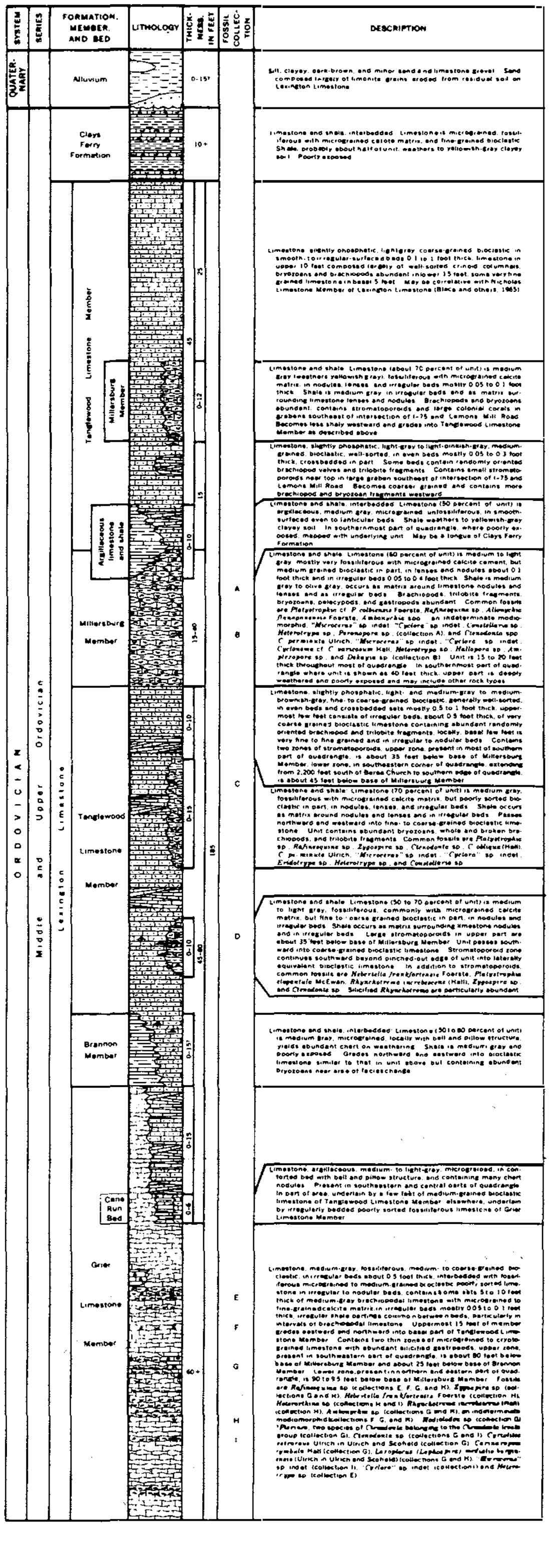
The Grier Limestone Member is the oldest formation exposed in this area (see Figure II-3). It is a medium- to coarse-grained, gray, fossiliferous, bioclastic limestone with irregular shale partings common between beds. The Tanglewood Member of the Lexington Limestone is parted by beds mapped as the Millersburg Member. The Tanglewood Member is comprised of a medium to light gray, fossiliferous limestone with irregular beds of shale which, in some areas, occur as a matrix around limestone nodules and lenses. The Millersburg Member is comprised of a gray, fossiliferous limestone and gray to olive-gray shale occurring in irregular beds and as a matrix surrounding limestone nodules.

Throughout most of the area, the Tanglewood Member is the predominant bedrock (approximately 60 percent); the Millersburg is not in excess of 30 percent. At the proposed site, however, the Millersburg and Tanglewood members are approximately equal in distribution, with Millersburg outcropping at or above an elevation of 910 feet. Quaternary alluvium, consisting of silt, minor amounts of sand, and limestone gravels derived from the above formations, is found along floodplains and at the bottoms of streams (Cressman, 1967).

(2) Structure

The most important structural feature of the region is the Cincinnati arch. This is a major anticline extending northeastward through Lexington nearly to Cincinnati. North of Cincinnati it divides; one branch continues northward and the other turns to the northwest. South of Cincinnati, the arch separates into two broad domes, one near Nashville, Tennessee and the other in Jessamine County in central Kentucky. From the apex of the Jessamine Dome, the rocks dip gently outward. The variation in the degree of dip indicates that the dome is not symmetrical (Matson and Palmer, 1909).

The Kentucky River Fault and the West Hickman Creek-Bryan Station Fault Zone are the two major fault zones that cut across the area. The Kentucky River Fault occurs in Jessamine and Clark Counties near the Kentucky River. It has a maximum throw of approximately 400 feet.



SOURCE: SOURCE: Cressman, 1967

FIGURE III-5
DETAILED STRATIGRAPHIC COLUMN

The West Hickman Creek-Bryan Station Fault Zone is composed of several minor faults and trends northeastward through Jessamine, Fayette, and Bourbon Counties parallel to the Cincinnati arch (Palmquist, 1961; Mull, 1968). Part of this fault zone occurs in the immediate vicinity of the industrial park site (see Figure III-3). To the east and north of the site, there is normal faulting with simple up-down movement of the blocks. These faults are aligned northwest-southeast as is the major joint system in this area. Most of this faulting is implied with only a small portion of the faults exposed in railroad and highway cuts.

The outcropping of the Millersburg in the general area seems to be oriented the same as the faulting. Structure contours drawn on the base of the Millersburg Member indicate that the industrial park site is on a structural high which may be the reason for the preservation of Millersburg in this region.

Several low intensity, non-damaging earthquakes with epicenters within 100 miles of the industrial park site have been reported. These are associated with the Kentucky River Fault. Maysville, Kentucky, about 50 miles east of the site, has experienced several shocks. An earthquake in 1854 was of epicentral Intensity VI (see Table III-1). Earthquakes in 1969 and 1933 were of Intensity V, and an earthquake in 1957 was of Intensity III. However, these earthquakes were not of sufficient intensity to shift the Quaternary and Tertiary sediments along the Kentucky River fault.

The most severe earthquakes which the site and the northeastern United States have experienced were the New Madrid earthquakes of 1811-1812. The New Madrid earthquakes originated along the Mississippi River fault near the Mississippi Embayment. From earthquake reports made in the Cincinnati area near the Ohio River, it is estimated that the New Madrid earthquakes at their epicenters had an intensity of XII on the Modified Mercalli scale and a magnitude of 8 on the Richter scale. The probable intensity at the site is estimated to have been almost V on the Modified Mercalli scale, corresponding to a ground acceleration at the site of 2.4 percent of the acceleration of gravity.

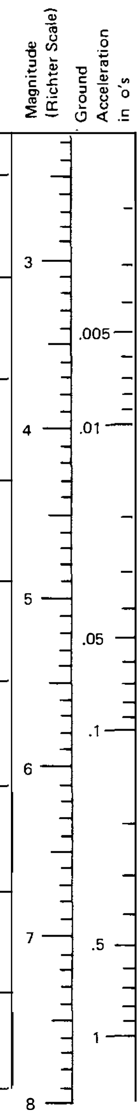
d. Mineral Resources

The chief mineral resource of the area is limestone which is used in the production of cement and agricultural products and as road-building aggregate. The only mining company in operation in Scott County at the present time is the Nally and Gibson Stone Co. in Georgetown. This firm operates a quarry located along the North Elkhorn Creek, approximately one mile from the industrial park site. Here the Grier Limestone member of the Lexington Limestone is quarried. In addition, many abandoned quarries are located throughout the quadrangle. The limestone from these quarries was used locally for building stone and road construction.

Table III-1. Modified Mercalli Intensity Scale Approximate Relationship with Magnitude and Ground Acceleration

Abridged Modified Mercalli Intensity Scale

I.	Not felt except by a very few under especially favorable circumstances.
II.	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III.	Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.
IV.	During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed: walls make creaking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V.	Felt by nearly everyone; many awakened. Some dishes, windows, etc. broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI.	Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster and damaged chimneys. Damage slight.
VII.	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures, considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.
VIII.	Damage slight in specially designed structure; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.
IX.	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes borken.
X.	Some well-built wooden structures destroyed; most masonary and frame structures destroyed with foundations, ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.



Notes:

Modified Mercalli Intensity Scale after Wood and Neumann, 1931. (Intensities XI and XII not included.)

Magnitude and acceleration values taken from Nuclear Reactors and Earthquakes, TID-7024, United States Atomic Energy Commission.

In the early 1900's barite was mined on a small scale (Fohs, 1913). Three workable veins were evident during mapping undertaken by the U.S. Geological Survey in 1965. The only vein which has been mined is located 1.45 miles east of the intersection of Highways I-75 and U.S. Route 227. The veining is in the vertical and strikes due north.

e. Soils

The Blue Grass Region has long been famous for its soils. The finest types occur in areas such as the proposed site where the Lexington Limestone forms the surface rock. Three major soil associations dominate the general vicinity of the industrial park site (see Figure III-6). They are the Eden, Lowell-Nicholson, and Maury-McAfee Associations (Weisenberger, 1974).

(1) Eden Association

The Eden Association is comprised of about 87 percent Eden soils and 13 percent minor soils. Minor soils include: 1) Cynthiana soils with rock outcrops on the very steep hillsides bordering the larger streams; 2) Lowell soils on the footslopes; 3) Lowell and Faywood soils on a few ridge tops; and 4) Nolin and Newark soils in the narrow floodplains. The soils of the Eden Association are moderately deep and well drained with clayey subsoils. They are underlain by soft, calcareous shale with thin layers of limestone and beds of siltstone. They are found on narrow ridges and hillsides principally in the northern part of the study area. This association is found in approximately 48 percent of Scott county.

About two-thirds of the soils in this association are used to produce hay and pasture. The other one-third is covered with trees or brush because the area is difficult to mow. Food crops are not widely cultivated because most slopes are too steep for row crops and very little land is plowed. Small gardens and tobacco are grown on Lowell soils in the narrow valleys (Weisenberger, 1974).

(2) Lowell-Nicholson Association

The Lowell-Nicholson Association consists of 80 percent Lowell soils, 8 percent Nicholson soils, and 12 percent minor soils. Minor soils include: 1) Faywood and Cynthiana soils on the steeper hillsides; and 2) Nolin, Huntington, and Newark soils in the floodplains. Lowell soils are deep and well drained with a thin, loamy subsoil over a clayey subsoil. Surface runoff is moderate and permeability is moderately low. Nicholson soils are deep and moderately well drained with a loamy subsoil over a fragipan. Surface runoff is moderate and permeability is low through the fragipan. The soils are underlain by limestone and calcareous shale.

This association covers about 25 percent of Scott County. It is found in an area of fairly broad, gently sloping ridges with sideslopes and narrow floodplains, bordering the area between the hills of

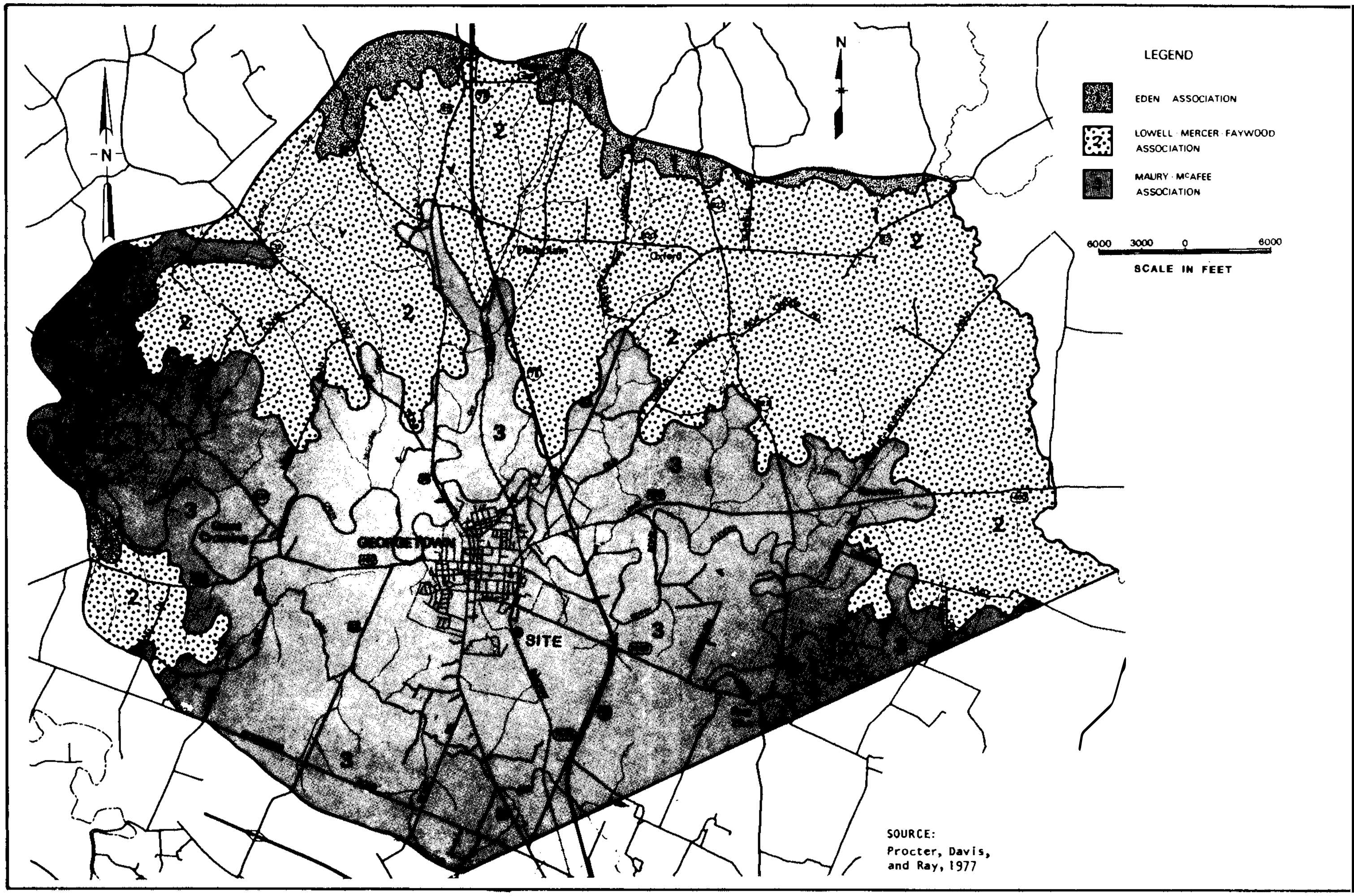


FIGURE III-6
GENERAL SOIL ASSOCIATIONS OF STUDY AREA

the Blue Grass Region and the Inner Blue Grass Region of Kentucky. This association is suited for general farming with proper conservation practices. Much of the land is in grass, but many of the more level areas are used for production of corn and tobacco (Weisenberger, 1974).

(3) Maury-McAfee Association

The Maury-McAfee Association consists of 57 percent Maury soils, 22 percent McAfee soils, and 21 percent minor soils. Minor soils include 1) Huntington, Dunning, and Newark soils in the floodplains; 2) Cynthiana soils in the steep areas near North Elkhorn Creek; and 3) Ashton soils on low stream terraces. The Maury soils are highly fertile, deep, and well drained, with a thin loamy subsoil over clayey subsoil. Surface runoff is moderate and permeability is moderate to high. McAfee soils are moderately deep and well-drained, with a thin loamy subsoil over clayey subsoil. Surface runoff is moderate and permeability is moderately low. The soils are generally underlain by limestone. The association covers about 27 percent of Scott County. It is found in areas of broad, gently sloping ridges, sinkholes, and drainageways. Houses and factories have been developed over a large portion of the association (Weisenberger, 1974).

(4) Soils in the Industrial Park Site

A detailed map of the various soils at the proposed site and in the immediate vicinity is shown in Figure III-7. A subsurface investigation for a proposed road, sanitary sewer, and waterline was performed at the industrial park site by Fuller, Mossbarger, and Scott (1973). The predominant soil types, Lowell silt loam, Maury silt loam, Nicholson silt loam, and Huntington silt loam, varied in thicknesses at the site from 3 to 11 feet.

Eighty-four percent of the land area (144 acres) at the proposed site has been designated by the Soil Conservation Service as prime agricultural land in accordance with U.S. Department of Agriculture criteria published in the Federal Register on August 23, 1977. That land so designated is shown in Figure III-8 (U.S. Department of Agriculture, 1977). The various properties of the soils leading to this classification and the suitability of the soils for crops and pasture are given in Tables III-2 and III-3, respectively. The permeability of soil types found on the site ranges from 0.6-6.0 in/hr. The available water capacity ranges from 0.14-0.23 inches of water per inch of soil. The soils are most suitable for the cultivation of corn, tobacco, grains, and grasses. Ranges of contents of trace elements from soils similar to those found on the proposed site are given in Figure III-9.

A complete analysis of the major soils mapped at the industrial park site, and Maury silt loam and Lowell silt loam, sampled at other similar locations and analyzed by the University of Kentucky Agricultural Experimental Station, is given in Appendix A. This analysis includes a description of the various soil horizons, particle sizes, pH, exchangeable bases, and organic matter for each horizon.

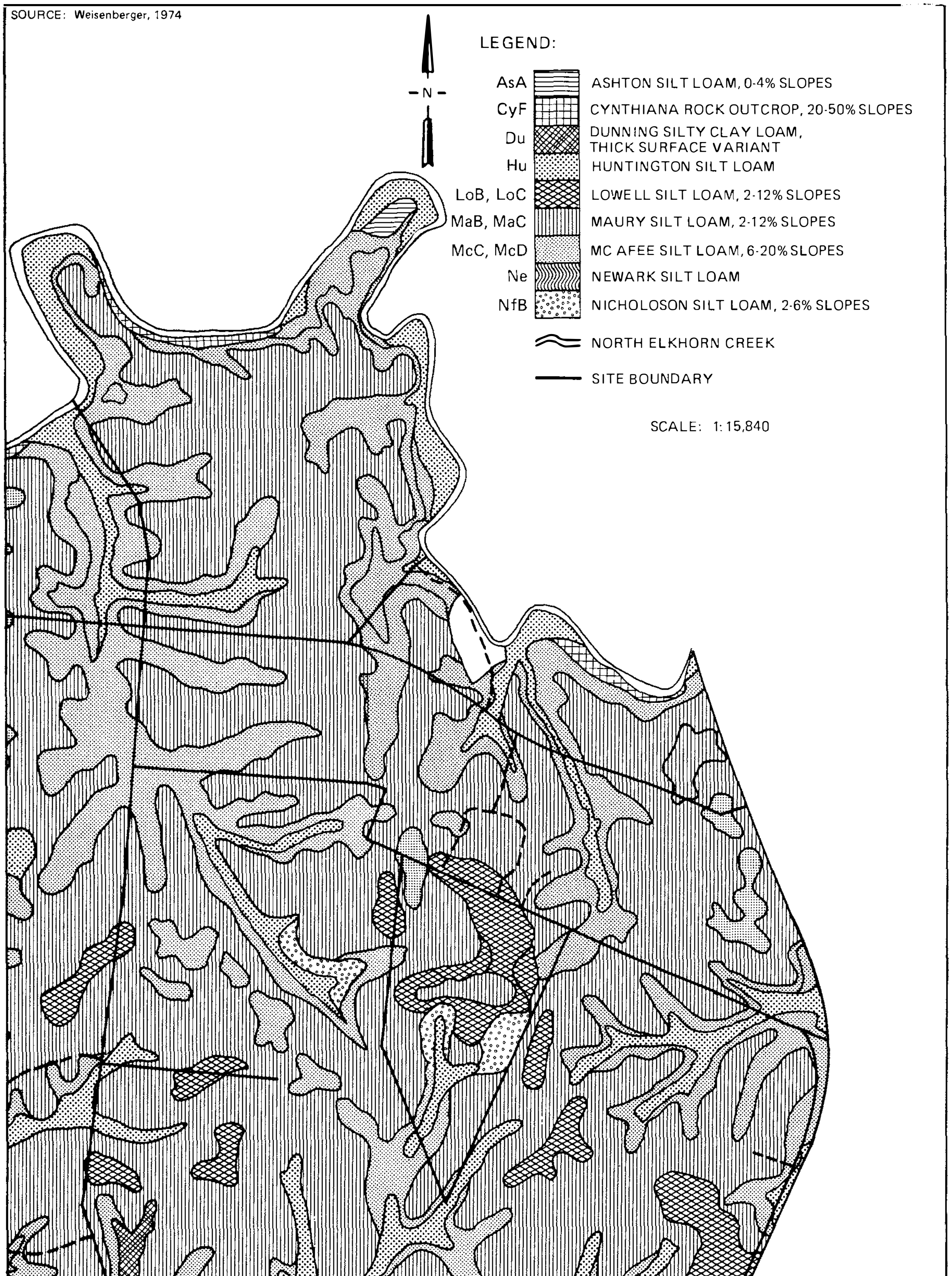


FIGURE III-7
SOILS MAP OF THE STUDY AREA

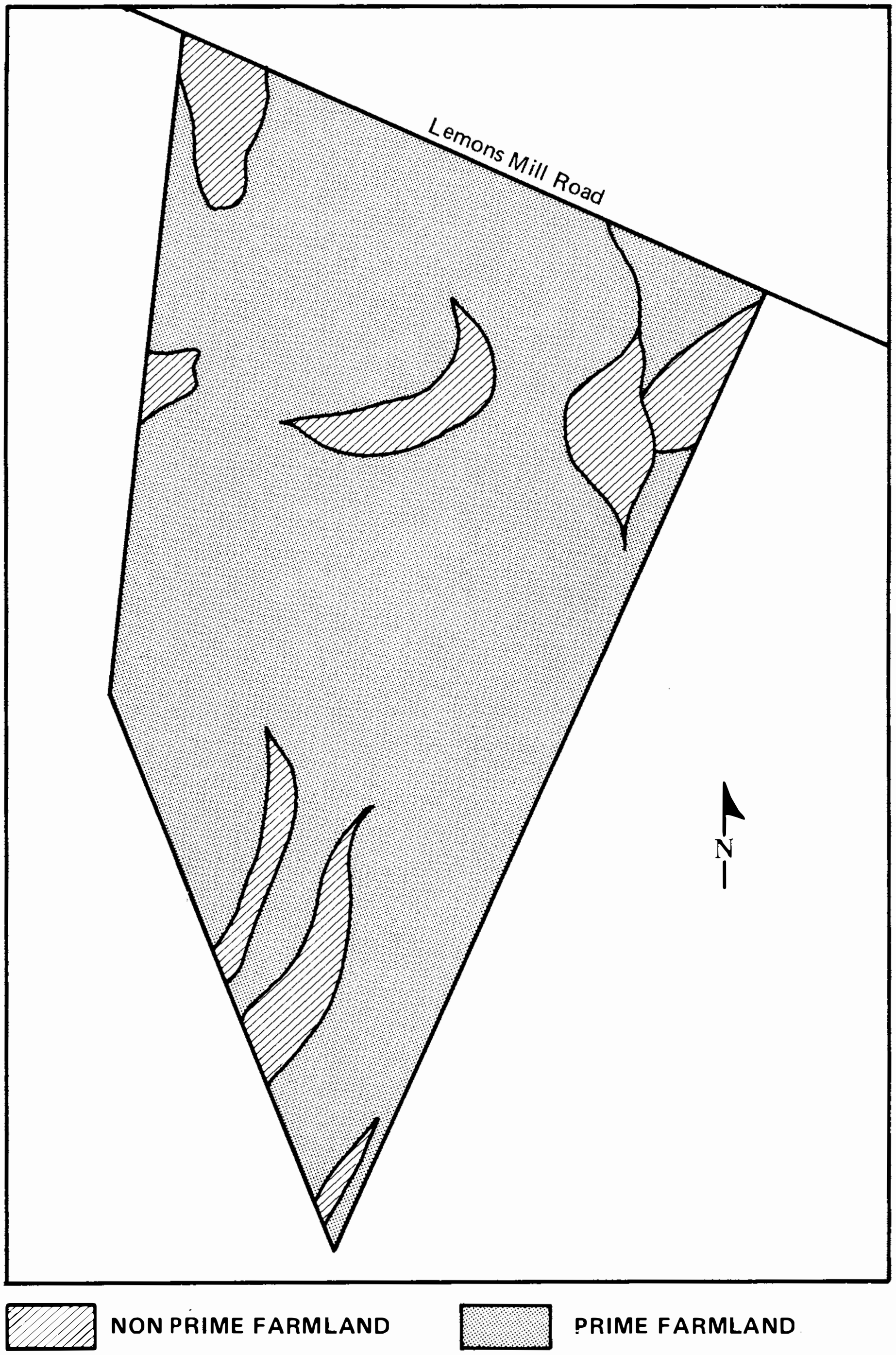


FIGURE III-8
AREAS DESIGNATED AS PRIME FARMLAND IN THE INDUSTRIAL PARK SITE

Table III-2. Estimated Engineering Properties of Proposed Site Soils

Map Symbols and Soil Series	Depth to Bedrock	Depth to Seasonal High Water Table	Depth from Surface	Classification 1 USDA Texture	Classification 1 Unified	Classification 1 ASSHO	Coarse Fractions Greater Than 3 Inches	Liquid Limit	Plasticity Index	Permeability	Available Water Capacity	Reaction	Shrink-swell Potential
	Feet	Feet	Inches				Percent			Inches Per Hour	Inches per In.of Soil	pH	
AsA-- Ashton	>4	>5[2/]	0-20	silt loam	ML or CL	A-4	-	25-35	5-10	0.6-2.0	0.19-0.23	5.6-7.3	low
			20-52	silt loam or silty clay loam	CL or ML	A-6 or A-4		30-40	5-20	0.6-2.0	0.18-0.22	5.6-7.3	low
			52-60	silt loam or silty clay loam	CL or ML	A-6 or A-4	0-5	30-40	5-20	0.6-2.0	0.16-0.20	5.6-7.3	low
CyF-- Cynthiana			18	thin bedded limestone	(No estimate was made of the rock outcrop portion of mapping unit CyF.)								
Du-- Dunning	>3 1/2	0-1/2[3/]	0-16	silty clay loam or silt loam	CL or ML	A-6 or A-4	-	25-40	10-20	0.6-2.0	0.19-0.22	6.1-7.8	low
			16-54	silty clay or clay	CL, CH or MH	A-7	-	45-60	20-30	<0.2	0.14-0.18	6.1-7.8	moderate
Hu-- Hunting-ton	>4	>3[3/]	0-60	silt loam or silty clam loam	ML or CL	A-4 or A-6	0-5	25-35	5-15	0.6-2.0	0.18-0.23	6.1-7.8	low
LoB, LoC, Lowell	>3 1/2	>5	0-7	silt loam or silty clay loam	ML or CL	A-4 or A-6	-	25-40	5-15	0.6-2.0	0.19-0.23	5.1-6.5	low
			7-23	silty clay loam	CL or CH	A-7	-	40-60	20-30	0.2-2.0	0.15-0.20	5.1-6.5	moderate
(For the Nolin part of unit LwB see the Nolin series.)													

Table III-2. Estimated Engineering Properties of Proposed Site Soils (Continued)

Map Symbols and Soil Series	Depth to Bedrock	Depth to Seasonal High Water Table	Depth from Surface	Classification 1 USDA Texture	Classification 1 Unified	Classification 1 ASSHO	Coarse Fractions Greater Than 3 Inches	Liquid Limit	Plasticity Index	Permeability	Available Water Capacity	Reaction	Shrink-swell Potential
	Feet	Feet	Inches				Percent			Inches Per Hour	Inches per In. of Soil	pH	
MaB, MaC Maury	>5	>5	0-11	silt loam	ML or CL	A-4 or A-6	0-1	25-35	5-15	0.6-6.0	0.19-0.23	5.1-7.3	low
			11-18	silt loam or silty clay loam	CL or ML	A-4 or A-6	0-1	30-40	10-20	0.6-6.0	0.18-0.22	5.1-6.5	low
			18-53	silty clay loam or silty clay	CL, CH or MH	A-6 or A-7	0-1	35-60	20-30	0.6-2.0	0.18-0.20	5.1-6.0	moderate
			53-60	silty clay or clay	CH, MH or CL	A-7	0-1	45-70	25-35	0.6-2.0	0.14-0.18	5.1-6.0	moderate
McC, McD--McAfee	1 1/2-3 1/2	>3 1/2	0-7	silt loam	ML or CL	A-4 or A-6	0-10	25-40	5-15	0.6-2.0	0.18-0.23	5.6-7.3	low
			7-13	silty clay loam or silty clay	CL, CH	A-6 or A-7	0-10	35-60	15-25	0.6-2.0	0.13-0.22	5.6-6.5	moderate
			13-32	silty clay or clay	CH, MH or CL	A-7	1-20	45-70	25-35	0.2-0.6	0.11-0.18	5.6-6.5	moderate
			32	limestone									
Ne--Newark	>4	1/2-1[3]	0-36	silt loam	ML or CL	A-4 or	-	25-35	5-15	0.6-2.0	0.19-0.23	6.1-7.8	low
			36-60	silty clay loam silt loam or silty clay	CL or ML	A-6 or A-7	-	25-50	12-20	0.6-2.0	0.18-0.22	6.1-7.8	low

Table III-2. Estimated Engineering Properties of Proposed Site Soils (Concluded)

Map Symbols and Soil Series	Bedrock	Seasonal High Water Table	Depth from Surface	Classification [1]: USDA Texture	Classification [1]: Unified	Classification [1]: ASSHO	Coarse Fractions Greater Than 3 Inches	Liquid Limit	Plasticity Index	Permeability	Available Water Capacity	Reaction	Shrink-swell Potential
	Feet	Feet	Inches				Percent			Inches Per Hour	Inches per In. of Soil	pH	
NfB--Nicholson	>5	1 1/2-2 1/2	0-7	silt loam	ML or CL	A-4 or A-6	-	25-35	5-15	0.6-2.0	0.19-0.23	5.1-7.3	low
			7-21	silty clay loam or silt loam	CL or ML	A-6	-	30-40	12-20	0.6-2.0	0.18-0.22	5.1-6.5	low
			21-34	silty clay loam	CL or ML	A-6	-	30-40	12-20	<0.2	0.9-0.12 [4]	5.1-6.0	low
			34-60	silty clay or clay	CH, MH or CL	A-7	-	45-70	25-35	<0.2	0.9-0.12 [4]	4.5-7.8	moderate

[1] Estimates based on 100 percent passing the 3-inch sieve

[2] Subject to rare floods

[3] Subject to common flooding

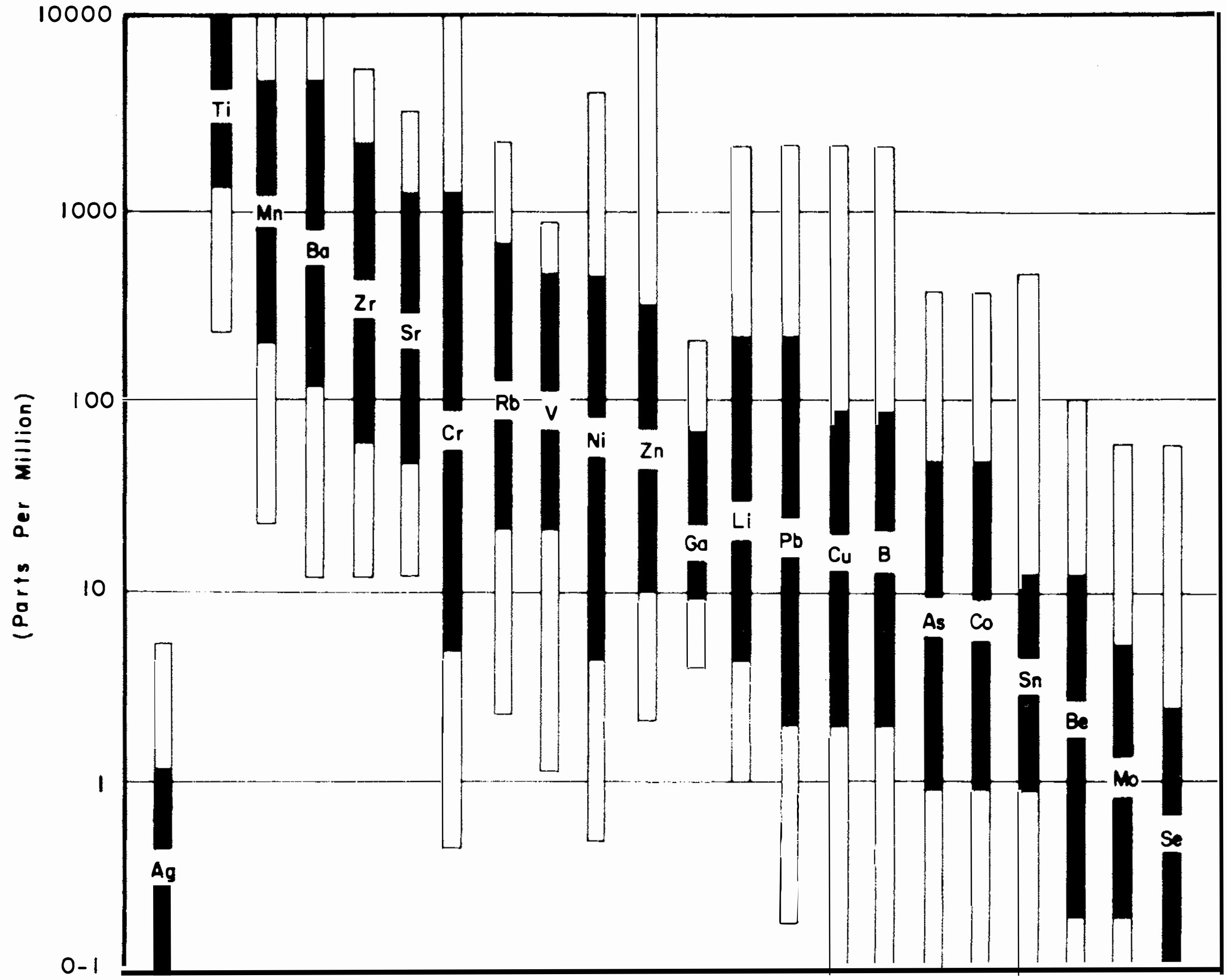
[4] Available water capacity estimate was reduced because of the fragipan layer

Source: Weisenberger (1974)

Table III-3. Suitability of Industrial Park Soils for Crops and Pastures

Map Symbol	Soil Name and Short Description	Limiting Property	Product-ivity	Suitable plants for Row Crops	Suitable plants for Pasture or Hay	Available Water Capacity	Organic Matter Content	Natural Fertility
AsA	Ashton silt loam, 0 to 4 percent slopes Deep, well-drained soil, on stream terraces, with a loamy, moderately permeable subsoil	None	High	Wide variety	Wide variety	High	Moderate	High
CyF	Cynthiana-Rock outcrop complex, 20 to 50 percent slopes Shallow, somewhat droughty soils with a subsoil that contains from 10 to more than 30 percent coarse limestone fragments	slope, coarse fragments	Low	Not suited		Low		
Du	Dunning silty clay loam, thick surface variant Deep, poorly drained soil, in floodplains, with a dark surface and a clayey slowly permeable subsoil	wetness	High where drained	Corn, soy-beans and small grain	Tall fescue, orchard grass, ladino clover and annual lespedeza	High	High	High
Hu	Huntington silt loam, (0 to 4 percent slopes) Deep, well-drained soil, in floodplains, with a loamy moderately permeable subsoil	Floods	High	Wide variety	Wide variety	High	High	High
LoB LoC	Lowell silt loam, 2 to 6 percent slopes Lowell silt loam, 6 to 12 percent slopes Deep, well-drained soil, with a clayey subsoil with a moderately slow permeability	Slope	Medium	Corn, tobacco and small grain	Bluegrass, tall fescue orchard, red clover, alfalfa, ladino clover, and sericea lespedeza	Moderate	Low	Medium
MaB MaC	Maury silt loam, 2 to 6 percent slopes Maury silt loam, 6 to 12 percent slopes Moderately deep, well-drained soil with a clayey lower sub-soil with moderately slow permeability	Slope	High	Wide variety	Wide variety	High	Moderate	High
Ne	Newark silt loam (0 to 4 percent slopes) Deep, somewhat poorly-drained soil, in floodplains with a loamy, moderately permeable subsoil	Wetness, floods	High where drained	Corn, soy-beans and small grain	Tall fescue, orchard grass, ladino clover, red clover, and annual lespedeza	High	Low	Medium
NfB	Nicholson silt loam, 2 to 6 percent slopes Deep, moderately well-drained soil a slowly permeable fragipan layer that restricts the movement of water and roots	Slope, wetness	Medium	Corn, tobacco and small grain	Tall fescue, orchard grass, ladino clover. red clover, white clover, and annual lespedeza	Moderate	Low	Medium

Source: Weisenberger (1974)



NOTE:
Range of contents of some trace elements commonly found in clay soils are similar to those found in the Georgetown area. White sections indicate more unusual values; certain extremely high values from localities influenced by ore deposits have been ignored.

SOURCE: Bear, 1964

FIGURE III-9
TYPICAL RANGE OF TRACE ELEMENTS FOUND IN SOILS

f. Hydrology

(1) Surface Water

Surface water features within the general vicinity of the proposed industrial park site include farm ponds, small lakes, and streams. Small lakes, especially those developed on sinkholes, tend to lose water to subsurface drainage and to be recharged by direct runoff or by springs.

All streams in the general vicinity of the proposed industrial park site eventually flow into the Kentucky River. While no streams actually cross the 173.6 acre site, surface runoff leaving the site flows either northeast into North Elkhorn Creek or southwest into Cane Run Creek. These two streams originate in Fayette County near Lexington, Kentucky and flow in a northwesterly direction.

North Elkhorn Creek is the largest stream in the area, being about 68 miles long. From its headwaters at the Fayette-Clark County line to a stream gauging station near Georgetown, North Elkhorn Creek drains approximately 119 square miles of rolling farmland. North Elkhorn Creek has an average slope of 3.42 feet per mile and an average flow near Georgetown of approximately 164 cubic feet per second (cfs) (USGS, 1977). Low flow frequency curves indicate that the lowest annual 7-day average flow for North Elkhorn Creek at Georgetown may be expected to be equal to or less than 0.1 cfs (65,000 gallons per day [gpd]), at average intervals of 10 years (Proctor, Davis, and Ray, 1977).

Maximum recorded discharge of North Elkhorn Creek is 8500 cfs which occurred on March 5, 1964 (USGS, 1977). Published flood-prone maps for this area indicate this recorded flood did not exceed the 810-foot elevation contour adjacent to the creek. Measurements of discharge by Faust (1977) indicate North Elkhorn Creek may be losing water to subsurface drainage in the reach from the gauging station east of Georgetown to almost the confluence with Cane Run Creek west of Georgetown.

There are no large storage facilities or flood control structures on North Elkhorn Creek except for several low dams that are remnants of industrial mills (see Figure III-10). These dams have had little effect on the flow characteristics of the creek (Mull, 1968), but have helped to pond water for water company supplies.

There are very little water quality data available for North Elkhorn Creek or Cane Run Creek, particularly in the vicinity of the site. Lykins and Smith (1976) have designated all reaches of both creeks and their tributaries as being water quality limited. A water quality limited stream is defined as any stream "segment where it is known that water quality does not meet applicable water quality standards and/or it is not expected to meet applicable water quality standards even after the application of the effluent limitations required by Section 301 (b)(1)(A)...and 301 (b)(1)(B)...of Public Law 92-500" (Lykins and Smith, 1976). Some water quality data are available for North Elkhorn Creek (Jones, 1973); however, these data are based on water samples collected about 5 miles downstream and

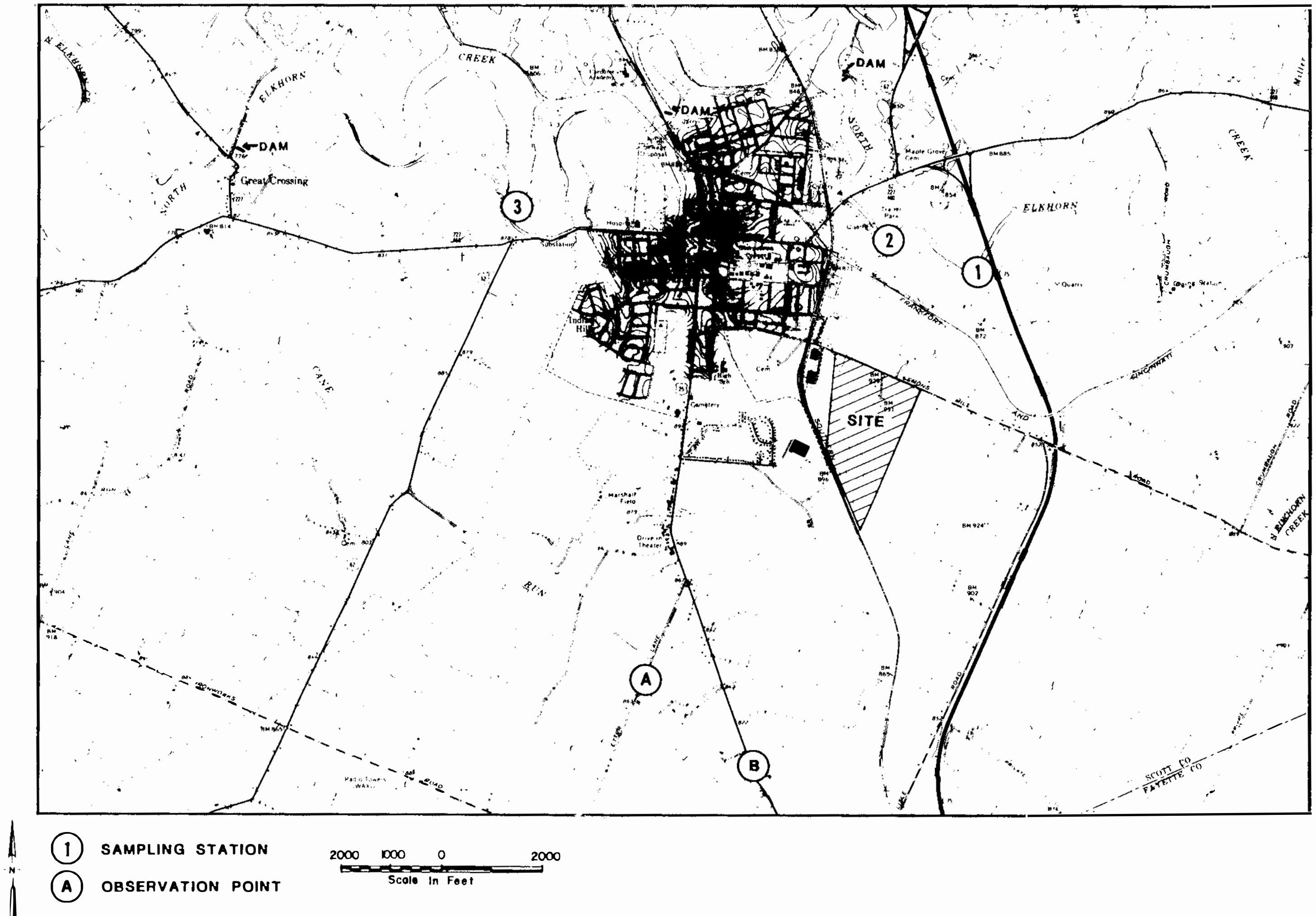


FIGURE III-10
SAMPLING LOCATIONS FOR WATER QUALITY AND AQUATIC ECOLOGY DATA

9 miles upstream from Georgetown. During the 2-year study (1968 and 1969), dissolved oxygen concentrations ranged from 4.6 to 13.3 mg/l and rarely fell below 5 mg/l (Jones, 1973). The BOD_5 was usually less than 5 mg/l, although in one case it was as high as 10 mg/l. Ammonia concentrations ranged from 0.01 to 0.96 mg/l and, for the most part, exceeded 0.02 g/l which is the maximum concentration recommended for optimum survival of aquatic organisms (National Academy of Sciences and National Academy of Engineering, 1972). Jones (1973) reported a pH range of 6.9 to 8.6. Data from the Georgetown Water Works' daily records (May 1976 to May 1977) indicate that the pH ranged from 7.0 to 7.9; most values, however, ranged from 7.4 to 7.6. The water of North Elkhorn Creek is of the calcium-magnesium-bicarbonate type and moderate to very hard (Mull, 1968).

Water quality samples were collected by Dames and Moore from the sites shown on Figure III-10 on July 8, 1977 to provide more recent data on North Elkhorn Creek. The water quality parameters measured in July (see Table III-4) are within acceptable limits set by the state of Kentucky (see Table III-5) with the exception of coliform bacteria. At Station 3, coliform bacteria is above allowable limits set for waters to be used for recreational purposes (total coliform should not exceed 1000 col./100 ml and/or fecal coliform should not exceed 200 col./100 ml). The high coliform levels at Station 3 may be attributed to the wastewater discharge from the Georgetown Sewage Treatment Plant. Nitrate and phosphate are not specifically limited by State water quality criteria; however, they are present in concentrations conducive to eutrophication. Phosphate concentrations of 0.05 mg/l and nitrate concentrations of less than 110 mg/l have been known to support plankton blooms and are considered to be typical of organically enriched and/or polluted waters (National Academy of Sciences and National Academy of Engineering, 1972; Reid, 1961).

Cane Run Creek, which joins North Elkhorn Creek about 4 miles downstream from Georgetown, is the second largest creek in the area. Cane Run Creek has a drainage basin of approximately 9.9 square miles and a length of approximately 11 miles. The average slope of this creek is 9.49 feet per mile. The headwaters for Cane Run drain the industrial and residential parts of the Lexington and Fayette county area. Measurements by Mull (1968) indicate that Cane Run loses water to underground drainage in various reaches through its course. The highest measured flow of this creek (Mull, 1968) was 590 cfs, and, except during heavy rains, Cane Run is pooled or dry during the summer months. No recent samples for chemical analysis of the water flowing in Cane Run have been taken. Analysis of the samples taken by Mull (1968) is presented in Table III-6. The water is hard and one sample had 0.05 mg/l of detergent. Detergent and slightly higher than average concentrations of sodium, chloride, and nitrate are indicative of pollutants that originate in residential and industrial areas.

Table III-4. Chemical Characteristics of North Elkhorn Creek, 8 July 1977*

Parameter	Station** 1	2	3
Time	1210	1215	1000
BOD_5	5.0	5.0	7.0
Temperature, water, C°	26.5	27.0	28.0
Specific conductance, μmhos/cm	320	320	520
pH, units	8.6	8.3	7.6
Total dissolved solids, mg/l	222.0	234.0	338.0
Total suspended solids, mg/l	10.0	11.0	16.0
Phosphate, mg/l	0.13	0.14	1.02
Nitrate, mg/l	0.44	0.43	1.84
Ammonia, mg/l	<0.01	<0.01	<0.26
Total alkalinity, mg/l	124.0	129.0	180.0
Chloride, mg/l	15.31	16.59	33.18
Sulfate, mg/l	15.6	24.2	23.0
Total hardness, mg/l	140.0	150.0	220.0
Total coliform, col./100 ml	200	1,200	4,000
Fecal coliform, col./100 ml	70	92	690
Fecal strep, col./100 ml	67	120	3,600
Boron, mg/l	<0.1	<0.1	<0.1
Arsenic, μg/l	8.60	8.60	8.60
Barium, μg/l	11.0	9.0	8.0
Cadmium, μg/l	0.8	1.1	1.3
Total chromium, μg/l	1.2	2.8	3.3
Soluble iron, μg/l	69.0	81.0	109.0
Lead, μg/l	0.4	1.9	3.1
Magnesium, mg/l	13.85	14.39	16.31
Manganese, μg/l	53.8	63.7	166.0
Calcium, mg/l	46.1	49.7	72.7
Selenium, μg/l	0.02	0.02	0.01
Mercury, μg/l	<0.01	<0.01	<0.01
Silver, μg/l	0.36	0.43	0.61
Sodium, mg/l	13.7	28.1	50.0
Total Fluoride, mg/l	0.34	0.35	0.43

*Except for temperature and specific conductance (determined in the field) all analyses were performed by Howard Laboratories, Dayton, Ohio.
**Station location shown on Figure III-10.

Source: Dames & Moore, 1977.

Table III-5. Kentucky Water Quality Standards

Constituent	Limitation
Coliform Bacteria	5000/100 ml
Dissolved Solids	500 mg/l
Arsenic	0.05 mg/l
Barium	1.0 mg/l
Cadmium	0.01 mg/l
Chromium (Hexavalent)	0.05 mg/l
Cyanide	0.025 mg/l
Fluoride	1.0 mg/l
Lead	0.05 mg/l
Selenium	0.01 mg/l
Silver	0.05 mg/l

Note: Standards are applicable to surface water at the point at which water is withdrawn for use for public water supply.

Source: Kentucky Dept. of Natural Resources and Environmental Protection (401 KAR 5:025)

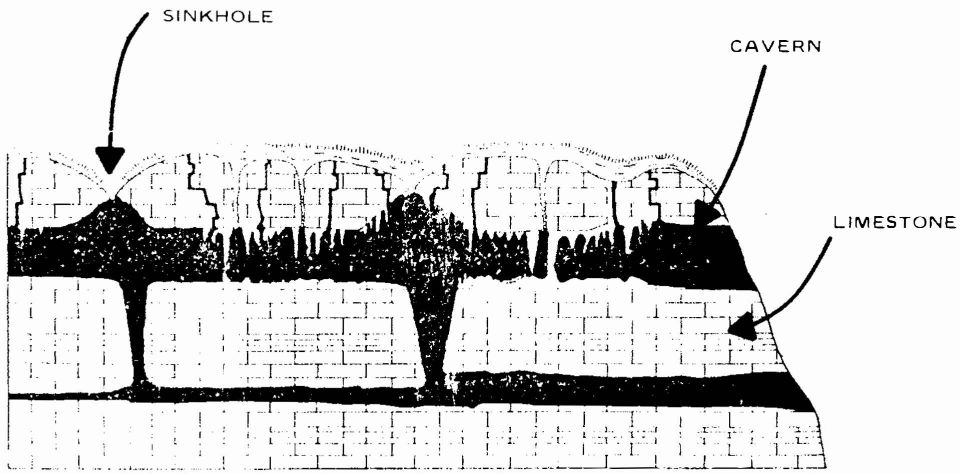
(2) Groundwater

Water from the surface travels downward along vertical joints and along bedding planes which become enlarged through solution. Carbonic acid (H_2CO_3) present in rainwater is responsible for the dissolution of the limestone which is composed primarily of calcium carbonate ($CaCO_3$). This acid attacks the limestone mostly at the point of entrance because the carbonic acid is used up as the water flows away from the point of entrance. This action will gradually lead to the formation of caverns. Sometimes the cavity will become so large as to be unable to support the overburden. Collapse may occur and sinkholes will form. On the surface they may appear as a hole or as a depression depending upon the degree of collapse. The fallen material may obstruct the opening so that the stream appears at the surface or it may leave a passage which will allow the drainage to continue underground. This situation is shown in cross section in Figure III-11. The Lexington Limestone presents an ideal situation for this kind of underground channel development. It occupies an area having gently rolling topography and much porous soil. Several caverns and springs are associated with the Lexington Limestone.

Royal Spring. The most important spring to the area is Royal Spring which surfaces at the foot of College Street in Georgetown. It was first discovered in 1774 and serves as the water supply to the town. The flow of the spring is highly variable. It ranges from 0.5 mgd during very dry periods to a recorded high of 55 mgd. The exact land mass which constitutes the recharge area of Royal Spring is not known. However, it is certain that there are two principal areas, the headwaters of Cane Run located approximately 12 miles to the southeast of Royal Spring and the area south of Lemons Mill Road. The proportion of flow contributed by each source is unknown (Wharton, 1977).

In an effort to determine whether a major conduit to Royal Spring was below the proposed site, a dye study was conducted by Dames and Moore during the summer of 1977. The sampling area is shown in Figure III-12. Dye was introduced at four sites at different times. These sites were Senge Sink, located 0.2 miles west of the gasifier site (site 4), two swallow holes located in the northeast and northwest corners of the park site (site 1 & 3) and Sharpe Sink located approximately 0.8 miles from the park site (site 5).

Dye introduced at Senge Sink appeared at Royal Spring (Path 10) in less than 24 hours indicating a velocity of 3600-3950 feet/day. Dye introduced into Sharpe Sink appeared at the Elkhorn River at point 12 (Path 14) sixteen days after its introduction. Dye introduced into the sinkhole #1 on the site was never detected. Dye introduced into sinkhole #3 appeared in a farm pond one hundred feet east of the sink fifteen minutes later. Eight days later it appeared in a farm pond 500 feet farther down the drainage (point 17) and in a small stream approximately 4000 feet down drainage (point 19).



SOURCE: Matson, 1909

FIGURE III-11
FORMATION OF SINKHOLES AND CAVERNS THROUGH THE ACTION OF GROUND WATER

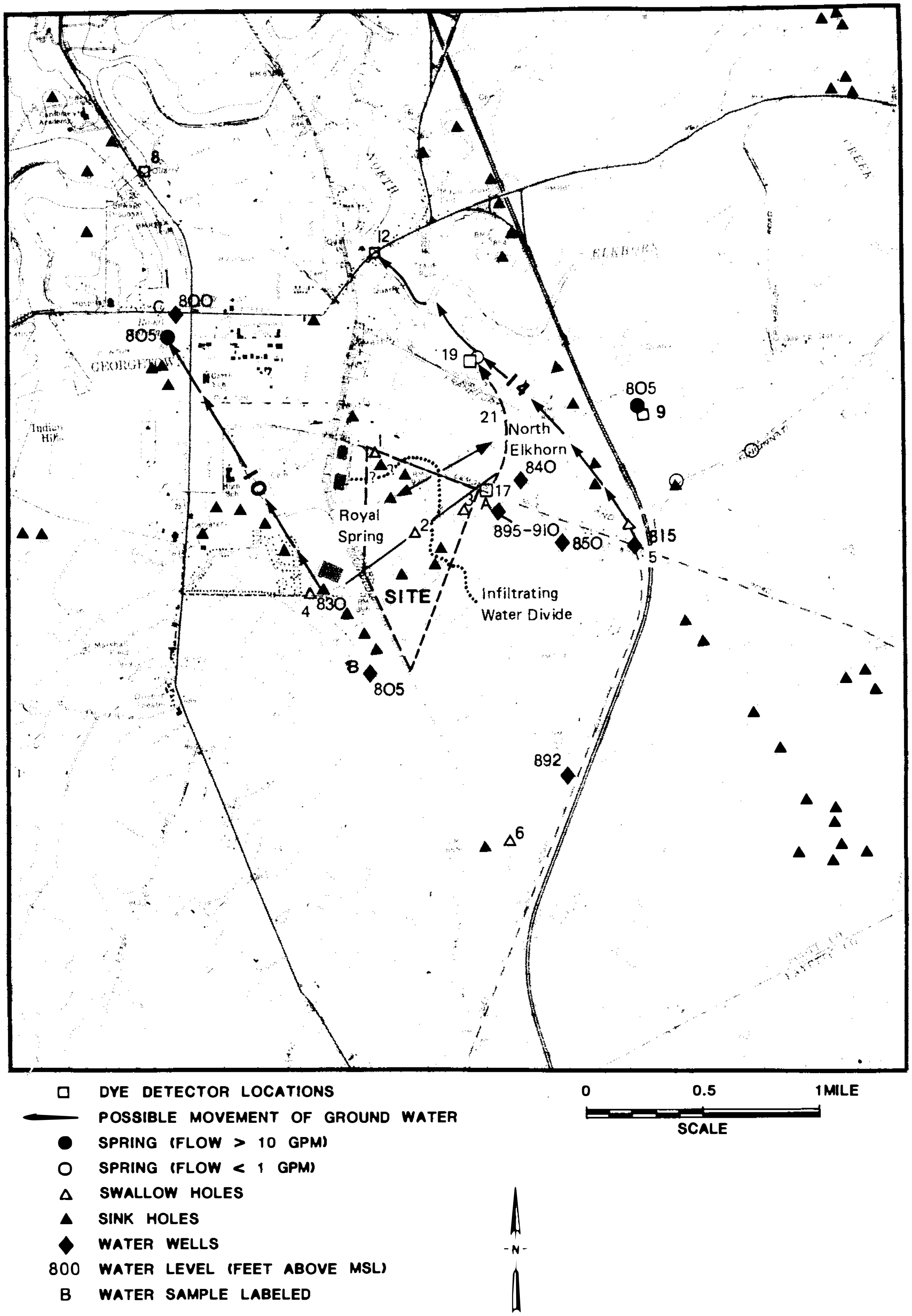


FIGURE III-12
WATER WELL, SPRING, AND SINKHOLE
LOCATIONS AND MOVEMENT OF GROUND WATER

Table III-6. Chemical Analysis of Water from Cane Run Creek

Parameter	Sample Collected 5/4/67	12/6/67	3/22/68
pH, units	7.9	7.8	7.3
Temperature, °C	17	10	7
Detergents, mg/l	-	.05	.00
Silica, mg/l	8.4	10.0	6.9
Iron, mg/l	0.07	0.02	0.10
Manganese, mg/l	0.00	0.02	0.01
Calcium, mg/l	74	84.0	57.0
Magnesium,mg/l	6.1	7.3	5.4
Sodium, mg/l	7.0	8.6	7.4
Potassium, mg/l	1.2	1.8	2.1
Bicarbonate, mg/l	179.0	194.0	132.0
Carbonate, mg/l	0	0	0
Sulfate, mg/l	45.0	65.0	37.0
Chloride, mg/l	18.0	14.0	14.0
Fluoride, mg/l	0.3	0.4	0.7
Nitrate, mg/l	13.0	17.0	17.0
Phosphorus, mg/l	-	1.0	1.4
Dissolved Solids, mg/l	267.0	289.0	225.0
Specific Conductance μmhos	210.0	240.0	167.0
Hardness (as $CaCo_3$)	438.0	480.0	360.0

Source: Mull, 1968

Well water levels and topographic contours indicate that there is a divide present in the northeast corner of the industrial park. This divide encompasses the sinkhole tested on the site.

From these data, the following conclusions are reached:

- Path 10 between Senge Sink and Royal Spring represents a major conduit.
- The land area northeast of the topographic divide does not contain a major conduit and drains Elkhorn Creek instead of Royal Spring. Subsurface drainage from North Elkhorn Creek along the northeastern corner of the industrial park follows surface drainage patterns to Path 21. Although the dye injected in the northeastern sinkhole was never detected, it is probable that this area also follows surface drainage patterns to North Elkhorn Creek.
- The remaining land area in the industrial park probably drains into Royal Spring. Whether there is a major pathway to the spring beneath the industrial park or whether the groundwater from the park interacts with the conduit designated as Path 10 cannot be determined from the existing information.

Other Springs. Other small springs found in this general area are not flowing as constantly as Royal Spring. These springs occur at elevations greater than 810 feet above mean sea level (msl) and are considered to be wet weather springs. The recharge areas for these springs are significantly smaller and conduit feeders to these springs are not likely to be well developed or greatly enlarged.

(3) Water Quality

Royal Spring. The quality of water discharging from Royal Spring is well documented. Public Health Services analyses exist and various authors have published chemical analyses of water from Royal Spring (Mull, 1968; Faust, 1977). In general, the water quality from Royal Spring has declined over the years. Table III-7 indicates a general increase in concentrations of total dissolved solids, chloride, sulfate, magnesium and calcium over 26 years of reported analyses (Dames and Moore, 1977).

Fluctuation in the water quality of springs in this area is also directly related to season of the year, number of consecutive wet or dry years, and precipitation events in the spring's recharge area. Water, moving down through the sinkholes to the solution channels of the limestone aquifer, is not subjected to the same filtration processes as water moving through the soil and porous bedrock horizons. Therefore, filtration is not as efficient (Dames and Moore, 1977).

Well Water. In general, rocks of the Lexington and Eden formations (see Figure III-13, Area 1) produce sufficient water for domestic supply when pumped. The wells completed in these formations typically yield at least 500 gallons per day and some wells in areas adjacent to larger streams may produce 432,000 gallons per day.

Wells completed in the Cynthiana Formation Area 2 vary in their capacity to yield water. Usually wells drilled in the western and southern areas of Scott County produce sufficient water for domestic use (100 to 500 gallons per day) but may be insufficient during dry periods (Faust, 1977). Wells drilled in Area 3 generally do not produce sufficient water for domestic demands except when located

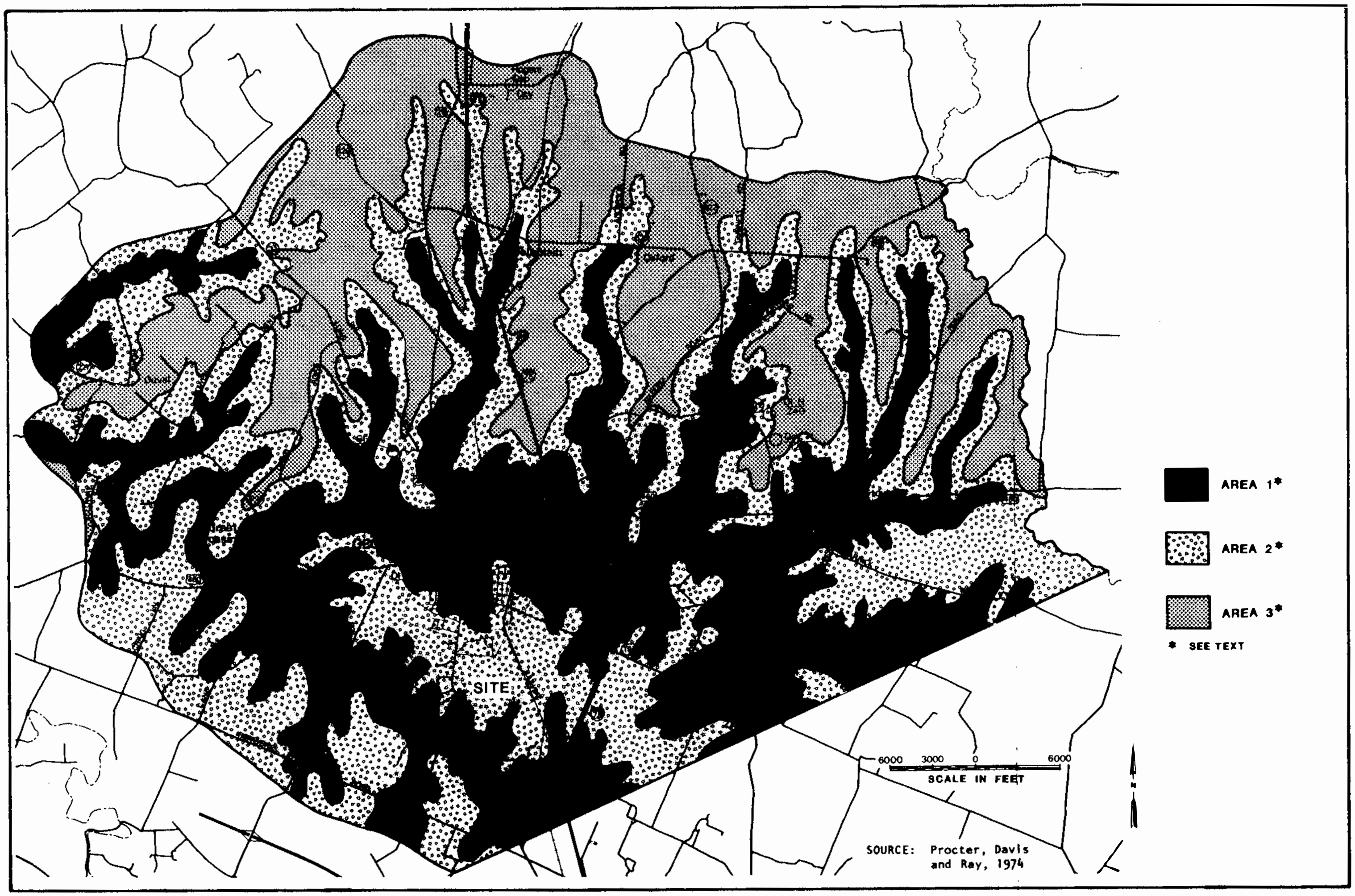


FIGURE III-13
AVAILABILITY OF GROUND WATER IN THE VICINITY OF GEORGETOWN

Table III-7. Analysis of Water from Royal Spring

Parameter	Sample Collected 8/4/77[1]	8/13/75[2]	5/27/68[3]	12/27/51[3]
pH	7.6	-	7.5	8.0
Suspended solids, mg/l	1.0	-	-	-
BOD, mg/l	1.0	-	-	-
TDS, mg/l	376.0	370	258	201
Chloride, mg/l	32.5	36	12	3.5
Sulfate, mg/l	50.3	59	40	25
Total floride, mg/l	0.68	1.0	0.6	1.6
Ammonia, mg/l	0.19	-	-	-
Nitrate, mg/l	2.71	7.1	18.0	23
Phosphorus, mg/l	0.59	-	-	-
Total alkalinity, mg/l	204.5	-	-	-
Total hardness, mg/l	251.5	270	199	329
Boron, mg/l	<0.1	-	-	-
Magnesium, mg/l	2.5	8.5	5.4	3.9
Calcium, mg/l	84.4	93	71	58
Sodium, mg/l	20.85	22	6.2	2.0
Arsenic, μg/l	<0.4	-	-	-
Barium, μg/l	80.0	-	-	-
Cadmium, μg/l	1.4	-	-	-
Total chromium, μg/l	3.7	2	-	-
Soluble iron, μg/l	99.0	940	140.0	160.0
Lead, μg/l	22.0	-	-	-
Manganese, μg/l	32.0	60	30	40.0
Selenium, μg/l	<0.01	-	-	-
Mercury, μg/l	0.9	-	-	-
Silver, μg/l	1.2	-	-	-
Silica, μg/l	-	6.9	5.6	8.3
Potassium, μg/l	-	2.8	1.7	1.0
Bicarbonate, μg/l	-	240	176	143
Specific conductance, μmhos	508	570	420	329

[1] Collected for Dames and Moore, 1977; analysis by Howard Laboratories, Dayton, Ohio.
[2] Source: Faust, 1977.
[3] Source: Mull, 1968.

in valleys. None of these wells, however, are dependable in dry weather. If a well penetrates a limestone solution conduit recharged by stream flow, it could support large capacity industrial wells (Faust, 1977).

Water wells in the industrial park site area have been measured by various workers (Mull, 1968; Faust, 1977). Wells with water-level measurements available in the area of the industrial park site are shown on Figure III-12. Most of the wells in this area are no longer used for a domestic supply due to the availability of a municipal supply. Only one well, B, measured for this report was being pumped continuously for stock supply. The rest of the wells were inactive.

Data on the quality of groundwater from wells in the general area of the industrial park site have been published in previous reports (Mull, 1968; Palmquist and Hall, 1953, 1960, and 1961; Faust, 1977). In addition, three samples of well water were analyzed for this report. Table III-8 is a summary of the various chemical analyses of water from wells made for this report and from previous reports. The three water well samples analyzed for this report represent various aspects of the groundwater aquifers:

- Sample A is from a shallow well (less than 15 feet deep) on a topographic high. It may represent a soil or perched water table.
- Sample B is from a well that is believed to penetrate the main feeder conduit to Royal Spring. The water obtained from this well is a representative sample of the groundwater from the major aquifer.
- Sample C is from a water well located north of Royal Spring and at the same elevation as the spring. It is believed that this water sample represents groundwater from a minor or secondary source of recharge that is flowing towards North Elkhorn Creek rather than Royal Spring.

In general, water obtained at depths less than 1000 to 2000 feet below stream level is a calcium-magnesium-bicarbonate type while deeper water is saline or a sodium-chloride type. Some shallower wells, however, produce saline water. Hamilton (1950) associated the occurrence of saline water with faults and associated joints.

g. Air

The topography of the Georgetown region (within a 20-mile radius) is gently rolling and covered with crops and deciduous trees. There are no major water bodies nearby to modify the continental-type climate. The difference between the highest and lowest temperatures of the year is approximately 100° Fahrenheit (F) or 56° Centigrade (C), while the difference between mean summer temperatures and mean winter temperatures is 44°F (24°C) (National Oceanic and Atmospheric Administration [NOAA], 1973). Precipitation is moderate (annual average total 44.5 inches, 1130 millimeters) and quite evenly distributed throughout the year, with autumn being the driest season (NOAA, 1973). Thunderstorms are frequent during spring and summer. Tornadoes are less common than in states to the west of Kentucky, but they are, nevertheless, a threat, particularly from March through June. Average wind speed is approximately 10 miles per hour (16 kilometers per hour) and the prevailing direction is from the south or south-southwest during all months.

Regional air pollution potential is greatest during late summer and autumn when anticyclones are most likely to stagnate over the eastern part of the country trapping air pollution below the mixing layer. Locally, air pollution is greatest when shallow early morning inversions trap local pollutants within a few hundred feet (100 to 300 meters) of the ground. These pollutants are normally dispersed by mid-morning when the inversions are eliminated by surface heating due to solar insolation.

(2) Emission Standards

The State of Kentucky has established Air Contaminant Concentration Standards, both primary and secondary (Kentucky Department for Natural Resources and Environmental Protection (DNREP) 1975). Primary ambient air quality standards define levels of air quality which the commission judges are necessary, with an adequate margin of safety, to protect the public health. Secondary ambient air quality standards define levels of air quality which the commission judges are necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. The standards which shall apply to any single point location for the pollutants which could conceivably be emitted from the proposed development are presented in Table III-9.

(3) Air Quality

Ambient air quality concentration limits for priority classes as established by 40 CFR 51, as amended, are given in Table III-10. Priority classifications have designations from I to III; I representing greatest pollution and III the least. The proposed site is within the DNREP Blue Grass Air Quality Control Region. This region is classified as Priority II by the DNREP (1975) for particulate matter and Priority III for sulfur oxides, carbon monoxide, nitrogen dioxide, and photochemical oxidants (hydrocarbons).

The proposed site falls within an area designated by the EPA as Class II in which the <u>increase</u> in sulfur dioxide and particulate concentrations contributed by a new source or sources may not exceed the significant deterioration increments shown in Table III-11, (PL 95-95 Clean Air Act as amended August 7, 1977).

Table III-11. Maximum Allowable Increase of Air Pollutants

Pollutant	Maximum Allowable Increase ($\mu g/m^3$)
Particulate Matter:	
Annual Geometric Mean	19
24-Hour Maximum	37
Sulfur Dioxide:	
24-Hour Maximum	91
3-Hour Maximum	512
Annual Arithmetic Mean	20

Table III-8. Chemical Analysis of Selected Water Wells

Parameter	Chemical Analysis Sample A[1]	Sample B[1]	Sample C[1]	Sample Mull[2]
pH	7.4	7.4	7.1	7.6
Suspended solids, mg/l	3.0	48.0	35.0	-
BOD, mg/l	3.0	10.0	11.0	-
TDS, mg/l	256.0	320.0	376.0	416
Chloride, mg/l	2.4	55.5	37.1	48
Sulfate, mg/l	25.0	8.8	65.7	75
Total fluoride, mg/l	0.44	1.01	1.01	0.8
Ammonia, mg/l	0.12	0.23	<0.1	-
Nitrate, mg/l	5.30	0.66	2.82	11
Phosphorus, mg/l	0.25	0.51	0.35	-
Total alkalinity, mg/l	150.0	261.0	172.0	-
Total hardness, mg/l	188.0	200.0	256.0	277
Boron, mg/l	<0.1	<0.1	<0.1	-
Magnesium, mg/l	2.89	9.46	3.69	12
Calcium, mg/l	64.8	68.6	100.0	91
Sodium, mg/l	4.21	30.9	23.9	32
Arsenic, μg/l	<0.4	<0.4	<0.4	-
Barium, μg/l	13.0	410.0	380.0	-
Cadmium, μg/l	0.9	4.1	16.6	-
Total chromium, μg/l	2.8	14.0	2.9	-
Soluble iron, μg/l	9.0	8.0	7.0	200
Lead, μg/l	1.3	63.2	97.0	-
Manganese, μg/l	0.7	82.4	999.0	20
Selenium, μg/l	<0.01	0.04	0.06	-
Mercury, μg/l	<0.1	<0.1	<0.1	-
Silver, μg/l	0.6	0.9	1.2	-

[1]Sampled for this report July 20, 1977; analyses by Howard Laboratories, Dayton, Ohio.

[2]Source: Mull, 1968

Table III-9. State of Kentucky Air Quality Standards

Pollutant	Primary Standard	Secondary Standard
(1) Sulfur Oxides (SO_2), $\mu g/m^3$		
Annual arithmetic mean, not to exceed	80 (0.03 ppm)	-
Maximum 24-hour average	365 (0.14 ppm)	-
Maximum 3-hour average	-	1300 (0.50 ppm)
(2) Particulate matter		
(a) Suspended particulates, $\mu g/m^3$		
Annual geometric mean, not to exceed	75	60
Maximum 24-hour average	260	150
(b) Settleable particulates (dustfall) (Tons/square mile/month measured as total water solubles & insolubles)		
Maximum 3-month average	-	15 (5.25/gm/sq. meter/mo.)
(c) Soiling index		
Annual geometric mean, not to exceed	-	0.4 COH/1000 linear ft.
Maximum 3-month average	-	0.5 COH/1000 linear ft.
Maximum 24-hour average	6.0 COH/1000 linear ft.	0.3 COH/1000 linear ft.
(3) Carbon monoxide, mg/m^3		
Maximum 8-hour average	10 (9.0 ppm)	Same as Primary
Maximum 1-hour average	40 (35.0 ppm)	Same as Primary
(4) Photochemical oxidants (measured as ozone) $\mu g/m^3$		
Maximum 1-hour average	160 (0.08 ppm)	Same as Primary
(5) Total nonmethane hydrocarbons (measured as C), $\mu g/m^3$		
Maximum 3-hour morning average (6 to 9 A.M.)	160 (0.24 ppm)	Same as Primary
(6) Nitrogen oxides, $\mu g/m^3$		
Annual arithmetic mean, not to exceed	100 (0.5 ppm)	Same as Primary

Source: Kentucky Department for Natural Resources and Environmental Protection, 1975.

Table III-10. Ambient Air Quality Concentration Limits for Priority Classes

Limit ($\mu g/m^3$)

	Priority I, GREATER THAN	Priority II FROM	Priority II TO	Priority III, LESS THAN
SULFUR OXIDES				
Annual Arithmetic Mean	100	60	100	60
24-Hour Maximum	455	260	455	260
3-Hour Maximum	--	1300*	--	1300
PARTICULATE MATTER				
Annual Geometric Mean	95	60	95	60
24-Hour Maximum	325	150	325	150
CARBON MONOXIDE				
8-Hour Maximum	14,000	--		14,000
1-Hour Maximum	55,000	--		55,000
NITROGEN OXIDES				
Annual Arithmetic Mean	110	--		110
PHOTOCHEMICAL OXIDANTS	195	--		195

*Any concentration above 1300 $\mu g/m^3$

Source: Code of Federal Regulations, Protection of the Environment, Vol. 40, Part 50, July 1, 1976.

Of the air quality monitoring stations DNREP operates in the Blue Grass Region, eight are within 20 miles of the industrial park site. Figure III-14 shows the location of these stations relative to the town of Georgetown and the site area (the station at Winchester is also included since it is 23 miles from the site). Four of the stations are located within the city limits of Lexington, a city which contains a moderate number of contaminant-emitting industries. The other stations are located in towns with light or no industries. The fish hatchery station provides a convenient measure of regional background air quality since it is isolated from both industrial development and vehicular traffic.

Figure III-15 presents variation in the contaminant concentrations of total suspended particulates (TSP), sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), nonmethane hydrocarbons (HC), and photochemical oxidants from 1974 through 1976 (most recently available data) from the Lexington, Frankfort, Winchester, Cynthiana and the fish hatchery stations. The emissions from the four Lexington stations have been averaged for convenience. The primary Kentucky air quality standards are also shown for comparison. There is no consistent trend toward improving or deteriorating air quality in the region.

The Kentucky Department for Natural Resources and Environmental Protection (1975) requires the registration of all significant industrial air contaminant sources. The estimated controlled emissions from all major registered sources within a 20-mile radius of the site are presented separately for each contaminant in Figure III-16. The highest levels of emissions are, by far, from the industrial developments located in Lexington, 8 to 10 miles south of the site. A second important source is in the vicinity of Versailles, 10 miles southwest of the site.

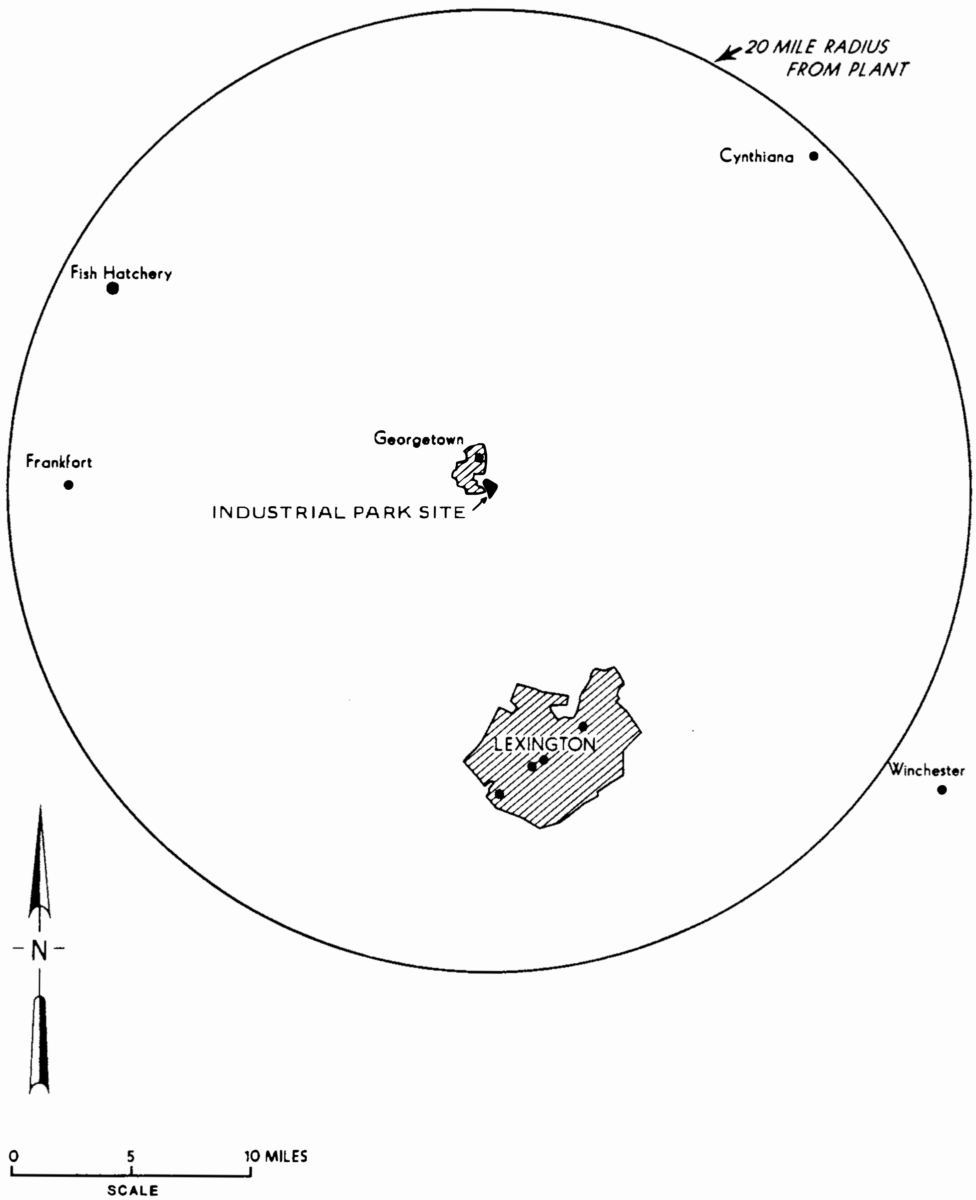
There are no identified nonattainment or noncompliance areas within the Blue Grass Air Quality Control Region. Consequently, this region was not required to submit a state implementation plan to the EPA under the 1974 Clean Air Act Amendments. However, the Clean Air Act was amended in August, 1977 and directives towards state implementation plans and plan requirements for nonattainment areas have been modified. The implications of these changes towards the Blue Grass Air Quality Control Region are not clear and must await State and Federal examination of and compliance with the amendments.

h. Noise

Dames and Moore (1977) conducted a sound survey near the proposed industrial park site. Measurements of ambient background sound levels were made at five locations. These locations are described in Table III-12.

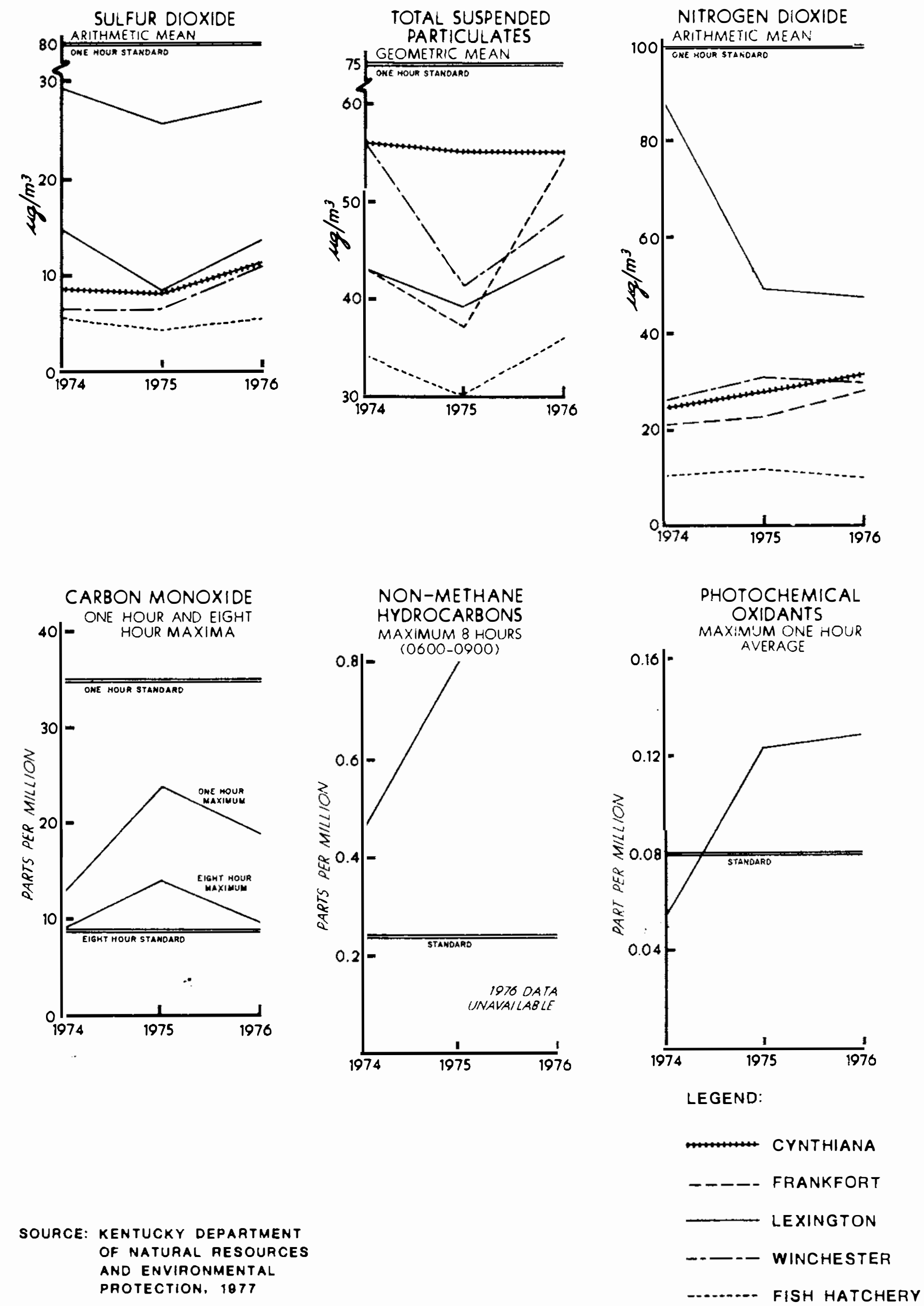
Table III-12. Ambient Sound Level Measurement Locations

Measurement Location	Description
1	Lemons Mill Rd. - NE corner of site
2	Clayton Ave and Avondale St.
3	Georgetown College on College St.
4	Scroggin Park Rd. and Showalter Dr.
5	Lemons Mill Rd. - NW corner of site



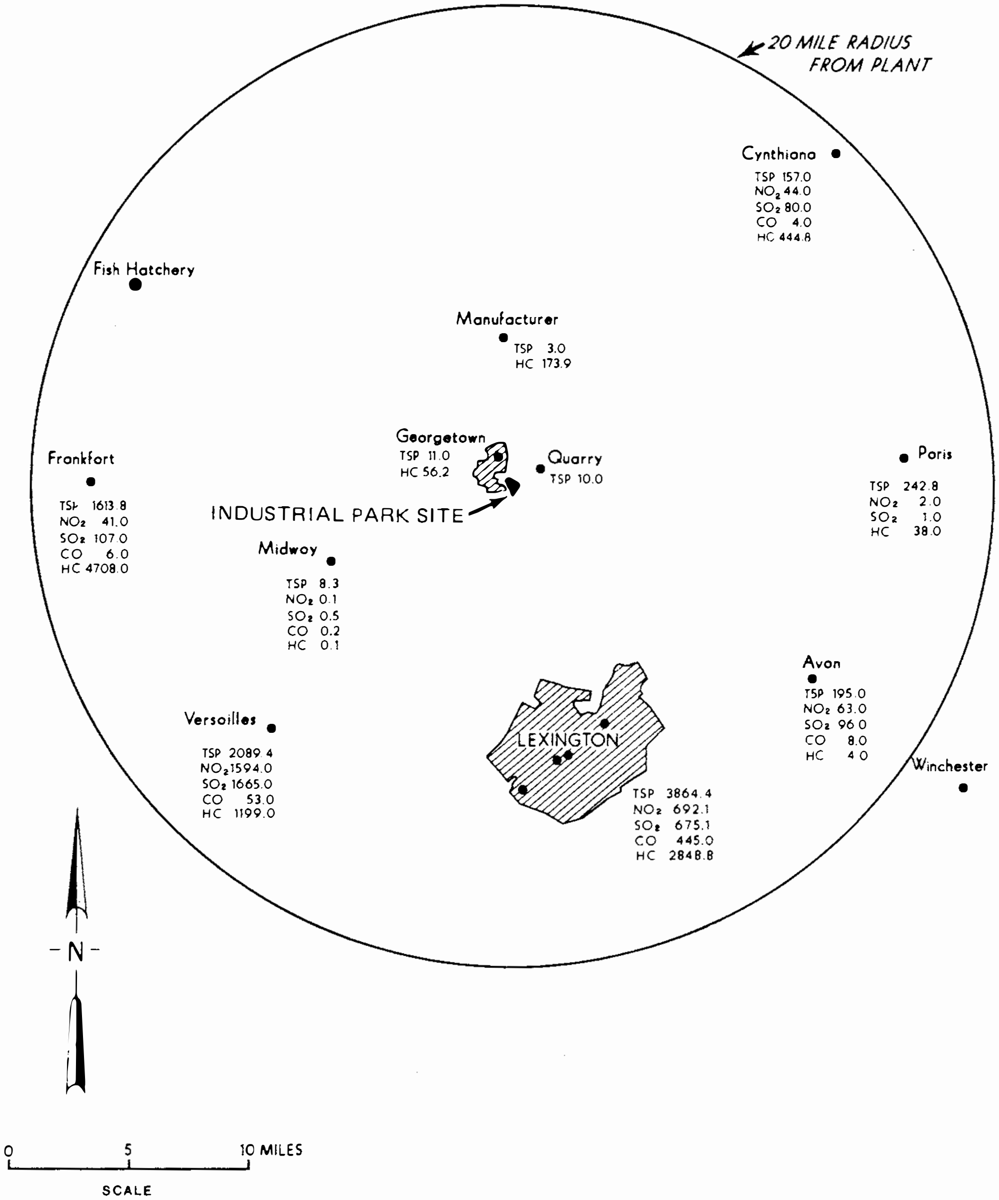
SOURCE: KENTUCKY DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION. 1977

FIGURE III-14
LOCATIONS OF BLUE GRASS REGION AIR QUALITY MONITORING STATIONS



SOURCE: KENTUCKY DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION, 1977

FIGURE III-15
VARIATIONS OF CONTAMINANT CONCENTRATIONS IN THE INDUSTRIAL PARK SITE AREA, 1974-1976



SOURCE: KENTUCKY DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION, 1977

FIGURE III-16
TSP, NO_2, SO_2, CO, AND HC EMISSIONS FOR VARIOUS SOURCES IN THE VICINITY OF GEORGETOWN, KENTUCKY
(in tons per year)

Table III-13. Summary of Statistical A-Weighted Sound Levels in Decibels

Location 1	TIME 7/6/77 0750	7/6/77 1413	7/6/77 2023	7/6/77 2338
L_{90}	41	36	38	40
L_{50}	44	40	40	41
L_{10}	61	55	55	45
L_{eq}	63	59	57	52
$L_{eq}(24)$				58.7
L_d				60.6
L_n				52.0
L_{dn}				61.1

Location 2	7/6/77 0840	7/6/77 1453	7/6/77 2050	7/6/77 0044
L_{90}	40	43	42	39
L_{50}	44	48	46	41
L_{10}	53	56	51	49
L_{eq}	53	56	51	52
$L_{eq}(24)$				53.4
L_d				54.1
L_n				52.0
L_{dn}				58.8

Note: L_x - A-weighted sound level exceeded X-% of the time during the measurement period.
$L_{eq}(24)$ - Twenty-four hour average sound level.
L_{dn} - Day/Night averages sound level. Nighttime (2200-0700) sound levels penalized by 10 dB.

Source: Dames & Moore, 1977

Table III-13. Summary of Statistical A-Weighted Sound Levels in Decibels (Continued)

Location 3	TIME 7/6/77 0924	7/6/77 1550	7/6/77 2123	7/6/77 0112
L_{90}	47	45	44	44
L_{50}	52	47	45	45
L_{10}	57	52	51	49
L_{eq}	55	49	49	47
$L_{eq}(24)$				50.7
L_d				50.2
L_n				47.0
L_{dn}				54.0

Location 4	7/6/77 1015	7/6/77 1630	7/6/77 2156	7/6/77 0145
L_{90}	41	43	42	42
L_{50}	47	49	444	43
L_{10}	63	65	54	47
L_{eq}	63	65	51	45
$L_{eq}(24)$				60.9
L_d				63.0
L_n				45.0
L_{dn}				61.3

Table III-13. Summary of Statistical A-Weighted Sound Levels in Decibels (Concluded)

Location 5	TIME 7/6/77 1143	7/6/77 1704	7/6/77 2230	7/6/77 0010
L_{90}	40	40	41	44
L_{50}	46	45	43	45
L_{10}	65	65	55	47
L_{eq}	66	70	68	54
$L_{eq}(24)$				66.5
L_d				68.5
L_n				54.0
L_{dn}				67.2

A summary of the results of this survey are shown in Table III-13. Measurements were made when there were no uncharacteristic activities on the site. Trucks from nearby industrial facilities and automobiles are the major contributors to ambient sound levels.

2. Biological Environment

a. Terrestrial Ecosystem

(1) Vegetation and Habitat

The study area lies within the Inner Bluegrass Section of the Western Mesophytic Forest Region (Braun, 1950; Wharton and Barbour, 1971). Except in isolated areas in the gorges of the Kentucky River and its tributaries, no areas of natural vegetation remain (Braun, 1950). While old forest trees such as oak, sugar maple, black walnut and wild cherry occur throughout the area, it is impossible to construct a picture of the original forest condition. In general, however, the Western Mesophytic Forest Region is considered to be transitional in that it is not characterized by a single climax type of forest.

The Inner Blue Grass Section contains some of the most unusual vegetation found in the eastern United States (Braun, 1950; Davis, 1953; Gibson, 1961; Wharton and Barbour, 1971, 1973). Possible reasons for this unusual vegetation include glacial influences (Braun, 1921; Keith, 1967); soil and chemical properties of the area (McInteer, 1946, 1947); and climate and precipitation (Transeau, 1935). Most of the original forest in the area has been reduced or modified by agricultural development, industrial expansion and urbanization. As a result, only one-fifth of the area in the total Blue Grass Section remains forested.

The proposed industrial park site, southeast of Georgetown, is located on land that has been primarily under agricultural development. Ecologically significant areas of the site include the woodlots and fencerows and pasture-hayfields. Of a total of 173.6 acres, corn cultivation accounts for 44 percent (76.4 acres); pasture-hayfield, 29 percent (50.3 acres); fencerows, 14 percent (24.3 acres); woodlots, 5 percent (8.7 acres); a farmstead, 3 percent (5.2 acres); roads, 3 percent (5.2 acres); and burley tobacco, 2 percent (3.5 acres). Current land use and vegetation of the proposed industrial park site are shown in Figure III-17.

The pasture-hayfield vegetation type is located in the northwestern section of the industrial park site (see Figure III-17) at elevations from 931 feet gradually sloping off to around 910-915 feet (Dames and Moore, 1977). The area has been used for livestock grazing and for cutting hay. Predominant species in the pasture-hayfield vegetation type include meadow fescue, (*Festuca elatior*), Kentucky bluegrass (*Poa pratensis*), and other species (Table III-14). Vegetation occurring along field borders and in abandoned fields include milkweed (*Asclepias syriaca*), hedge bindweed (*Convolvulus sepium*),

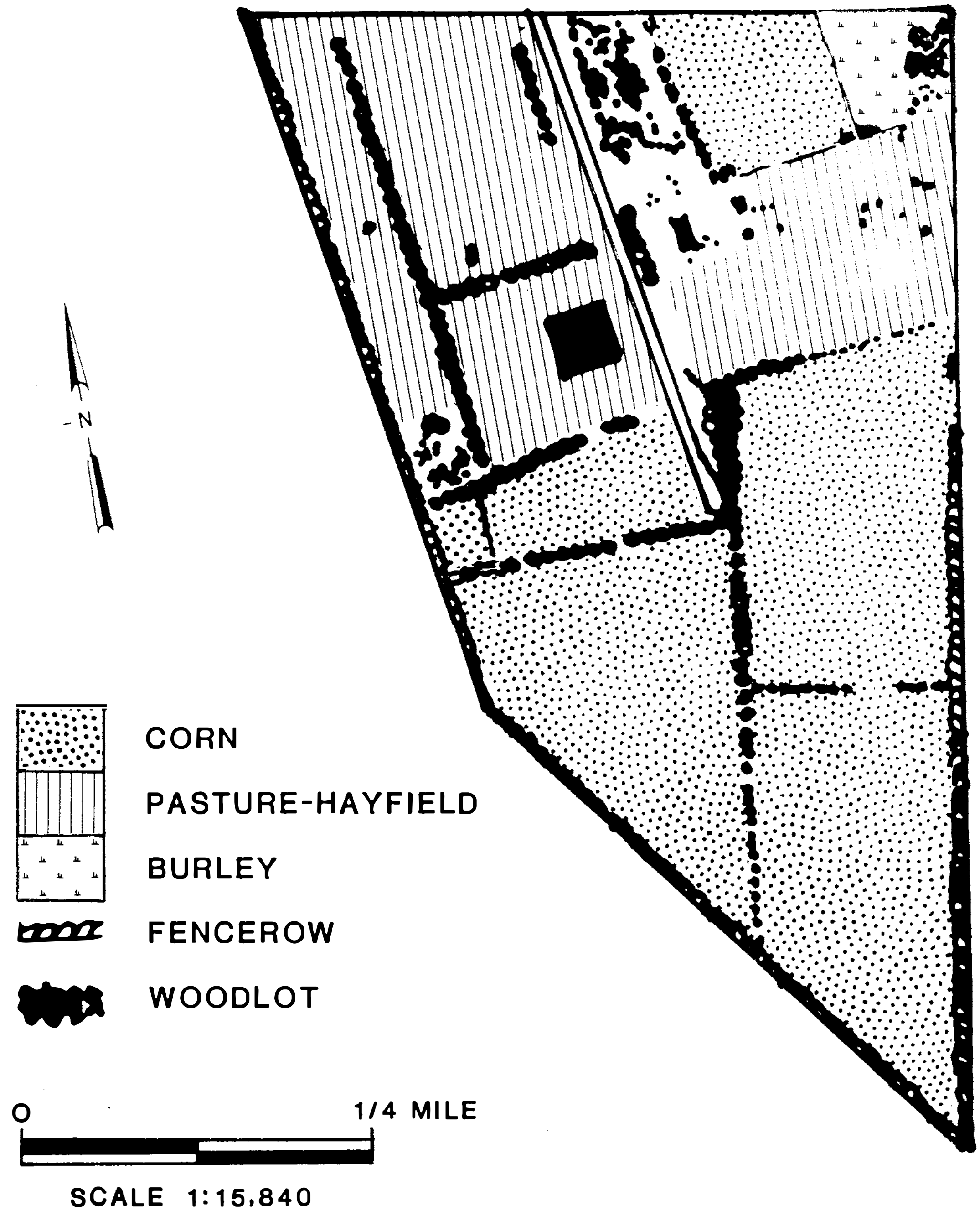


FIGURE III-17
VEGETATION OF THE INDUSTRIAL PARK SITE

Table III-14. Pasture-Hayfield Vegetation of Industrial Park Site

Common Name	Scientific Name
UNDERSTORY - GROUNDCOVER SPECIES	
Corn cockle	Agrostemma githago L.
Garlic - mustard	Alliaria officinalis Andrz.
Common milkweed	Asclepias syriaca L.
Winter cress	Barbarea vulgaris R. Br.
Chess	Bromus secalinus L.
Downy brome	Bromus tectonom L.
Nodding thistle	Carduus nutans L.
Chicory	Chichorium intybus L.
Field thistle	Cirsium discolor (Muhl.) Spreng.
Hedge bindweed	Convolvulus sepium L.
Field dodder	Cuscata pentagonia Engelm.
Orchard grass	Dactylis glomerata L.
Wild carrot	Daucus carota L.
Barnyard grass	Echinochloa crus-galli L.
White top	Erigeron annus (L.) Roth.
Meadow fescue	Festuca elatior L.
Common morning glory	Iopmoea purpurea (L.) Roth.
Prickly lettuce	Lactuca serriola L.
Peppergrass	Lepidium campestre (L.) R. Br.
Creeping bush-clover	Lespedeza procumbens Michx.
Alfalfa	Medicago sativa L.
White sweet clover	Melilotus alba (L.)
Yellow wood sorrel	Oxalis europaea Jordan.
Fall panicum	Panicum dichotomiflorum Michx.
Wild parsnip	Pastinaca sativa L.
Clammy ground cherry	Physalis heterophylla Nees.
Pokeweed	Phytolacca americana L.
Buckhorn plantain	Plantago lanceolata L.
Rugel's plaintain	Plantago rugelii Delne.
Kentucky bluegrass	Poa pratensis L.
Oldfield cinquefoil	Potentilla simplex Michx.
Smooth sumac	Rhus glabra L.
Sheep sorrel	Rumex acetosella L.
Rye grass	Secale glauca (L.) Beauv.
Black nightshade	Solanum nigrum L.
Meadow goatsbeard	Tragopogon dubius L.
Red clover	Trifolum pratense L.
Common mullein	Verbascum thapsus L.
Common cockleburr	Xanthium pensylvanicum Wallr.

Source: Dames and Moore, 1977 (taxonomy based on Wharton and Barbour, (1971, 1973).

III-15. Woodlot-Fencerow Vegetation of Industrial Park Site

Common Name	Scientific Name
OVERSTORY SPECIES	
Ohio buckeye	Aesculus glabra Willd.
Shagbark hickory	Carya ovata (Mill.) K. Koch.
Hackberry	Celtis occidentalis L.
Black walnut	Juglans nigra L.
White mulberry	Morus alba L.
Red mulberry	Morus rubra L.
Wild Black Cherry	Prunus serotina Ehrl.
Black locust	Robinia pseudoacacia L.
Red elm	Ulmus rubra Muhl.
UNDERSTORY AND GROUND COVER SPECIES	
Nodding wild onion	Allium cernuum Roth.
Common ragweed	Ambrosia artemisifolia L.
Common milkweed	Asclepias syriaca L.
Wild oat	Avena fatua L.
Sticktight	Bidens cornua L.
Downy brome	Bromus tectonom L.
Trumpet creeper	Campsis radicans (L.) Seem.
Nodding thistle	Carduus nutans L.
Common lambsquarter	Chenopodium album L.
Field daisy	Chrsanthemum leucanthimum var. pinnatifidum L.
Chicory	Cichorium intybus L.
Water hemlock	Cicuta maculata L.
Field thistle	Cirsium discolor (Muhl.) Spreng.
Hedge bindweed	Convolvulus sepium L.
Yellow nut grass	Cyperus esculentus L.
Wild Yam	Dioscorea villosa L.
White top	Erigeron annuus (L.) Pens.
Mistflower	Eupatorium coelestinum L.
Joe-pye weed	Eupatorium purpureum L.
Pale touch-me-not	Impatiens pallida Nutt.
Ivy leaved morning glory	Ipomoea hederacea L.
Common morning glory	Impoca purpurea (L.) Roth.
Red cedar	Juniperus virginiana L.
Peppergrass	Lepidium campestre (L.) R. Br.
Creeping bush clover	Lespedeza procumbens Michx.
Japanese honeysuckle	Lonicera japonica Thunb.
Pineapple weed	Matricaria matricarioides L.
White sweet clover	Melicotus alba L.
Fall panicum	Panicum dichotomiflorium Michx.
Wild parsnip	Pastinaca sativa L.
Reed canarygrass	Phalaris arundinacea L.
Wild sweet william	Phlox divaricata L.
Clammy ground cherry	Physalis heterophylla Nees.
Pokeweed	Phytolacca americana L.
Buckhorn plantain	Plantago lanceolata L.
Rugel's plantain	Plantago rugelli Decne.
Pennsylvania smartweed	Polygonum pennsylvanicum L.
Oldfield cinquefoil	Potentilla simplex Michx.
Yellow wood-sorrel	Oxalis europaea Jordan.
Poison ivy	Rhus radicans L.
Black raspberry	Rubus occidentalis L.
Sessile ruellia	Ruellia humilis Nutt.
Sheep sorrel	Rumex acetosella L.
Elderberry	Sambucus canadensis L.
Bouncing bet	Saponaria officinalis L.

Taxonomy based on Wharton and Barbour, (1971, 1973).

III-15. Woodlot-Fencerow Vegetation of Industrial Park Site (Concluded)

Common Name	Scientific Name
Yellow foxtail	Setaria glauca (L.) Beauu.
Black nightshade	Solanum nigrum L.
Johnson grass	Sorghum halepense (L.) Pers.
Hedge-nettle	Stachys palustris L.
Meadow goatsbeard	Tragopogon dubius L.
Red clover	Trifolium pratense L.
Ironweed	Vernonia altissima Nutt.
Common blue violet	Viola papilionacea Pursh.
Summer grape	Vitis aestivalis Michx.

Table III-16. Relative Abundance of Birds Observed at the Industrial Park Site During June 1977

Common Name	Relative Abundance*
Turkey vulture	U
Bobwhite quail	C
Killdeer	U
Rock dove	C
Mourning dove	C
Yellow-billed cuckoo	U
Common nighthawk	C
Chimney swift	C
Common flicker	U
Downy woodpecker	U
Blue jay	U
Common crow	C
Carolina chickadee	C
Mockingbird	U
Brown thrasher	U
American robin	A
Starling	A
Prairie warbler	C
Common yellowthroat	C
House sparrow	C
Eastern meadowlark	C
Red-winged blackbird	A
Common grackle	A
Brown-headed cowbird	C
Cardinal	C
Indigo bunting	C
Field sparrow	C
Song sparrow	C

*The relative abundance of bird species was determined from field observations made during June 1977 at the site, Georgetown, Kentucky.

Abundant - a bird likely to be seen in large numbers at all times in its preferred habitat at the proper season.

Common - a bird seen most of the time or in small numbers under the same circumstances.

Uncommon - a bird seen quite regularly in small numbers in the appropriate habitat and season.

Table III-17. Mammals Likely to Occur in the Kentucky Blue Grass Region[1]

Common Name	Scientific Name	Status[2]
Virginia opossum[3]	*Didelphis virginiana*	C
Short-tailed shrew[4]	*Blarina brevicauda*	C
Least shrew[4]	*Cryptotis parva*	C
Eastern mole[4]	*Scalopus aquaticus*	C
Little brown myotis[4]	*Myotis lucifugus*	U
Gray myotis	*Myotis grisescens*	R
Indiana myotis	*Myotis sodalis*	R
Silver-haired bat	*Lasionycteris noctavagans*	N.A.
Eastern pipistrelle[4]	*Pipistrellus subflavus*	C
Big brown bat[4]	*Eptesicus fuscus*	C
Red bat[4]	*Lasiurus borealis*	C
Hoary bat	*Lasirus cinereus*	N.A.
Evening bat	*Nycticeius humeralis*	R
Eastern cottontail[3]	*Sylvilagus floridanus*	C
Eastern chipmunk[4]	*Tamias striatus*	C
Woodchuck[3]	*Marmota monax*	C
Gray squirrel[3]	*Sciurus carolinensis*	C
Fox squirrel[3]	*Sciurus niger*	C
Southern flying squirrel	*Glaucomys volans*	C
Beaver	*Castor canadensis*	R
Eastern harvest mouse[4]	*Reithrodontomys humulis*	C
Deer mouse[4]	*Peromyscus maniculatus*	C
White-footed mouse[3]	*Peromyscus leucopus*	C
Eastern woodrat	*Neotoma floridana*	U
Meadow vole[3]	*Microtus pennsylvanicus*	U
Prairie vole[4]	*Microtus ochrogaster*	C
Woodland vole[4]	*Microtus pinetorum*	C
Muskrat	*Ondatra zibethicus*	C
Southern bog lemming[4]	*Synaptomys cooperi*	C
Norway rat[4]	*Rattus norvegicus*	C
House mouse[4]	*Mus musculus*	C
Meadow jumping mouse	*Zapus hudsonius*	R
Coyote	*Canis latrans*	N.A.
Red fox[3]	*Vulpes vulpes*	C
Gray fox	*Urocyon cinereoargenteus*	C
Raccoon[3]	*Procyon lotor*	C
Long-tailed weasel	*Mustela frenata*	U
Mink	*Mustela vison*	C
Striped skunk[3]	*Mephitis mephitis*	C
Bobcat	*Lynx rufus*	N.A.
White-tailed deer	*Odocoileus virginianus*	U

[1]Source: U.S. Army Corps of Engineers Topographic Laboratories, 1974.
[2]Status: C = Common to abundant at least locally.
U = Uncommon, but found regularly in small numbers.
R = Rare, found infrequently but may be expected especially at certain times of the year.
V = Very rare or irregular
A = Accidental visitor
N.A.= Not available
[3]Mammals and/or their signs observed at the energy park site.
[4]Likely site residents based upon available habitat and species distribution in Kentucky.

thistle (Cirsium discolor), foxtail (Setaria glauca), bush clover (Lespedeza procumbens), and grasses of various types.

Woodlots and fencerow areas represent a maturing overstory (wooded forested) cover type. Where disturbances have been minimum (along railroad right-of-way, fencerows, and small woodlots), trees up to 16 inches diameter at breast height have developed. The most common overstory species include black cherry (Prunus serotina), hackberry (Celtis occidentalis), black walnut (Jugloans nigra), black locust (Robinia pseudoacacia), and white and red mulberry (Morus alba and M. rubra). Understory species include hackberry, (Celtis occidentalis L.), red cedar (Juniperus virginiana), red elm (Ulmus rubra) and elderberry (Sambucus canadensis). A listing of plants reported from the site is presented in Table III-15.

(2) Wildlife Population

Two hundred and fifty species of birds may be found in the general study area. These species and their status are listed in Appendix B, Table B-1. The lack of preferred habitat and the proximity of the proposed industrial park site to urban development preclude the presence of many of the species reported for the area. A listing of birds observed during a June 1977 survey of the proposed site is given in Table III-16. Songbirds were the most diverse grouping of birds; the most abundant species were common grackle, robin, starling, and redwing blackbird. Common inhabitants included the cardinal, song sparrow, brown-headed cowbird, common yellowthroat, prairie warbler, eastern meadowlark, Carolina chickadee, and house sparrow (Dames and Moore, 1977).

The types and distribution of the vegetation at the proposed industrial park site provide essential resources required by two species of gamebirds, mourning dove and bobwhite quail. The hayfields and agricultural lands provide food; the fencerows and bushy areas provide cover and roosting areas; and the scattered ponds supply water needs. At least three coveys of quail were in the area in 1976 (Clifton, 1977). While both the quail and dove are hunted on site, no harvest estimates are available. Other birds observed during the June survey included killdeer, spotted sandpiper, turkey vulture, pigeons, swifts, goatsucker, cuckoos, and woodpeckers.

The occurrence and status of the 41 species of mammals occurring in the Blue Grass Region of Kentucky are presented in Table III-17. Also noted on Table III-17 are the mammals observed at the proposed industrial park site during field investigations in June, 1977, and mammals not observed but expected to occur on the site.

Four species of furbearers, oppossum, raccoons, striped skunk and red fox, are known to occur at the site. Three species classified as game animals occur on site. These are the cottontail rabbit, gray squirrel, and fox squirrel. A fourth game species, the white tailed deer, has been reported in the site area on rare occasions (Clifton, 1977).

The woodchuck is the most common medium-sized mammal on site (Dames and Moore, 1977). Two species of small mammals were trapped during a summer field survey of the site (Table III-18). Other small mammal species expected on site include deer mouse, prairie vole, woodland vole, house mouse, Norway rat and chipmunk. The most likely occurring species of bats on the site are the little brown myotis and big brown bat. The eastern pipistrelle and red bat could also occur on site. However, since these two species are woodland and woodland edge inhabiting species neither would be expected to be common. No bats were observed during the June field investigation (Dames and Moore, 1977).

Table III-18. Small Rodent Trapping Results at the Industrial Park Site June 1977

Common Name	Habitat Type	No. of Captures	Trap Success(%)
White-footed mouse	Wooded fence row	3	3.0
White-footed mouse	Old field	1	1.0
Meadow vole	Old field	3	3.0

While at least 23 species of reptile and 28 species of amphibians occur in the Blue Grass Region, the actual occurrence and abundance of these species at the proposed industrial park site is unknown. No amphibians or reptiles were encountered during the June field investigations conducted by Dames and Moore. The implied presence of several species at the site is based on the known range and habitat requirements of individual species, combined with the habitat available at the site. A listing of reptiles and amphibians likely to occur in the proposed industrial park site region is given in Table III-19.

b. Aquatic Ecosystems

(1) Aquatic Habitats

While no streams actually cross the proposed industrial park site, surface drainage from the northern portions eventually flows into North Elkhorn Creek and surface drainage from southern portions flows into Cane Run Creek. These two streams originate in Fayette County near Lexington, Kentucky and flow in a northwesterly direction. North Elkhorn Creek is the largest stream in the area (about 68 miles long) and Cane Run Creek is the second largest stream in the area (about 11 miles long). Both streams eventually flow into the Kentucky River.

A general description of North Elkhorn Creek has been given by Dames and Moore (1977) for the location where they collected water quality information. These three station are located in the vicinity of the proposed industrial park site (Stations 1 and 2) and about 1.4 miles downstream from the Georgetown Sewage Treatment Plant wastewater discharge (Station 3) (see Figure III-10).

Table III-19. Reptiles and amphibians Likely to Occur in the Industrial Park Site Region[1]

Common Name	Scientific Name	Status[2]
Hellbender	Cryptobranchus alleganiesis	U
Jefferson's salamander	Ambystoma jeffersonianum	U
Small-mouthed salamander	Ambystoma texanum	C
Marbled salamander	Ambystoma opacum	U
Spotted salamander	Ambystoma maculatum	U
Dusky salamander	Desmognathus fuscus	C
Seal salamander	Desmognathus monticola	U
Zig-zag salamander	Plethodon dorsalis	C
Ravine salamander	Plethodon Richomndi	C
Slimy salamander	Plethodon glutinosus	C
Four-toed salamander	Hemidactylium scutatum	N.A.
Spring salamander	Gyrinophilus porphyriticus	R
Mud salamander	Pseudotriton montanus	C
Red salamander	Pseudotriton ruber	N.A.
Two-lined salamander	Eurycea bislineata	C
Long-tailed salamander	Eurycea longicauda	U
Cave salamander	Eurycea lucifuga	C
Newt	Ntophthalmus viridenscens	U
Mudpuppy	Necturus maculosus	C
Bullfrog	Rana catesbeiana	C
Green frog	Rana clamitans	C
Leopard frog	Rana pipiens	U
Pickerel frog	Rana palustris	R
American toad	Bufo americanus	C
Fowler's toad	Bufo woodhousei	C
Cricket frog	Acris crepitans	R
Spring peeper	Hyla crucifer	U
Gray-tree frog	Hyla versicolor	U
Snapping turtle	Chelydra serpentina	C
Stinkpot	Sternotherus odoratus	C
Box turtle	Terrapene carolina	U
Map turtle	Graptemys geographica	C
Painted turtle	Chrysemys picta	U
Red-eared turtle	Chrysemys scripta elegans	C
Smooth softshell turtle	Trionyx muticus	R
Spiny softshell turtle	Trionyx spinifer	U
Fence lizard	Sceloporus undulatus	C
Five-lined skink	Eumeces faciatus	C
Broad-headed skink	Emeces laticeps	N.A.
Worm snake	Carphophis amoenus	C
Ringneck snake	Diadophis punctatus	U
Hognose snake	Heterodon platyrhinos	U
Rough green snake	Opheodrys aestivus	U
Black racer	Coluber constrictor	U
Rat Snake	Elaphe obsoleta	C
Black king snake	Lampropeltis getulus niger	R
Milk snake	Lampropeltis doliata triangulum	C
Garter snake	Tramnophis sirtalis	C
Brown snake	Storeria dekayi	R
Queen water snake	Regina septemvittata	C
Common water snake	Natrix sipedon	C
Copperhead	Agkistrodon contortrix	R

[1]Source: U.S. Army Corps of Engineers Topographic Laboratories, 1974.

[2]Key
- C = Common to abundant at least locally.
- U = Uncommon, but found regularly in small numbers.
- R = Rare, found infrequently but may be expected especially at certain times of the year.
- V = Very rare or irregular
- A = Accidental visitor
- N.A.= Not available

Table III-20. Fish of the Elkhorn Creek Drainage, Kentucky (With Notes on Distribution)[1]

Scientific Name	Common Name	Distribution[2]			
LEPISOSTEIDAE					
Lepisosteus osseus	Longnose gar	E	M		
CLUPEIDAE					
Dorosoma cepedianum	Gizzard Shad	E	M		
HIODONTIDAE					
Hiodon tergisus	Mooneye	E	M		
CYRPRINIDAE					
Campostoma anomalum	Stoneroller	E	M	N	S
Carassius auratus	Goldfish				S
Cyprinus carpio	Carp	E			S
Hybopsis amblops	Bigeye chub	E		N	
Hybopsis biguttata	Hornyhead chub	E		N	
Hybopsis micropogon	River chub	E	M		S
Notropis crysoleucas	Golden shiner			N	
Notropis ardens	Rosefin shiner	E	M	N	S
Notropis atherinoides	Emerald shiner	E	M	N	S
Notropis cornutus	Common shiner	E	M	N	S
Notropis photogenis	Silver shiner	E	M	N	S
Notropis rubellus	Rosyface shiner	E			
Notropis spilopterus	Spotfin shiner	E			
Notropis volucellus	Mimic shiner	E		N	
Pimephales notatus	Bluntnose shiner	E	M	N	S
Rhinichthys atratulus	Blacknose dace	E			S
Semotilus atromaculatus	Creek chub	E		N	S
CATOSTOMIDAE					
Carpiodes carpio	River carpsucker	E	M		
Carpiodes velifer	Highfin carpsucker	E			
Catostomus commersoni	White sucker	E		N	S
Hypentelium nigricians	Northern hog sucker	E		N	S
Ictiobus bubalus	Smallmouth buffalo	E			
Ictiobus cyprinellus	Bigmouth buffalo	E			
Moxostoma breviceps	Shorthead redhorse	E			
Moxostoma carinatum	River redhorse			N	
Moxostoma duguesnei	Black redhorse	E			
Moxostoma erythrurum	Golden redhorse	E	M	N	S
ICTALURIDAE					
Ictalurus melas	Black bullhead	E		N	
Ictalurus natalis	Yellow bullhead	E		N	
Ictalurus nebulosus	Brown bullhead				S
Ictalurus punctatus	Channel catfish				S
Noturus flavus	Stonecat	E	M		
Pylodictis olivaris	Flathead catfish	E			
ESOCIDAE					
Esox americanus vermiculatus	Grass pickerel			N	
POECILIIDAE					
Roccus chrysops	White bass	E			

Table III-20. Fish of the Elkhorn Creek Drainage, Kentucky (With Notes on Distribution)[1] (Concluded)

Scientific Name	Common Name	Distribution[2]			
CENTRARCHIDAE					
Ambloplites rupestris	Rock bass	E	M	N	S
Chaenobryttus gulosus	Warmouth	E		N	
Lepomis cyanellus	Green sunfish	E		N	S
Lepomis macrochirus	Bluegill	E	M	N	S
Lepomis megalotis	Longear sunfish	E	M	N	S
Micropteru punctulatus	Spotted bass	E			
Micropteru dolomieui	Smallmouth bass	E	M	N	S
Micropteru salmoides	Largemouth bass	E	M	N	S
Pomoxis annularis	White crappie			N	
Pomoxis nigramaculatus	Black crappie	E		N	
Lepomis microlophus	Redear sunfish	E	M		
Lepomis sp. x sp.	Hybrid sunfish	E	M	N	S
PERCIDAE					
Etheostoma blennioides	Greenside darter	E	M	N	
Etheostoma flabellare	Fantail darter	E	M	N	S
Etheostoma nigrum	Johnny darter	E		N	
Etheostoma spectabile	Orangethroat darter	E			
Percina caprodes	Logperch	E	M	N	
Percina maculata	Blackside darter	E		N	
Stizostedion canadense	Sauger	E			
SCIAENIDAE					
Aplodinotus grunniens	Freshwater drum	E	M		
COTTIDAE					
Cottus carolinae	Banded sculpin	E		N	S
ATHERINIDAE					
Labidesthes sicculus	Brook silverside	E		N	

[1] Source: Jones, 1968; Laflin, 1970 (based on data from 1960-1969);
[2] Distribution: E - Reported for Elkhorn Creek, no specific location noted.
M - Main stem Elkhorn Creek
N - North Fork Elkhorn Creek
S - South Fork Elkhorn Creek

The characteristics of North Elkhorn Creek at Stations 1 and 2 are similar. At these points, it is 50 feet wide, 8 feet deep, and has no noticeable flow. These stations are also characterized by steep banks (5 to 15 feet high), heavy tree cover and moderate quantities of algae and Lemna sp. (duckweed). At Station 3 it is about 3 feet deep, has a slight flow, and a very heavy concentration of algae and Lemna sp.

Cane Run Creek is about 50 feet wide and 2 feet deep downstream from the proposed industrial park site drainage and has no noticeable flow here. In this area, Cane Run is surrounded by horse farms and seasonally has very heavy algal blooms. During the algal blooms, Cane Run has very little open water. Upstream from the site drainage, Cane Run ranges from 5 to 25 feet in width and 0.5 to 3 feet in depth. Flow is slight and the creek is used as a watering area for horses and cattle. While algal mats were not observed at this location in July, the water did have a green cast indicative of an algal bloom (Dames and Moore, 1977). Cane Run Creek is apparently stressed by runoff from farmlands and is not likely to have good water quality.

(2) Aquatic Biota

Sixty-one species of fish have been identified from the Elkhorn Creek drainage including 36 species reported from North Elkhorn Creek (Table III-20) (Jones, 1968; Laflin, 1970; U.S. Army Corps of Engineers, 1974). The standing crop of fishes in North Elkhorn Creek was estimated to be 78 pounds per acre (792 fish per acre) by Laflin (1970). Largemouth bass, smallmouth bass, black crappie and white crappie were the major sport fish collected, and they accounted for about 3 percent of the fish population (Laflin, 1970). Pan fish (primarily rock bass), suckers, carp, and catfish accounted for approximately 30 percent of the fish population while minnows, darters and sculpins accounted for 67 percent of the total population.

Creel surveys conducted by the Kentucky Department of Fish and Wildlife from 1960 through 1965 on North Elkhorn Creek indicated a decline in total fisherman hours from 21,950 hours in 1960 to 19,131 hours in 1965 (Jones, 1968). The decline in fishing pressure may be related to concomitant decreases in fish harvest per hour and fish weight per hour. Average fish harvested per hour decreased from 0.86 to 0.60, and average fish weight harvested per hour decreased from 0.29 to 0.13 pounds between 1961 and 1965. Black bass and panfish were the most abundant groups represented in the survey; however, bass catches declined slightly between 1961 and 1965.

Eleven species of fish were collected from North Elkhorn Creek during a recent fisheries survey (Dames and Moore, 1977). Fish were collected using electrofishing techniques from three stations (see Figure III-10 for location). Results of this survey are presented in Table III-21. Stations 1 and 2 (upstream of Georgetown) produced the greater numbers of fish (27 and 28, respectively) and greatest number of species (8 and 9, respectively) when compared to Station 3 (12 fish and 5 species). The decrease in fishery resources at Station 3 may be a result of wastewater discharge from the Georgetown Sewage Treatment Plant and other perturbations from the city of Georgetown (Dames and Moore, 1977). While no data have been collected from Cane Run Creek, fishery resources may be expected to be limited due to poor water quality and to the small size of the creek (Dames and Moore, 1977).

Data on benthic macroinvertebrates for Elkhorn Creek are sparse; however, Laflin (1970) reported 12 major groups of organisms during a 1968 survey (not in vicinity of site). During this survey densities ranged from 6 to 489 organisms per square foot. The most abundant organisms were caddisflies (Trichoptera) and midges (Niptera).

A limited amount of data for North Elkhorn Creek on benthic macroinvertebrates was collected in July, 1977 by Dames and Moore (1977). Results of this survey are presented in Table III-21. Oligochaetes (worms) were the most common benthic organism in North Elkhorn Creek and ranged in abundance from 615 individuals per square foot at Station 1 to 112 individual per square foot at Station 2. The immature stage of two families of Diptera (mosquitoes and midges) were also common at Station 1. While no crawfish were collected during the survey, many were observed at Station 3. Based on the general groupings of organisms collected, and the dominance of the worms and diptera, North Elkhorn Creek is apparently stressed. There are no data on the benthic macroinvertebrates of Cane Run Creek.

Table III-21. Fish Collected from North Elkhorn Creek, 7 July 1977

Species	Station		
	1	2	3
Bluntnose minnow	9[1]	4	7
Northern hog sucker	-	-	1
Rockbass	4	3	1
Warmouth	7	2	-
Bluegill	-	6	-
Longear sunfish	1	4	2
Smallmouth bass	1	2	-
Fantail darter	3	5	1
Johnny darter	1	1	-
Logperch	-	1	-
Banded sculpin	1	-	-

[1]Numbers indicate total number of fish collected; dash indicates no fish were collected.

Source: Dames and Moore, 1977.

c. Rare and Endangered Species

Three species of wildlife classified as endangered by the Department of the Interior have ranges that encompass the industrial park site location (Babcock, 1977; U.S. Department of Interior, 1976). They are the southern bald eagle, peregrine falcon, and Indiana bat. Lack of suitable habitat at the site for

Table III-22. Density (in square feet) of Benthic Macroinvertebrates Collected from North Elkhorn Creek, 7 July 1977[1]

Name	Station 1	Station 2	Station 3
Diptera			
Culicidae (mosquitoes)	187	2	-
Chironomidae (midges)	187	11	25
Ceratopogonidae (biting midges)	4	-	-
Ephemeroptera (mayflies)			
Stenonema sp.	-	-	R
Hexagenia sp.	R[2]	2	-
Odonata			
Coenagrionidae (damselflies)	-	R	-
Annelida			
Oligochaeta (worms)	615	112	247
Coleoptera (beetles)	2	36	-
Hempitera (bugs)	R	-	-
Isopoda (aquatic sowbugs)	-	7	R
Hydracarina (water mites)	-	-	R
Decapoda			
Orconectes sp. (crayfish)	-	-	R
Gastropoda (snails)			
Ferrissia sp.	-	2	-
Pleurocera sp.	-	4	4
Viviparius sp.	R	2	R
Helisoma sp.	-	R	-
Pelecypoda (clams)			
Sphaeridae	10	11	10
Lampsilinae	-	-	R
Total Density	1,005	189	286

[1] Collections based on one Ponar grab sample (523 cm^2).
[2] R - indicates organism was collected by random sampling by hand and not included in quantitative analysis.

Source: Dames and Moore, 1977.

these species and the site's urban location make it very unlikely that any of these species would be found there. The Scott County Conservation office has received no reports of any rare or endangered wildlife species occurring in the proposed industrial park area (Clifton, 1977). Several species of wildlife classified as threatened by the National Audubon Society could occur in the industrial park site area, including the sharp-shinned hawk, Coopers hawk, turkey vulture, black vulture, Bewicks wren, eastern bluebird, loggerhead shrike, and barn owl. All of these species have been recently observed in the vicinity of Frankfort and/or Lexington, Kentucky (Babcock, 1977). The turkey vulture was the only threatened species observed at the industrial park site during the June field survey.

None of the plants observed on the industrial park site belong to the rare or endangered species which do occur in the Inner Blue Grass Region (Casey, 1974) and in Kentucky (Kentucky Academy of Science, 1973). Furthermore, none of the recorded plant species appears in House Document No. 94-51 (Ripley, 1974), the U.S. Department of Interior, (1975, 1976), or in Babcock (1977).

None of the fish known from the North Elkhorn Creek drainage system are included on State or Federal endangered species lists (Kentucky Department of Fish and Wildlife Resources, 1975; U.S. Department of Interior, 1976). The hornyhead chub, however, has been reported as rare in Kentucky by Babcock (1977) and according to Clay (1975) the only verified records of this fish in Kentucky are from the North Elkhorn Creek drainage in Franklin County (this is well downstream from the study area). Babcock (1977) also considers the highfin carpsucker to have an "indeterminate" status (apparently threatened but data insufficient to make evaluation). Although this fish has not been reported from the North Elkhorn Creek, it has been reported in the North Elkhorn Creek drainage (see Table IV-20) and may be considered a potential inhabitant of the study area.

No rare or endangered invertebrates are known from the Elkhorn Creek drainage (Babcock, 1977; Kentucky Department of Fish and Wildlife Resources, 1975; U.S. Department of Interior, 1976).

3. Socioeconomic Setting

In the assessment of socioeconomic impact, three areal configurations were used as units of analyses and constitute the data assessment bases for the discussion in this section:

- an immediate impact area defined as that area within a one-mile radius of the industrial park site;
- an intermediate impact area consisting of Scott County; and
- a regional impact area defined as the Scott County labor market area (Bourbon, Fayette, Franklin, Grant, Harrison, Owen, Scott, and Woodford Counties).

a. Demography

(1) Population Structure

In 1970 the population of Scott County numbered 17,948, representing an increase of 16.7 percent over the census count of 1960. Scott County was one of the fastest growing counties in Kentucky, greatly exceeding the 5.9 percent increase in the state's population (from 3,038,156 in 1960 to 3,218,706 in 1970) for the period 1960-1970. The rate of population increase in Scott County slowed considerably in the 1970's. The Scott County population in 1975 numbered 18,654, representing a 3.1 percent increase for the period 1970-75 (See Table III-23).

Georgetown, the principal city in Scott County, experienced a 23.5 percent increase in population during the period 1960-1970, exceeding the population growth rate for Scott County and other areas within the county. Comparatively, the nonGeorgetown segment of Scott County grew by 11.1 percent during this same period. During the 1970's Georgetown's population growth more closely paralleled the rate of population increase in Scott County showing an estimated increase of 3 percent for the period 1970-1975 (see Table III-23).

Population projections for Scott County and Kentucky have been prepared by the Kentucky Program Development Office (1972) and the University of Louisville (1977) and are compared in Table III-24. In light of U.S. Census Bureau population figures for 1975, the University of Louisville Land Resources Policy Model projections appear to be overstated while the Kentucky Program Development Office projections appear more accurate.

Scott County's 16.7 percent population gain in the 1960's included a 6 percent in-migration rate, due largely to a change in the manner in which college students were counted during the 1970 census. Adjusting for this change in reporting would indicate a small net out-migration, rather than a 6 percent in-migration. See Table III-25 for net migration figures for the Scott County labor market area. (The Fayette County in-migration figure in Table III-25 is somewhat inflated due to the presence of the University of Kentucky in Lexington.)

(2) Urban-Rural Population Distribution

Reflecting a nationwide trend toward increased urbanization and decreased rural farm residency, both Scott County and Kentucky have shown a steady increase in the percentage of urban based population and a corresponding decrease in rural based population. The rural population for both Scott County and Kentucky is increasingly nonfarm while the rural-farm population continues to decline (see Table III-26).

Table III-23. Population Trends in Kentucky, Scott County, Georgetown, and the Scott County Labor Market

	1940	1950	% Change 1940-50	1960	% Change 1950-60	1970	% Change 1960-70	July 1 1973[1]	July 2 1975[2]	% Change 1970-75
Kentucky	2,845,627	2,944,806	3.5	3,038,156	3.2	3,218,706	5.9	3,322,782	3,387,860	5.3
Scott County	14,314	15,141	5.8	15,376	1.6	17,948	16.7	18,085	18,654	3.1
Georgetown	4,420	5,516	24.8	6,986	26.7	8,629	23.5	8,816	8,892	NA
Other Counties in Labor Market Area:										
Bourbon		17,752		18,178	2.4	18,476	1.6	18,880	18,815	1.8
Fayette		100,746		131,906	30.9	174,317	32.2	183,806	186,048	6.7
Franklin		25,933		29,421	13.5	34,181	16.2	36,062	36,913	8.0
Grant		9,809		9,489	-3.3	9,999	5.4	11,341	11,562	15.6
Harrison		13,736		13,704	-.2	14,158	3.3	14,400	14,550	2.8
Owen		9,755		8,237	-15.6	7,470	-9.3	7,707	7,915	6.0
Woodford		11,212		11,913	6.3	14,434	21.2	15,177	16,367	13.4

1 U.S. Bureau of Census (1977) estimate.

2 U.S. Bureau of Census (1977) estimate of "Scott County - Subcounty Area." This is a larger area than the city of Georgetown.

Source: U.S. Bureau of Census, 1942, 1952, 1962, 1972, 1977.

Table III-24. Population Projections[1]

	1970[2]	1975	1980	1990	2000	2020
Kentucky	3,218,745	3,375,638	3,564,414	4,001,657	4,506,952	5,757,634
Scott County KPDO projection[3]	17,948	18,749	19,608	21,548	23,340	26,237
Percent Increase		(4.5)	(4.6)	(9.9)	(8.3)	(12.4)
University of Louisville projection[4]	17,948	19,958	21,766	24,432	25,913	NA
Percent Increase		(11.2)	(9.1)	(12.2)	(6.1)	

[1]Percent growth since previous period in parentheses.

[2]Actual census figures.

[3]Kentucky Program Development Office projection.

[4]Land Resources Policy Model, University of Louisville.

Source: U.S. Bureau of Census, 1972; Kentucky Program Development Office, 1972; and University of Louisville, 1977.

Table III-25. Population Change and Migration by County

County	Population Change 1960-70 (%)	Net Migration (%)
Bourbon	1.6	-7.5
Fayette	32.2	17.0
Franklin	17.2	5.1
Grant	5.4	0.6
Harrison	3.3	-2.4
Owen	-9.3	-13.2
Scott	16.7	6.0
Woodford	21.2	6.5
KENTUCKY TOTAL	6.0	-5.0

Source: U.S. Bureau of Census, 1977.

Table III-26. Urban, Rural, Rural/Farm, and Rural/Non-Farm Percent Distributions for Kentucky and Scott County 1950, 1960, and 1970

	Kentucky (%)	Scott County (%)
Urban		
1950	36.8	36.4
1960	46.7	45.4
1970	52.3	48.1
Rural		
1950	63.2	63.6
1960	53.3	54.6
1970	47.7	51.9
Rural/Farm		
1950	52.4	NA
1960	29.8	56.4
1970	25.1	39.0
Rural/Non-Farm		
1950	47.6	NA
1960	70.2	43.6
1970	74.9	61.0

Source: U.S. Bureau of Census, 1972.

(3) Racial Composition and Age and Sex Distribution

Although the percentage of nonwhite persons in Kentucky has shown a steady, but small increase since 1950 (6.9 percent in 1950, 7.2 percent in 1960, 7.4 percent in 1970), the percentage of nonwhite persons in Scott county and Georgetown has shown a steady decrease. However, as a comparison of total population, the percentage of nonwhites in Georgetown exceeds that of Scott County and the percentage of nonwhites in Scott County exceeds that of Kentucky (see Table III-27).

Birth rates dropped in Kentucky in the 1960s, resulting in a proportional drop in the number of persons in the 1- through 9-year-old age cohort. The figures for Scott County and Georgetown also reflect this trend of slowing birth rates in the 1960s (see Table III-23 and Table III-28). In 1970, both Scott County and Georgetown had a lower proportion of persons under 18 (32.2 and 18.2 percent, respectively) than Kentucky (34.6 percent). For the 18-64 "work force" age group, both Scott County and Georgetown had a higher proportion of working-age persons (57.0 and 60.3 percent) than did Kentucky (54.9 percent). Both Scott County and Georgetown had a higher percentage of over-64 inhabitants than did the state in 1970. Georgetown has maintained a slightly higher percentage of female residents than Scott County (54.1 to 51.7 percent in 1970).

(4) Education and Income

In 1970 the median number of school years completed by Scott County residents was 10.7, which ranked Scott County 18th (of 120 counties) in the state. However, the 1970 census includes college students as local residents. Correcting for the college student population in the county (Georgetown College) would rank Scott county slightly lower than 19th but still substantially higher than the state median number of school years completed of 9.9.

Scott County has shown a steady increase in per capita income since 1969, and in 1974 ranked 6th within the Scott County Labor market area although it experienced the greatest percentage increase in per capita income for the period 1969-1974. The 1974 per capita income for Scott County slightly exceeded that for Kentucky ($4,502 and $4,442, respectively). In 1969 the median family income for Scott County was $7,568. The 1969 median family income for Georgetown was $8,193. Both the Scott County and Georgetown median family income exceeded that for Kentucky ($7,441).

In general, the income figures indicate an improvement in real income for residents of Georgetown, Scott County, and the Georgetown labor market area. Of particular note is the 126 percent increase in farm-family income for Scott County residents over the period of 1960 to 1970. This increase is well above the 95 percent increase registered by all Scott County families over the same period. The income of nonwhite families, however, increased less rapidly, registering a 67 percent rise during

Table III-27. Percent of White and Nonwhite Population, Kentucky, Scott County, and Georgetown 1950, 1960, and 1970

	White (%)			Nonwhite (%)		
	1950	1960	1970	1950	1960	1970
Kentucky	93.1	92.8	92.6	6.9	7.2	7.4
(Number)				(203,192)	(218,747)	(238,184)
Scott County	88.2	88.4	90.6	11.8	11.6	9.4
(Number)				(1,781)	(1,778)	(1,653)
Georgetown	86.4	88.5	89.4	13.6	11.5	10.6
(Number)				(750)	(803)	(915)

Source: U.S. Bureau of Census, 1972.

Table III-28. Age Distribution in Kentucky, Scott County, and Georgetown

	% of Population Under 18			% of Population 18-64			% of Population 65 and Over		
	1950	1960	1970	1950	1960	1970	1950	1960	1970
Kentucky	36.0	37.5	34.6	56.0	52.9	54.9	8.0	9.6	10.5
Scott County	29.9	32.4	32.3	59.5	55.7	57.0	10.6	11.9	10.7
Georgetown	25.2*	31.2*	28.1	63.1*	57.1*	60.3	11.2	11.7	11.6

Source: U.S. Bureau of Census, 1972.

*Denotes estimates, since the 1950 and 1960 censuses include only a 15 to 19 age bracket.

the 1960 decade. Since the consumer price index, by comparison increased by 28.6 percent over the same period for the nearest survey city, Cincinnati, one can reasonably conclude that most residents of the Scott County labor market area realized a net increase in real income (see Table III-29).

The number of families with incomes below the low-income level in Scott County in 196 comprised 16.7 percent of all families in the county. The percentage of Georgetown families with incomes below the low income level was 14.2 percent and 19.2 percent for Kentucky (see Table III-30).

b. General

(1) Commuting Patterns

The Kentucky Department of Commerce has defined a geographical area (consisting of counties contiguous to Scott County) which exemplifies significant interdependent commuting patterns as the Scott County labor market area (Bourbon, Fayette, Franklin, Grant, Harrison, Owen, Scott, and Woodford Counties). Scott County provides employment for 52.4 percent of its resident work force in addition to a fair number of commuters from surrounding counties. In 1970 there were an estimated 4950 jobs in Scott County (Craycraft, 1977), and commuters from surrounding counties represented approximately 11 percent of the persons working in Scott County (see Tables III-31 and III-32).

Table III-31. Scott County Work Force - Place of Employment

County of Residence	Working Inside County of Residence	Working Outside County of Residence (In Specified County)	Working Outside County of Residence (In County Not Specified)	Place of Work Not Reported
Scott	52.4%	28.6%	1.6%	17.4%

Source: Kentucky Department of Commerce, 1973.

(2) Employment and Unemployment

Extensive data on employment and unemployment for Georgetown are not available. However, data for Scott County show that the county has experienced generally lower unemployment rates than Kentucky as a whole* (see Table III-33).

*The Kentucky Department of Human Resources data for 1973 through 1976 and all of the U.S. Bureau of Census data are based on place of residence, while the 1970-72 Kentucky Department of Human Resources data are based upon place of work and, as such, are not readily comparable.

Table III-29. Per Capita Income in Kentucky and the Scott County Labor Market Area

	1959	1969	1970	1973	1974	% Change 1969-74
Kentucky	1,976	2,894	3,112	4,050	4,442	53.5
Counties:						
Bourbon		3,166	3,277	4,314	4,894	54.6
Fayette		3,740	3,844	4,930	5,287	41.4
Franklin		3,339	3,590	4,643	5,067	51.8
Grant		2,687	2,899	3,343	4,054	50.9
Harrison		3,034	2,945	4,129	4,729	55.9
Owen		2,599	2,679	3,833	4,104	57.9
Scott	2,428	2,769	2,854	3,891	4,502	62.6
Woodford		3,890	4,020	5,068	5,507	41.6

Source: U.S. Bureau of Census, 1972; and Kentucky Deskbook of Economic Statistics, 1975

Table III-30. Selected Income Characteristics for Kentucky, Scott County, and Georgetown, 1959 and 1969

	Kentucky		Scott County		Georgetown	
	1959	1969	1959	1969	1959	1969
TOTAL FAMILIES	752,671[2]	825,222[1]	3,929[2]	4,599[1]	1,765[2]	2,108[1]
FAMILY INCOME (%)						
Less than $3,000	38.0	18.5	37.3	16.1	26.0	14.5
$ 3,000-4,999	22.7	14.0	25.5	14.0	29.0	11.8
5,000-6,999	18.4	14.3	17.4	16.1	22.2	16.6
7,000-9,999	12.8	20.7	8.7	20.2	10.4	20.5
10,000-14,999	5.5	20.9	5.9	22.3		23.6
15,000-24,999	1.7	9.2	2.0	9.6	12.4	11.8
>25,000	0.8	2.4	0.6	1.7		1.3
MEDIAN FAMILY INCOME ($)						
All families	4,051	7,441	3,901	7,568	4,676	8,193
-White	4,193	7,604	-	7,944	-	-
-Nonwhite	2,570	5,172	2,645	4,424[3]	-	-
-Farm	-	-	3,365	7,598		
FAMILIES BELOW LOW-INCOME LEVEL (%)		19.2[4]		16.7[4]		14.2
FAMILIES BELOW 125% OF LOW-INCOME LEVEL (%)		25.5[4]		22.2[4]		
FARM POPULATION Persons below low-income level (% of total population)		23.8[4]		15.0[4]		

[1] 1970 data.
[2] 1960 data.
[3] Data not shown for counties with population of less than 400 for each race. Figure shown is for black families.
[4] The national low-income level was computed to be $3,388 in 1970.

Source: U.S. Bureau of Census, 1972.

Table III-32. Commuting Patterns of Scott County Residents and Persons Who Are Employed in Scott County

Persons Commuting Out of Scott to	County	Persons Commuting into Scott
0	Anderson, KY	12
16	Bourbon, KY[1]	48
3	Campbell, KY	0
0	Clark, KY	6
1541	Fayette, KY[1]	272
255	Franklin, KY[1]	42
16	Grant, KY[1]	6
31	Harrison, KY[1]	85
3	Kenton, KY	0
0	Nicholas, KY	14
12	Owen, KY[1]	63
32	Woodford, KY[1]	24
25	Hamilton, OH	0
25	Dearborn, IN	0
1959		572

Persons who work and reside in Scott County: 3589
Net commuter flow out of Scott County: 1363

[1] Labor market area for Scott County.

Source: Kentucky Department of Commerce, 1973.

Table III-33. Labor Force, Employment, and Unemployment for Kentucky, Scott County, and Georgetown

	1950[1]	1960[1]	1965[2]	1970[1]	1971[2]	1972[2]	1973[2]	1974[2]	1975[2]	1976[2]
Kentucky										
Civilian Labor Force	991,071	996,194	NA	1,190,344	NA	NA	1,377,000	1,411,000	1,409,000	1,488,000
Employed	954,986	935,944	NA	1,136,572	NA	NA	1,326,000	1,347,000	1,306,000	1,367,000
Unemployed	36,085	60,250	NA	53,772	NA	NA	51,000	64,000	103,000	81,000
% Unemployed	3.7	6.0	NA	4.5	NA	NA	3.7	4.5	7.3	5.6
Scott County										
Civilian Labor Force	5,633	6,020	6,275	7,163	5,460	5,570	9,101	9,202	9,037	9,497
Employed	5,390	5,871	5,947	6,901	5,030	5,320	8,922	8,949	8,623	9,210
Unemployed	243	149	328	262	430	250	179	253	414	287
% Unemployed	4.3	2.3	5.2	3.7	7.6	4.3	2.0	2,7	4.6	3.0
Georgetown										
Civilian Labor Force	2,270	2,945	NA	3,504	NA	NA	NA	NA	NA	NA
Employed	2,166	2,881	NA	3,369	NA	NA	NA	NA	NA	NA
Unemployed	104	64	NA	135	NA	NA	NA	NA	NA	NA
% Unemployed	4.6	2.2	NA	3.8	NA	NA	NA	NA	NA	NA

[1]For the 1950 and 1960 data, the labor force consists of all county residents 14 years old or over; for the 1970 data, the Census Bureau redefined "labor force" to include only those residents 16 years old or over.

[2]In 1974 the Kentucky Department of Human Resources changed its figures from place of employment to place of residence.

Source: U.S. Bureau of Census, 1972; and Kentucky Department of Human Resources, 1977.

As data from Table III-34 show, labor force, employment, and unemployment data for the Scott County labor market area are generally comparable, with Scott County ranking low in terms of unemployment. The size and composition of the available labor force are presented in Table III-35, and the percentage distribution of Scott County's labor force among occupational categories for 1970 is presented in Table III-36. The distribution of employment by standard industrial classification is presented in Table III-37 and the agricultural employment for the Scott County labor market area is presented in Table III-38. With the exception of Fayette and Franklin Counties, the entire labor market area had at least 2.3 times the statewide average in agricultural employment.

(3) Industrial, Agricultural, and Livestock Production

The Georgetown area is the locus of manufacturing activities in Scott County. The variety of manufacturing activities is extensive but is predominantly light industry. A listing of Scott County industries is presented in Table III-39. Mining activity in Scott County is limited to a single firm engaged in the production of agricultural lime, crushed limestone, road aggregate, and cements. Similarly, Scott County has a single timber milling operation engaged in the production of walnut veneering. Scott County has approximately 182,000 acres of timber resources.

Agricultural activities in Scott County are rather extensive, and in 1974 farming activities engaged 164,816 acres of land. The major crops harvested in Scott County are hay, tobacco, and wheat (see Table III-40). Scott County's livestock production is concentrated primarily in cattle and horses with some minor activity in hog and chicken production (see Table III-41).

c. Taxes

When the site of the proposed industrial park was annexed into the legal boundaries of the city of Georgetown it became subject to Georgetown city taxes. Georgetown's tax rate is $0.199 per $100 of assessed value (which is applied to land, buildings, cars, aircraft, watercraft, finished products and business furniture and fixtures). A payroll tax of $1.00 per $100 payroll is levied on all Georgetown businesses (Vance, 1977).

Scott County's tax rate is currently $0.837 per $100 of assessed valuation but is expected to soon rise to $0.937 due to a hospital levy recently passed (Vance, 1977). Scott County also receives $0.972 per $100 of value for all vehicles as part of its tangible property tax.

Major state taxes which would affect the proposed industrial park include a corporate income tax, general property taxes, and sales and use taxes. An annual tax on net corporate income is levied by the state at a rate of 4 percent on the first $25,000 (with a minimum of $5,000), and 5.8 percent on

Table III-34. Labor Force, Employment, and Unemployment for the Scott County Labor Market Area

	1971	1972	1973[1]	1974[1]	1975[1]	1976[1]	April 1977[1]
Bourbon							
Civilian Labor Force	6,360	6,390	9,205	9,284	9,084	9,609	10,033
Employed	6,090	6,100	9,068	9,095	8,764	9,360	9,830
Unemployment Rate (%)	4.3	4.5	1.5	2.0	3.5	2.6	2.0
Fayette							
Civilian Labor Force	89,240	95,600	92,525	93,256	91,111	96,637	100,619
Employed	86,490	93,500	90,626	90,903	87,591	93,550	98,242
Unemployment Rate (%)	3.1	2.3	2.1	2.5	3.9	3.2	2.4
Franklin							
Civilian Labor Force	22,320	22,870	17,647	17,481	17,761	18,881	17,658
Employed	21,600	22,130	17,203	16,817	16,893	18,164	16,928
Unemployment Rate (%)	3.2	3.3	2.5	3.8	4.9	3.8	4.1
Grant							
Civilian Labor Force	2,740	2,890	4,378	4,273	4,212	4,473	4,149
Employed	2,630	2,820	4,259	4,145	4,000	4,311	4,042
Unemployment Rate (%)	4.0	2.5	2.7	3.0	5.0	3.6	2.6
Harrison							
Civilian Labor Force	5,290	5,270	7,282	7,565	7,479	7,697	7,240
Employed	5,010	5,090	7,148	7,395	7,129	7,418	7,046
Unemployment Rate (%)	5.3	3.5	1.8	2.2	4.7	3.6	2.7
Owen							
Civilian Labor Force	2,480	2,320	2,974	3,391	3,576	3,732	3,402
Employed	2,310	2,170	2,878	3,268	3,392	3,595	3,302
Unemployment Rate (%)	6.9	6.2	3.2	3.6	5.1	3.7	2.9
Scott							
Civilian Labor Force	5,460	5,570	9,101	9,202	9,037	9,497	9,865
Employed	5,030	5,320	8,922	8,949	8,623	9,210	9,672
Unemployment Rate (%)	7.6	4.3	2.0	2.7	4.6	3.0	2.0
Woodford							
Civilian Labor Force	5,760	5,800	7,704	7,768	7,599	8,025	8,362
Employed	5,590	5,680	7,564	7,587	7,311	7,808	8,200
Unemployment Rate (%)	2.9	2.1	1.8	2.3	3.8	2.7	1.9
TOTAL							
Civilian Labor Force	139,650	146,710	150,697	152,220	149,859	158,551	161,328
Employed	134,750	142,810	147,668	148,159	143,703	153,416	157,262
Unemployment Rate (%)	3.6	2.7	2.0	2.7	4.1	3.2	2.5

[1] Based upon place of residence. Previous years based on place of employment.

Source: Kentucky Department of Human Resources, 1977.

Table III-35. Available Labor Force in the Scott County Labor Market Area, 1975

County	Total Labor Supply			Labor Supply Outside Labor Force Population		Labor Supply From Labor Force Population			
						Unemployed		Underemployed	
	Total	Male	Female	Male	Female	Male	Female	Male	Female
Bourbon	980	500	480	0	0	230	90	270	390
Fayette	13,600	6,670	6,930	0	990	2,490	1,030	4,180	4,910
Franklin	5,090	2,940	2,150	1,750	1,050	560	310	630	790
Grant	580	330	250	0	10	160	50	170	190
Harrison	820	430	390	0	0	250	100	180	290
Owen	610	310	300	0	130	140	50	170	120
Scott	1,330	670	660	0	0	260	150	410	510
Woodford	840	400	440	0	0	180	100	220	340

Source: Kentucky Department of Human Resources, 1977.

Table III-36. Occupation of Employed Persons Age 16 and Over, Scott County, 1970

Occupation	Percent of Labor Force
Professional, technical, and related	11.1
Nonfarm managers and administrators	5.1
Sales workers	4.4
Clerical workers	16.5
Craftsmen, foremen, and related	10.6
- construction craftsmen	3.1
- mechanics, repairmen	3.1
- machinists, other metal craftsmen	0.7
- other	3.8
Operatives, except transport	17.0
- durable goods manufacture	11.9
- non-durable goods manufacture	2.0
- non-manufacturing	3.1
Transport equipment operatives	4.1
Non-farm laborers	4.1
Farm Workers	15.8
Service workers, except private household	8.8
- cleaning and food service workers	5.1
- personal, health, and other	2.7
Private household workers	2.5

Source: U.S. Department of Labor, Manpower Administration, 1973

Table III-37. Percent Distribution of Employment by Industry Division for Georgetown Labor Market Area, 1974

Industrial Classification	County							
	Bourbon	Fayette	Franklin	Harrison	Owen	Scott	Woodford	Grant
Agricultural services, forestry, and fisheries	11.4*	0.9	0.1*	0.3*	0	1.5*	4.7	0
Mining	11.4*	1.1	0.6*	0.3*	0	1.5*	0	0.8*
Contract construction	11.3	7.8	7.6	1.8	3.9	6.9	2.2	3.4
Manufacturing	41.6	24.1	38.1	53.4	29.8*	51.6	67.5	5.3*
Transportation and other public utilities	3.4	6.6	4.4	2.8	16.0	2.0	1.5*	15.5*
Wholesale trade	4.9	7.2	2.4	9.4	10.0	2.0	1.5	4.6
Retail trade	18.4	22.8	21.0	13.9	27.6	16.0	11.0	43.3
Finance, insurance, and retail trade	4.8	8.1	4.6	3.8	11.2	3.9	3.0	8.8
Services	11.8	20.2	20.7	13.6	10.2*	14.9	9.5	14.4
Non-classifiable establishments	2.0	1.1	0.7	0.4	1.4	1.4	1.5*	1.3
TOTAL REPORTED EMPLOYMENT	3,287	71,080	10,261	3,822	588	4,072	3,942	1,125

*The Census Bureau does not publish data for counties having a low number of employees in any given industrial classification; therefore, the percentage figures denoted with an asterisk are estimates, based on the mid-point value ranges given for a particular classification.

Source: U.S.Department of Commerce, 1977.

Table III-38. Agricultural Employment for Counties in the Scott County Labor Market Area, 1971-1976

County	1971[1]	1972[1]	1973[1]	1974	1975	1976
BOURBON						
Agricultural Employment	1,669	1,553	1,503	1,703	1,689	1,784
% of Labor Force	NA	NA	NA	18.3	18.6	18.6
FAYETTE						
Agricultural Employment	2,687	2,501	2,424	2,741	2,724	2,875
% of Labor Force	NA	NA	NA	2.9	3.0	3.0
FRANKLIN						
Agricultural Employment	479	451	438	496	493	521
% of Labor Force	NA	NA	NA	2.8	2.8	2.8
GRANT						
Agricultural Employment	485	468	445	504	500	528
% of Labor Force	NA	NA	NA	11.8	11.9	11.8
HARRISON						
Agricultural Employment	1,060	986	956	1,082	1,073	1,132
% of Labor Force	NA	NA	NA	14.3	14.3	14.7
OWEN						
Agricultural Employment	897	836	809	916	910	960
% of Labor Force	NA	NA	NA	27	25.4	25.7
SCOTT						
Agricultural Employment	1,353	1,260	1,222	1,384	1,374	1,451
% of Labor Force	NA	NA	NA	15.0	15.2	15.3
WOODFORD						
Agricultural Employment	1,086	1,009	978	1,110	1,101	1,162
% of Labor Force	NA	NA	NA	14.3	14.5	14.5
KENTUCKY						
Agricultural Employment	84,218	78,447	75,940	85,953	85,374	90,128
% of Labor Force	NA	NA	NA	6.1	6.1	6.2

[1] Agricultural employment not comparable to nonagricultural employment. Agricultural employment based on county of residence, nonagricultural employment on place of employment.

Source: Kentucky Department of Human Resources, 1977.

Table III-39. Manufacturing Firms of Scott County, 1976

Firm	Product	Employment		
		Male	Female	Total
Blue Ribbon Pen and Pencil Co., Inc.	Imprinted pens, pencils	20	120	140
Carbide Products, Inc.	Carbide tools, accessories	51	21	72
Chism & Wilborn, Inc.	Ashtrays	2	0	2
Clark Equipment Co.	Electric fork lifts	-	-	399
Electric Parts Corp.	Electrical wire, wiring harnesses	150	320	470
Frye Printing Co.	Letterpress printing	2	2	4
Georgetown American Swiss Products, Inc.	Screw machine products, motor shafts, metal stampings	13	17	30
Georgetown Cable Products, Inc.	Electronic wiring, components	15	70	85
Georgetown Metal Stamping Co.	Metal stampings, wire forms	18	40	58
Georgetown Tool and Manufacturing Co.	Tools, gauges, special machinery	12	9	21
Hydro Plastic Co.	Typewriter parts, plastic parts	20	45	65
Johnson Controls, Inc.	Environmental control systems	128	162	290
Kentucky Heat Treating Co.	Heat subzero treating metal parts, wheelabrator-tumblashing of parts	28	2	30
Lee Dog Food Co.	Dog food	10	0	10
Lujo Grinding Co.	Machine shop, machine tool accessories	4	1	5
Nally and Gibson	Ready mix concrete.	24	0	24
Polynesian Pools, Inc.	Pool covers, liners, airdomes	3	7	10
Preferred Stamping, Inc.	Metal stampings, induction welding	28	42	70
Russell Manufacturing Co., Inc.	Advertising specialties	2	10	12
SMF Manufacturing Co.	Chrome plating	-	-	-
STM, Inc.	Special and grinding machines	7	2	9
Southern States Georgetown Co-op	Fertilizer	16	3	19

Table III-39. Manufacturing Firms of Scott County, 1976 (Concluded)

Firm	Product	Employment		
		Male	Female	Total
Stamping Ground Tool and Die	Stampings, weldments	70	5	75
Stiohn Products Corp.	Machine shop special machines	25	85	110
Triangle Electro-chemical Corp.	Electroplating, chrome furniture, metal castings	10	2	12
Universal Wire Spring Division, Hoover Ball & Bearing Company	Auto seat springs, frames, furniture and bedding springs, office chair equipment	417	21	438

Source: Kentucky Department of Commerce, 1976; and Proctor, Davis and Ray, 1977.

Table III-40. Crops Harvested in Scott County in 1964, 1969, 1974: in Kentucky, 1969 and 1974

Crop	Kentucky 1969	Kentucky 1974	Scott County 1964	Scott County 1969	Scott County 1974
Corn, all purposes					
-Farms	39,295	42,667	355	254	283
Sorghum, for grain or seed					
-Farms	366	589	0	2	0
-Acres	6,861	19,141	0	6	0
Wheat for grain					
-Farms	6,878	8,590	55	54	47
-Acres	6,878	8,590	915	843	674
Soybeans for beans					
-Farms	6,395	10,860	1	0	4
-Acres	845,835	391,458	1	0	173
Hay (excluding sorghum hay) and grass silage					
-Farms	55,439	54,692	NA	501	559
-Acres	1,280,296	1,283,204	15,318	15,374	18,215
Tobacco					
-Farms	91,472	72,413	921	920	784
-Acres	162,323	174,859	4,758	3,751	4,517
Cotton					
-Farms	116	39	0	0	0
-Acres	4,279	3,991	0	0	0
Vegetables, melons, or sweet corn for sale					
-Farms	2,133	2,088	5	11	8
-Acres	6,136	4,527	53	91	39
Land in orchards					
-Farms	1,705	1,222	6	17	14
-Acres	6,471	4,897	7	46	25

Source: U.S. Department of Commerce, 1972, 1977.

Table III-41. Livestock and Poultry in Scott County and Kentucky

Crop	Kentucky 1969	Kentucky 1974	Scott County 1964	Scott County 1969	Scott County 1974
Cattle and calves					
-Farms	81,108	73,446	782	777	769
-Number	2,591,935	2,983,411	26,883	34,209	41,809
Hogs and pigs					
-Farms	29,119	20,539	259	197	102
-Number	1,251,302	885,709	10,623	8,785	4,011
Sheep and lambs					
-Farms	2,093	880	172	101	39
-Number	118,622	42,322	12,426	8,471	2,854
Horses and ponies					
-Farms	25,008	17,868	NA	249	191
-Number	79,316	62,367	NA	1,290	1,316
Chickens (3 months old and over)					
-Farms	23,534	18,374	364	138	117
-Number	3,207,975	2,794,003	10,109	3,685	3,376
Broilers					
-Farms	181	202	NA	0	2
-Number	5,040,981	4,702,255	NA	0	6

Source: U.S. Department of Commerce, 1972, 1977.

Table III-42. State and Local Taxes as a Percentage of Personal Income, 1970-71

Rank	State	Percentage	Rank	State	Percentage
1	Vermont	14.7	26	Nebraska	11.7
2	Wisconsin	14.6	27	Delaware	11.7
3	New York	14.5	28	Oregon	11.5
4	North Dakota	14.2	29	Illinois	11.5
5	Hawaii	14.1	30	Pennsylvania	11.4
6	Wyoming	13.9	31	West Virginia	11.1
7	South Dakota	13.8	32	Connecticut	11.1
8	California	13.7	33	New Jersey	11.0
9	Arizona	13.2	34	Kansas	10.9
10	Minnesota	13.2	35	Indiana	10.8
11	Nevada	13.0	36	New Hampshire	10.7
12	Maine	12.7	37	North Carolina	10.6
13	Montana	12.7	38	Florida	10.6
14	Massachusetts	12.7	39	Kentucky	10.5
15	New Mexico	12.7	40	Virginia	10.4
16	Idaho	12.6	41	Alaska	10.4
17	Louisiana	12.5	42	South Carolina	10.3
18	Utah	12.5	43	Georgia	10.1
19	Iowa	12.3	44	Tennessee	9.9
20	Mississippi	12.3	45	Oklahoma	9.9
21	Washington	12.3	46	Texas	9.9
22	Michigan	12.2	47	Missouri	9.9
23	Maryland	12.1	48	Alabama	9.8
24	Colorado	12.1	49	Arkansas	9.7
25	Rhode Island	12.1	50	Ohio	9.3
	United States	11.9			

Source: Kentucky Department of Commerce, 1973.

Table III-43. Land Use, Local Impact Area

Existing Land Use

Land Use Category	Acreage	Percent
Agricultural	3632	72.0
Urban and Built Up	972	19.0
Rural Residential	206	4.0
Industrial	128	2.5
Commercial	86	2.0
Public and Semi-Public	26	0.5
TOTAL	5050	100.0

Source: Scruggs and Hammond, 1974.

Future Land Use

Land Use Category	Acreage	Percent
Agricultural	1923	38.1
Residential	1645	32.6
Industrial	719	14.2
Conservation	311	6.2
Commercial	75	1.5
Other	377	7.4
TOTAL	5050	100.0

Source: Scruggs and Hammond, Inc., 1974.

Table III-44. Agricultural Land Uses, Scott County and Kentucky

	Scott County			Kentucky		
	1964	1969	1974	1964	1969	1974
Number of farms	1,112	1,154	1,045	133,038	125,029	109,725
Total acreage in farming	165,835	173,080	164,816	16,265,180	15,989,243	14,535,067
Proportion of all land in farming, %	91.2	95.2	90.7	63.8	62.9	57.0
Average value per acre	375.6	488	751	181.07	253	435
Farms under 10 acres, %	NA	18	11	40.0	11	10
Farms over 1,000 acres, %	NA	0.8	1.3	<0.1	0.6	0.8
Average value of agricultural products sold per farm	7,810	9,959	16,075	4,447	6,155	11,180
Land in farms according to use:						
Cropland, total, acres	109,437	117,650	102,455	130,723	9,443,545	8,732,123
- Harvested, acres	27,758	24,859	28,863	123,100	3,128,222	3,612,537
- Pasture, acres	76,667	82,340	67,308	4,572,854	4,915,575	447,499
- Other, acres	5,012	9,851	6,284	52,834	1,399,657	645.567
Woodland, woodland pasture acres	13,869	15,496	17,121	84,031	3,822,882	3,302,792
All other acres	42,495	45,240	40,534	2,654,550	2,701,907	2,500,152

Source: U. S. Census of Agriculture, 1969 and 1974.

Table III-45. Georgetown Area Colleges and Universities

Name	Location (Miles from Georgetown)	Enrollment, Fall 1975	Highest Degree Conferred
Georgetown College	Georgetown	1,062	Masters
Midway Junior College	Midway (10)	350	Associate
Transylvania University	Lexington (12)	722	Masters[1]
University of Kentucky	Lexington (12)	22,526	Ph.D., M.D., D.M.D, J.D
Lexington Technical Institute	Lexington (12)	1,654	Associate
Kentucky State University	Frankfort (18)	2,246	Masters
Southeastern Christian College	Winchester (33)	91	Associate
Asbury college	Wilmore (34)	1,225	Baccalaureate
Eastern Kentucky University	Richmond (39)	13,430	Masters, Ph.D[2]
Berea College	Berea (51)	1,504	Baccalaureate
Centre College	Danville (51)	775	Baccalaureate
		45,585	

[1]Courses in the Masters degree program are taught on the Transylvania campus by Xavier University of Cincinnati faculty members. The degree is issued by Xavier University.

[2]Cooperative program with the University of Kentucky, Lexington, for a Ph.D. in education only.

Source: Kentucky Department of Commerce, 1976.

all income in excess of $25,000. An ad valorem tax is levied on 100 percent of the fair cash value of corporate property at a rate of 1.5 cents per $100 assessed value for real estate, and 15.0 cents per $100 assessed value for tangible property. A state-wide sales tax of 5 percent is imposed upon gross receipts from retail sales of tangible personal property. A use tax of 5 percent is levied on the use, storage, or other consumption of tangible personal property (Kentucky Department of Revenue, 1974). Generally, as a percentage of personal income, state and local taxes in Kentucky are lower than in other states (See Table III-42).

d. Land Use

Land use in the impact area is predominantly agricultural with such usage accounting for 72 percent of land consumption. Only 19 percent of impact area land is classified as urban. The remaining 9 percent consists of rural residential, industrial, commercial, public, and semi-public land uses. Table III-43 presents a delineation of acreage and percentages by land use category. A delineation of agricultural land usage is presented in Table III-44.

e. Public Sector Infrastructure

(1) Schools and Libraries

Georgetown's public schools were recently absorbed into the Scott County school system. With the exception of two grade schools (grades 1-6), all of Scott County schools have excess capacity ranging from 50 to 500 spaces (for total combined grade categories). Should overloading occur in either grade category system (junior high or high school), space can be provided by shifting space overload from one system to the other (Johnson, 1977).

The Georgetown/Scott County area is well served by vocational-technical schools, colleges and universities. Georgetown College, offering masters degree programs, is located in the city of Georgetown, and Central Kentucky State Vocational Technical School and Fayette County Area Vocational Education Center are nearby. Within a 50-mile radius of Georgetown are located 11 institutions of higher education serving some 45,000 students. (See Table III-45 for a listing of area colleges and universities, enrollments and degree programs.) Scott County is served by two public libraries, the Scott County Public Library and the Stamping Ground Public Library, and one private library, Georgetown College Library, with a combined collection of 158,900 volumes (Kentucky Department of Commerce, 1977).

(2) Health Care and Medical Facilities

Scott County is served by a single hospital, John Graves Ford Hospital, located in Georgetown, with a 45-bed capacity. Nearby Lexington hospital facilities provide alternative and back-up support for Scott County hospital care needs. The ratio of hospital admission to population in Scott County averaged 148.8 persons per 1000, compared to a state average of 164 per 1000 for the period 1974-76. Georgetown's physician population ratio of one doctor per 900 persons far exceeds the federal minimum standard for primary health care of one doctor per 3500 persons. Primary care does not include specialists. A delineation of health care facilities and services is presented in Table III-46.

(3) Police and Fire Protection

Georgetown and Scott County have police protection services with a combined total personnel of 26, and 8 radio-dispatched patrol vehicles. Both areas are served by volunteer fire departments with a combined volunteer total of 40. A delineation of police and fire protection facilities for the immediate Scott County area is presented in Table III-47.

f. Housing, Utilities and Transportation Facilities

(1) Housing

In 1970, Georgetown's housing stock was, in general, newer, better-equipped and more fully utilized than were Scott County's or Kentucky's in general (see Table III-48). Fifty-seven percent of Georgetown's units were built after 1959, compared to 33 percent for the county and 25.1 percent for the state. Although the majority of the housing units in Georgetown were owner-occupied, a relatively high proportion of them were renter-occupied (41.1 percent in Georgetown, 35.7 percent in Scott County). In addition, it is important to note that there was (and is now) a very low vacancy rate in the Georgetown area. Thus, it is not surprising that both median rent and "median value, year-round, owner-occupied units" were higher in Georgetown than in Scott County or in Kentucky.

In the fall of 1976, the Blue Grass Area Development District (BGADD) updated the 1970 housing data for Georgetown, Stamping Ground, Sadieville, and the remainder of Scott County (see Table III-49). The survey indicated that the housing stock in Scott County, and particularly in Georgetown, was more fully utilized in 1976 than it was in 1970. BGADD estimated a need for 145 additional housing units in Georgetown, 9 in Stamping Ground, 5 in Sadieville, and 1453 in the remainder of Scott County by 1980, based upon Kentucky Department of Commerce population projections. These projections predicted an additional housing need of 306 units in Georgetown, 20 units in Stamping Ground, 11 units in Sadieville, and 301 units in the remainder of Scott County by 1990.

BGADD also generated projections for housing needs based upon the Battelle Population Projection model. The Battelle estimates are higher than those of the Kentucky Department of Commerce. By 1980,

Table III-46. Health Care Facilities in Scott County

Local Medical Personnel

Physicians - 10
Dentists - 5

Hospitals

General Hospital	Location	Beds
John Graves Ford Memorial	Georgetown	40

General hospital facilities and services - 2 laboratories, EKG, nursery, emergency room, operating rooms, obstetrical sections, diagnostic X-ray, inhalation therapy, opthalmology, orthopedics, intensive coronary care and physical therapy departments.

Medical staff - 10 doctors, 17 registered nurses, 10 licensed practical nurses.

Other Medical Facilities

Scott County Comprehensive Care Center

Ambulance Service

Name - Goergetown-Scott County Ambulance Service
Staff - 3 full-time, 6 volunteers (8 staff members are Emergency Medical Technicians)
Service - County-wide, 24 hours a day
Equipment - 2 ambulances, fully equipped

Nursing Homes

	Number	Beds
Extended care homes	1	50
Personal care homes	2	45

Public Health

Facility - Scott County Health Department
Staff - 3 registered nurses, 2 health environmentalists, family planning unit with 1 nurse and 1 health service aide, 2 clerks, health officer (part-time), nutritionist (part-time).

Source: Kentucky Department of Commerce, 1976.

Table III-47. Police and Fire Facilities in Scott County, 1977

Facility	Georgetown	Stamping Ground	Sadieville	Scott County
Police				
Total Staff	19	1	1	7 full-time;
Radio patrol cars	5	1	1	3
Fire				
American Insurance Association Fire Rating	7	7		
Volunteers	24	12	14	16
Equipment:				
1,000 gpm pumpers	2			1
750 gpm pumpers	1		1	1
500 gpm pumpers	1			1
275 gpm pumpers				1
1,250 gallon tanker				2
1,000 gallon tanker				1
Squad truck				
Other:	1 station wagon used as an emergency unit 2 portable plants			1 van equipped for use as an ambulance 1 65-foot aerial ladder

Source: Kentucky Department of Commerce, 1975: and Southworth, 1977.

Table III-48. Selected Housing Statistics, 1970

	Kentucky	Scott County	Georgetown
Number, all-year-round units	1,060,364	5,851	2,741
Number, single-family structures (%)	849,958 (80.2)	4,541 (77.6)	1,897 (69.2)
Persons per occupied unit	3.2	3.1	2.9
-owner-occupied	3.2	3.0	2.9
-renter-occupied	3.1	3.3	2.9
Lacking some or all plumbing facilities(%)	220,646 (20.8)	1,338 (22.9)	130 (4.7)
No water (%)	123,667 (11.7)	849 (14.5)	7 (0.3)
-cold water only (%)	56,141 (5.3)	277 (4.7)	48 (1.8)
No toilet in unit (%)	184,664 (17.4)	1,165 (19.9)	17 (0.6)
Number, owner-occupied units (%)	657,909 (62.9)	3,330 (56.9)	1,447 (53.9)
Number renter-occupied units (%)	325,756 (30.7)	2,088 (35.7)	1,126 (41.1)
Renter vacancy rate (%)	8.6	9.7	7.0
Median gross monthly rent ($)	63[1]	61	64
Median value, year-round, owner-occupied housing	12,600[2]	14,200	15,800
Age of housing			
- built before 1950 (%)	590,376 (55.7)	816 (13.9)	776 (28.3)
- built 1950-1959 (%)	145,051 (13.7)	583 (10.0)	406 (14.8)
- built after 1959	266,307 (25.1)	1,931 (33.0)	1,559 (56.9)
Median number rooms, year-round units	4.9	4.9	-

[1]Excludes one-family homes on 10 acres or more.

[2]Limited to one-family homes on less than 10 acres and no business on property.

Source: U.S. Bureau of Census, 1972.

Table III-49. Fall 1976 Housing Data for Scott County

	Georgetown	Stamping Ground	Sadieville	Remainder of Scott County
Number of occupied units	2,940	188	133	2,985
Number of vacant units	25	0	1	77
Total stock available	2,965	188	134	3,062
Housing classified as standard (% of total)	2,525 (85.2)	179 (95.2)	69 (51.5)	-
Housing classified as having minor deterioration (%)	286 (9.6)	7 (3.7)	27 (20.1)	-
Housing classified as having major deterioration (%)	98 (3.3)	2 (1.1)	18 (13.4)	206 (6.9)
Housing classified as being structurally dilapidated (%)	56 (1.9)	0 (0)	19 (14.2)	-
Vacancy rate (% of total)	0.8	0	0.7	2.5

Source: Bluegrass Area Development District, 1977.

it is predicted that there will be a need for 462 additional units in Georgetown, 14 in Stamping Ground, 9 in Sadieville, and 290 in the remainder of Scott County. The rate of growth predicted by the Battelle model decreases considerably after 1980. The BGADD housing analysis concluded that the low-vacancy rate in Scott County indicated a current need for additional housing units, and that particular attention should be paid to housing for low-income people.

(2) Utilities

Electrical Scott County is serviced by the Kentucky Utilities Company, which covers Georgetown and Stamping Ground, by the Harrison Rural Electric Cooperative Corporation (RECC), and by Owen County RECC. Kentucky Utilities Company has a generating capacity of 1,615,500 KW, and the East Kentucky Power Cooperative, which supplies the Harrison and Owen County RECC's, has a generating capacity of 496,000 KW.

Natural Gas Columbia Gas of Kentucky, Incorporated, supplied by Columbia Gas Transmission Corporation, serves Georgetown. Its transmission mains are 36 inches (supplier) and 6 inches (distributor) in diameter. Natural gas is not available in Scott County except in the Georgetown area.

Telephone Service South Central Bell services all of Scott County.

Water Georgetown and most of Scott County are serviced by the Georgetown Municipal Water and Sewer Service. The eastern portion of Scott County is served by the Kentucky-American Water Company, and Stamping Ground is served by the Stamping Ground Municipal Water Works. The West Scott County Water District services rural western Scott County, deriving its raw water from Eagle Creek at Sadieville. The Great Crossing Water District, Inc., serves the southern corner of Scott County and purchases its water from the Georgetown system. For the most part, the water main system does not extend to the northern sector of the county. Table III-50 lists relevant data on water companies in Scott County with the exception of the Great Crossing Water District, Inc. The Georgetown Water and Municipal Sewer Service has recently upgraded the water treatment plant capacity to approximately 4.0 mgd. The system currently serves a population of 10,000. Current average daily demand is 1.4 mgd. Current peak daily demand is 1.8 mgd (Proctor, Davis, and Ray, 1977). Approximately 10 percent of the volume is utilized by industrial facilities. A listing of these facilities appears in Table III-51. The location of the water treatment plant is shown in Figure III-18.

The major source of water for the Georgetown area is Royal Spring. During normal conditions Royal Spring is capable of meeting the demand. However, during drought conditions, its flow may drop to 0.5 mgd which is insufficient to meet the demand. There are emergency supplies impounded behind Elkhorn Creek Dam and De Garis Dam. The total storage capacity of these reservoirs is 64,000,000 gallons. It has been projected that during a drought as severe as that of 1953, Royal Spring and the impoundments would not be sufficient to meet the demand (Proctor, Davis, and Ray, 1977).

Sewer System The Georgetown wastewater treatment facility accommodates the wastewater generated by 2,846 customers comprised of 2,722 residential, 113 commercial, and 11 industrial. The characteristics of the wastewater treatment plant are shown in Table III-52. The waste treatment plant is located west of U.S. 25 on the south bank of North Elkhorn Creek.

The plant was upgraded and expanded in 1975. The new plant incorporates a raw sewage pumping station, static screens, rotating biological contactors, clarifier, chlorinator, aerobic and anaerobic digestors, sludge thickener, and sludge drying beds. The facility has a nominal design capacity of 3.0 mgd. The upgraded facility was designed to discharge an effluent conforming to a BOD_5 of 30 mg/l and total suspended solids of 30 mg/l (Proctor, Davis, and Ray, 1977).

Table III-53 presents a summary of analysis for the months of May, 1975 to April, 1976. Average flow to the plant during this time period was 1.12 mgd. The plant was in violation of their NPDES permit limitations (BOD_5 = 30 mg/l and TSS = 30 mg/l) during August, 1975 and January, February, and April, 1976.

Table III-50. Water in Scott County

Company serving Georgetown: Georgetown Municipal Water and Sewer Service[1]
West Main Street
Georgetown, Kentucky 40324
(502) 863-1156

Source: Royal Spring and two impoundments on the North Forks of Elkhorn Creek

Treatment plant capacity: 4,000,000 gpd

Average daily consumption: 1,300,000 gallons

Peak daily consumption: 1,600,000 gallons

Type treatment: Chemical and chlorine addition, flocculation, clarification, filtration

Storage capacity: 1,400,000 gallons

Size lines: Up to 16 inches

Average pressure: 80 psi

Average temperature: 55°F.(winter; 75°F.(summer)

Monthly water fees:

Wholesale and Industrial Consumers

First	300 cu ft	- $2.60 (minimum)
Next	300 cu ft	- .94 per 100 cu ft
Next	1,000 cu ft	- .71 per 100 cu ft
Next	2,400 cu ft	- .64 per 100 cu ft
All over	4,000 cu ft	- .53 per 100 cu ft

Tap-on Charge: Residential - $225
Commercial and Industrial - On application

Company serving Stamping Ground: Stamping Ground Municipal Water Works
Stamping Ground, Kentucky 40379
(502) 535-6223

Source: North Fork of Elkhorn Creek and Buffalo Springs

Treatment plant capacity: 322,000 gallons

Average daily consumption: 20,000 gallons

Peak daily consumption: 30,000 gallons

Type treatment: Pre-chlorination, coagulation, sedimentation, filtration

Storage capacity: 55,000 gallons

Size lines: 6 inches

Average pressure: 75 psi

Average temperature: 46°F.

Table III-50. Water in Scott County (Concluded)

Monthly water fees:

2,000 gallons or less	$ 4.00 (minimum)
5,000 gallons	6.25
10,000 gallons	9.25
15,000 gallons	11.75
20,000 gallons	13.75
25,000 gallons	15.75
50,000 gallons	23.25
100,000 gallons	35.75
150,000 gallons	48.25
200,000 gallons	60.75

Tap-on Charge: None
Fee for installing a new meter: $100

Surface water source: North Elkhorn Creek

Average discharge: North Elkhorn Creek near Georgetown, 161 cfs (25 years, USGS)

Expected groundwater yield: 50 to 200 gpm in central portion of county and along southwestern boundary; 5 to 50 gpm in southern half of county; 5 gpm or less in remainder of county

Company serving the eastern portion of Scott County: Kentucky-American Water Co.
P O. Box 7500
2300 Richmond Road
Lexington, Kentucky 40502
(606) 269-2386

Source: Kentucky River and impounded reservoirs

Treatment plant capacity: 40,000,000 gpd

Average daily consumption: 27,000,000 gallons

Peak daily consumption: 37,000,000 gallons

Type treatment: Coagulation and filtration

Storage capacity in Scott County: 899,999 gallons[2]

Size lines in Scott County: 12, 8, 6, 4, and 2 inches

Average pressure: 90 psi

Average temperature: 68°F.

Monthly water fees:

Commercial Users

First	7,000 gallons	- $10.50 (minimum)
Next	3,000 gallons	- 1.50 per M gallons
All over	10,000 gallons	- 1.00 per M gallons

Large Industrial Users

First	225,000 gallons or less	$337.50
All over	225,000 gallons	0.55 per M gallons

Tap-on Charge: None

[1] An expansion project increasing the water treatment plant capacity to 4,000,000 gpd has been completed. A study to upgrade flow in various sections of the system is to begin in the summer of 1976.

[2] Includes a 380,000-gallon standpipe recently completed at Sadieville.

Source: Kentucky Department of Commerce, 1976.

Table III-51. Major Industrial Water Users Served by the Georgetown Municipal Water System

Title	Products	Total Employment
Blue Ribbon, Pen & Pencil Co., Inc.	Imprinted pens, pencils	120
C&C Cutter Co.	Cutting tools	16
Carbide Products, Inc.	Carbide tools, accessories	72
Electric Parts Corporation	Electrical wire, wiring harness	291
Georgetown American Swiss Products, Inc.	Motor Shafts	60
Georgetown Cable Products, Inc.	Electronic wiring, components	85
Georgetown Industries, Inc.	Ballpoint pens	58
Georgetown Metal Stamping Co.	Metal stampings	70
Georgetown Tool & Mfg. Co., Inc.	Tool, dies	12
Hydro Plastic Co.	Typewriter parts, plastic parts	65
Johnson Service Co.	Environmental control systems	350
Kentucky Die Casting Corp.	Aluminum die casting	65
Kentucky Heat Treating Co.	Heat treating	20
Mallard Pen & Pencil Co., Inc.	Wood case pencils, ballpoint pens	160
Preferred Stampings, Inc.	Metal stampings	70
Stiohn Products Corporation	Tools, fixtures	55
Universal Wire Spring Division, Hoover Ball & Bearing Company	Auto seat springs, furniture springs	390

Source: Kentucky Department of Commerce, 1971 Kentucky Directory of Manufacturers.

Table III-52. Sewerage in Scott County

Company serving Georgetown:	Georgetown Municipal Water and Sewer Service[1] West Main Street Georgetown, Kentucky 40324 (502) 863-1156
Design capacity:	3,000,000 gpd
Average daily flow:	1,000,000 gallons; peak daily flow - 1.8 mgd
Treatment:	Secondary plus
Type treatment:	Static screens, rotating biological contractors, clarification, chlorination
Treated effluent discharged into:	North Elkhorn Creek
Size of sanitary mains:	Up to 18 inches
Size of storm mains:	24 to 36 inches
Rates:	75 percent of monthly water bill
Tap-on charge:	Residential - $225 Commercial and industrial - On application
Company serving Stamping Ground:	Stamping Ground has received a Federal grant award for the construction of a sewerage system. Sewer lines have been installed throughout the city and the construction of the treatment plant is expected to be completed in the spring of 1978. The sewage treatment plant will provide tertiary treatment and will have a design capacity of 100,000 gpd.

[1]A project to increase the capacity of the wastewater treatment plant to 3,000,000 gpd and to improve the treatment process has been completed. A project to correct infiltration and inflow problems in the sewerage system began in the summer of 1976.

Source: Kentucky Department of Commerce, 1976.

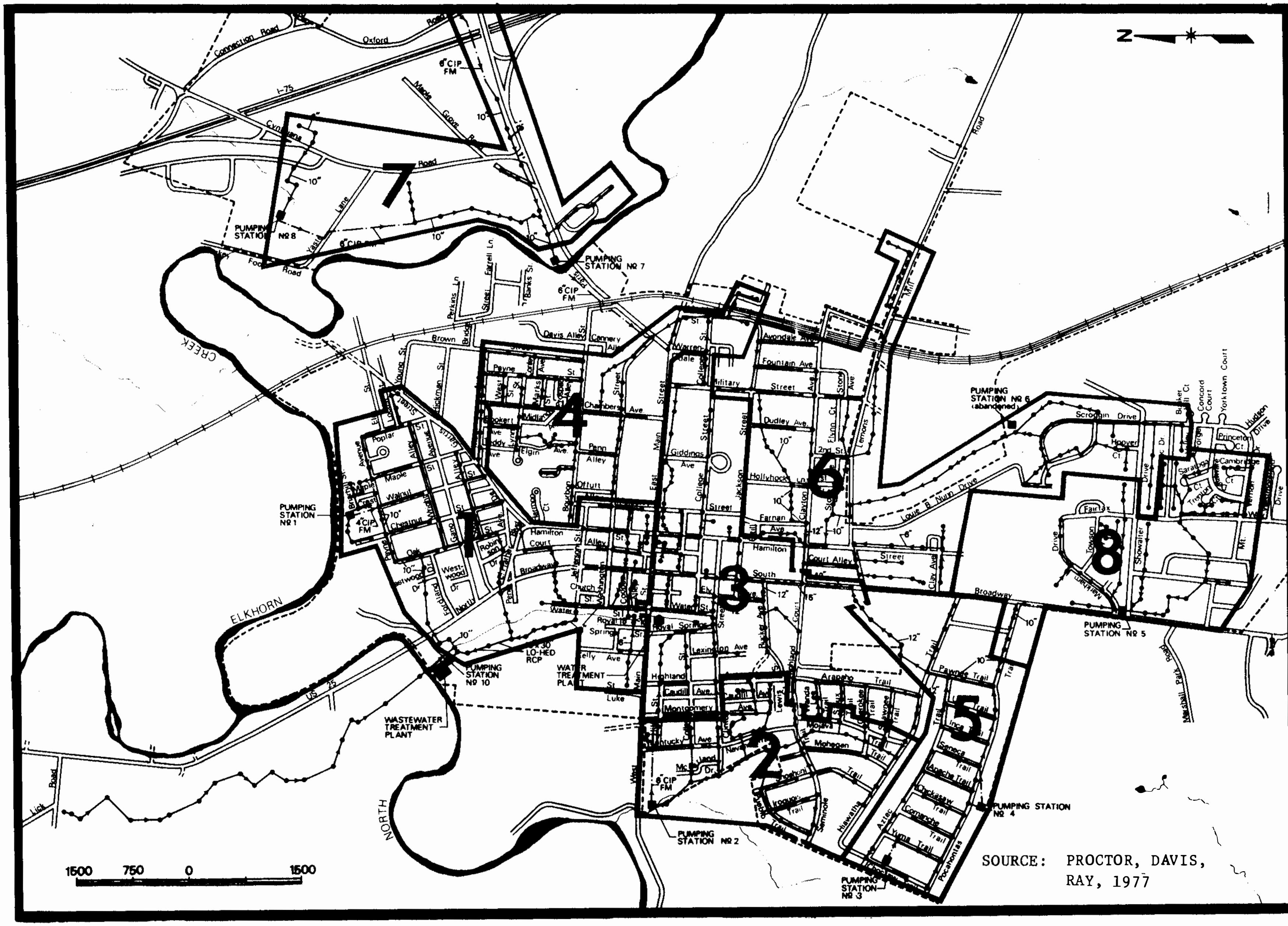


FIGURE III-18
LOCATION OF WATER TREATMENT PLANTS

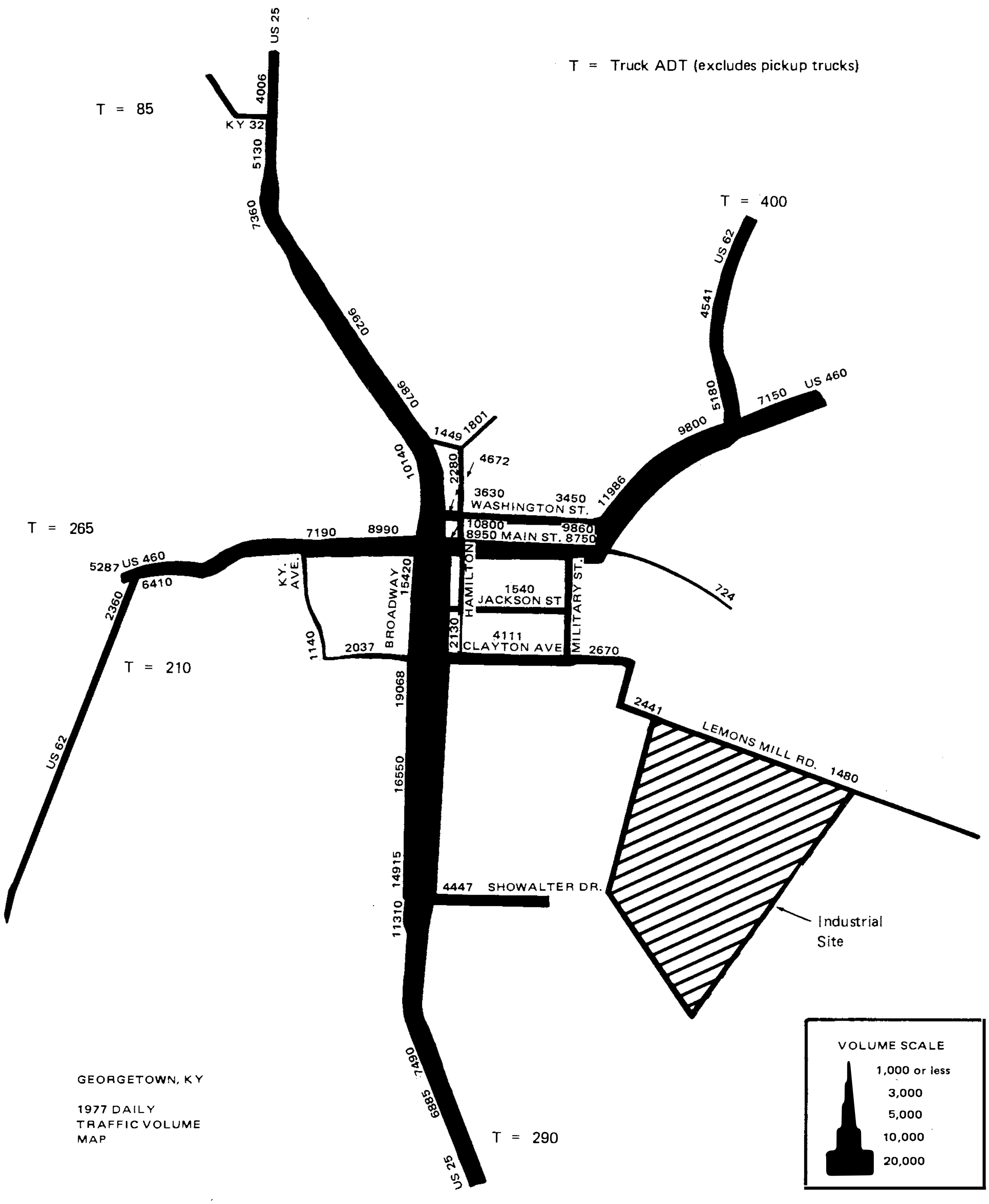


FIGURE III-19
DAILY TRAFFIC COUNT PATTERNS

Industrial wastewaters account for approximately 14 percent of the flow to the wastewater treatment plant. A list of the eleven industries which discharge to the municipal system and pertinent information such as flow and degree of pretreatment are shown in Table III-53 (Proctor, Davis, and Ray, 1977).

(3) Transportation Facilities

Highways and Roads. Interstate 75 (a major north-south highway which runs from Michigan to Florida) and Interstate 64 (which connects Norfolk, Virginia, and St. Louis) pass through the Georgetown area and provide excellent access to other regions. Two main secondary roads U.S. Highways 62 (east-west) and 25 (north-south) also provide good linkage to Frankfort and Lexington. Other secondary roads provide local access.

The daily traffic count patterns for 1977 as taken by the Kentucky Department of Transportation are shown in Figure III-19. The industrial park would be directly accessed by Lemons Mill Road which is currently supporting approximately 1500 vehicles per day.

Rail Lines. Two rail lines cross Scott County, intersecting in Georgetown. The Frankfort and Cincinnati line is Georgetown's east-west connection, and the Southern line runs north and south. The Southern provides Georgetown with a linkage to Lexington, which is the major rail center of the region. Southern Railway provides freight service seven days a week.

c. Airports and Airways

The only airfield in Scott County is Marshall Field, located 1 mile south of Georgetown. Marshall Field has an 1800-foot unlighted, turf runway suitable for accommodating light aircraft. The only control at Marshall Field is a wind sock. This field is used largely for flight training and light transport.

Blue Grass Field outside of Lexington is the nearest airport offering commercial passenger service. Eastern, Delta, Allegheny, and Piedmont airlines service Blue Grass Field.

d. Waterways

No navigable waterways exist in Scott County. The nearest navigable waterway is the Kentucky River, with a 6- to 9-foot depth, which runs through Frankfort to the west, and flows northward to connect with the Ohio River at Carrollton.

The National Register of Historic Places (43FR5214) includes 40 listings for Scott County. Table III-56 presents an inventory of historical resources near the proposed site. These resources are geographically located in Figure III-20.

Table III-53. Georgetown Wastewater Treatment Plant--Operational Information

Month	Total Flow (MGD)	Suspended Solids			5-Day BOD			pH Influent	D.O Effluent (mg/l)
		Influent (mg/l)	Effluent (mg/l)	Percent Reduction	Influent (mg/l)	Effluent (mg/l)	Percent Reduction		
May (1975)	-	204	18.6	91	-	-	-	-	-
June	-	269	14.0	95	-	-	-	-	-
July	-	304	12.0	96	270	29.0	89	-	-
August	-	281	31.0	89	-	-	-	-	-
September	-	216	11.0	95	-	-	-	-	-
October	1.36	267	12.0	96	180	21.0	88	-	-
November	1.26	252	18.4	93	216	23.0	89	-	3.2
December	1.07	230	9.0	96	321	13.2	96	7.1	3.4
January (1976)	1.25	161	12.0	93	212	36.0	83	7.2	2.9
February	1.16	188	12.8	93	256	34.0	87	7.1	2.8
March	1.02	182	15.6	91	219	10.2	95	7.1	3.6
April	0.73	190	31.0	84	214	16.0	93	7.2	4.5
TOTAL	7.85	2744	197.4	-	1888	182.5	-	35.7	20.4
AVERAGE	1.12	228.7	16.4	93	236	22.8	90	7.14	3.4

Source: Proctor, Davis and Ray, Inc., 1977.

Table III-54. Industrial Wastewater Dischargers--Georgetown Sewerage System

Industry	Description	Sewer System District	Wastewater Flow to Municipal System (GPD)			Wastewater Pretreatment	Wastewater Flow Not Returning to Municipal System	
			Sanitary Wastewater	Process Wastewater	Cooling Wastewater		Flow (GPD)	Terminal Point & Treatment Process
Georgetown American Swiss	Metal Products	1	350	0	0	None	0	-
Stamping Ground Tool & Die	Tooling	1	370	0	0	None	0	-
Georgetown Metal Stamping	Metal Stamping	3	540	0	0	None	0	-
Carbide Products	Metal Cutting Tools	6	590	0	0	None	0	-
SMF Plating & Manufacturing	Electro-Plating	8	100	5,210	0	Lime Addition & Settling	100 Sanitary 5210 Process	Sanitary - Septic Tank Process - Evaporation Pond
Blue Ribbon Pen Co.	Retractable Pens	4	3,950	40	0	Lime & Caustic Soda Addition & Settling	0	-
Johnson Control Co.	Lights Assembly	6	4,300	0	20,300	Caustic Soda Addition & Settling	0	-
Electric Parts	Cord Sets	6	5,720	0	0	None	Cooling Water 5,350	Ditch
Hydro Plastic	Injection Molding Parts	8	1,230	0	0	None	0	-
Kentucky Heat Treating	Heat Treating	8	290	0	16,660	None	0	-
Hoover Ball Bearing	Automotive Parts	6	5,000	48,760	0	None	Cooling Water 15,880	-
TOTAL	-	-	22,440	54,010	36,960	-	21,230	-

Source: Dames and Moore, 1977

Table III-55. Scott County Parks and Recreation Areas

Facility	Acreage
Scott County Community Park	90
Garth School Park	5
Big Royal Spring Park	2
Marshall Field	12
A.C. Proctor Lake (Stamping Ground)	6 (Water)
Bluegrass Coon Hunters	2
Cardome Academy	
Croquet Court	1
Georgetown City Park	10
Georgetown College	28
Hubert Humphrey Fishing Lake	6 (Water)
Lees Trailer Park	
Long View Golf Club	137 (17 Water)
Midway Sportsman Club	32
Stamping Ground Softball Park	6
Trailer Park (US 62 & Cynthiana Road)	25
Eastern School	25
Georgetown High School	28
Great Crossing School	2
Southern Elementary School	15
St. Johns School (Military Street)	1
Stamping Ground School	20
Big Eagle Creek Area	2000
County Farm (Delaplain Road)	200
Elkhorn Creek Area	
Rest Area 105-1, US 25	1
Rest Area 105-21, 75 N	7
Rest Area 105-3, 175	8
Suffoletta Park	10
Boston Park	2

Sources: U.S. Army Corps of Engineers, Louisville District, 1974
Parks and Recreation Board, 1974

Table III-56. Historical Resources Inventory

Name	Register	Landmark	Description
Aulick House		✓	Brick Victorian house.
Cardome (Gov. J. F. Robinson) House	✓		Convent of the Sisters of Visitation, built around the home of Gov. James F. Robinson (1862, 1863).
Cave, John--Log House		✓	Simple 1-1/2 story log house with two chimneys on ends. Built by leading pioneer.
Craig, Jefferson House	✓		1-1/2 story Greek revival, high basement house.
Crumbaugh, Solomon House		✓	Home of builder of the historic Crumbaugh Mill, the dam of which regulates Elkhorn Creek.
Eclipse Place		✓	Victorian front created from 1-1/2 story residence of Elijah Hawkins (1800, 1879).
Elmwood House	✓		Two-story 5-bay brick house dating from Greek Revival Period, built by Robert Holmes, Lexington chair manufacturer.
Grant-Warren Stone House	✓		Log house dating from 1785, built by a nephew of Daniel Boone. Bought in 1819 by Rev. Stone, founder of Christian Church.
Hawkins-Showalter House		✓	Home of Jackson Showalter (1859-1935), world chess champion in late 19th and early 20th centuries.
Offutt, Mitchum Webb House		✓	Transitional house with late Federal and early Grecian woodwork and mantels dating from 1832.
Osborne, John William House	✓		Large 3-story Victorian house with balconies, carved catwalks, porches, and rhythmic window arrangement, 1900.
Holy Trinity Episcopalian Church	✓		An unaltered stone church of English Gothic design that seats 325, featuring a square bell tower completed in 1904 and a full basement completed in 1908.
Johnson, Henry Viley House		✓	Two-story Victorian house of attorney who became reform mayor of Denver, Colorado, 1879.
Kelly, James--Log House		✓	Eighteenth Century, 1-1/2 story log house with stone chimneys and portholes.
Main Street Historic District	✓*		Forty-eight buildings, mostly residential, ranging in age from 1814-1920.
Miller, John Andrew House	✓		A 3-bay 1-1/2 story log structure that became a wing to a stone house dating from mid-1780s.
Mosby-Tilford-Webb House		✓	Eighteenth Century two-story 5-bay brick house.
Royal Spring	✓		Largest spring in Kentucky and water supply source for Georgetown.
Scott County Courthouse	✓		One of the few buildings of Second Empire or General Grant style to survive in this country, designed by Pittsburgh Architect Boyd, constructed in 1877, renovated in 1971.
Stevenson House		✓	Two-story temple style Greek Revival house and original carriage house.
Thorn, James House		✓	Eighteenth Century 2-story brick house originally facing unpaved extension of East Main Street.

*Pending nomination.

Source: Ann B. Bevins, Scott County Representative, Kentucky Heritage Commission, Correspondence, October 18, 1977.

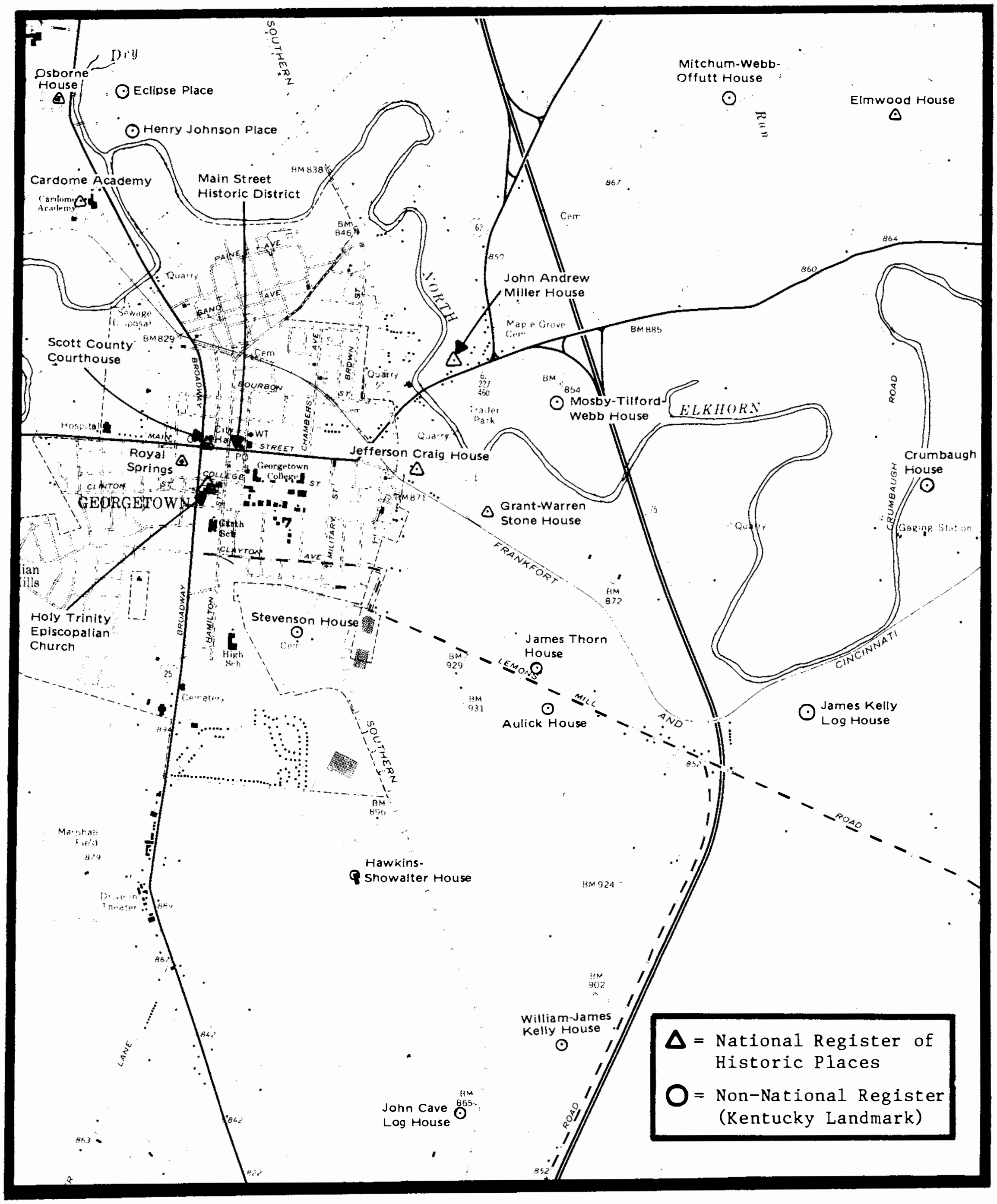


FIGURE III-20
LOCATIONS OF HISTORICAL RESOURCES

On July 20 and August 10, 1977 an archeological survey and limited soil testing were conducted at the proposed industrial park site. In the course of the survey, 14 prehistoric archeological sites were located. Three of these sites were examined further (soil profiles were measured) to determine if there was any likelihood of intact archeological deposits being present. The probing revealed that none of these sites were significant (Collins, 1977).

D. References

Babcock, J.V., 1977. Endangered Plants and Animals of Kentucky: Institute of Mining and Mineral Research, University of Kentucky, Lexington, 128 pp.

Bear, F.E. 1964, Chemistry of the Soil, Rheinholt Publishing Co., New York.

Bevins, Ann B., 1977, Correspondence, October 18.

Bluegrass Area Development District, 1975, Various Population Statistics.

Braun, C.L. 1921, Composition and Source of the Flora of the Cincinnati Region: Ecology II(3): 162-178.

________, 1950, Deciduous Forests of Eastern North America: Blakiston Company, Philadelphia, Pennsylvania.

Casey, W., 1974, Rare or Endangered Plants of the Inner Blue Grass Region of Kentucky: U.S. Dept. of Agriculture, Soil Conservation Service.

Clay, W.M., 1975, The Fishes of Kentucky: Kentucky Department of Fish and Wildlife Resources, Frankfort, Kentucky, 416 pp.

Clifton, C., 1977, Scott County Conservation Officer, personal communication.

Code of Federal Regulations, 1976, Protection of the Environment, vol. 40, part 50, July 1.

Collins, M., 1977, An Archaeological Survey of the Proposed Georgetown Industrial Park, Scott County, Kentucky.

Craycraft, C., 1977, Kentucky Dept. of Human Resources, personal communication.

Cressman, E.R., 1967, Geologic Map of Georgetown Quadrangle: U.S. Geological Survey, Quad. Map GQ-605.

Cressman, E.R. and M.C. Noger, 1976, Tidal-Flat Carbonate Environments in the High Bridge Group (Middle Ordovician) of Central Kentucky: U.S. Geological Survey, Bull. 1224-C, 29 pp.

Dames and Moore, 1977, Environmental Report, Kentucky-Federal Energy Park, Georgetown, Kentucky, for Irvin Industrial Development, Inc.

Davis, P.A., 1953, The Status of Floristic Studies in Kentucky: Transactions of the Kentucky Academy of Science 14(2):49-58.

Faust, R.J., 1977, Groundwater Resources of the Lexington, Kentucky Area: U.S. Geological Survey, Open-file report.

Federal Register, 1977, National Register of Historical Places (with supplement of February 8, 1977, April 12, 1977, May 3, 1977 and July 26, 1977): Vol. 42, No. 21 (February 1).

Federal Register, 1977, Prime and Unique Farmlands, 42FR42359, August 23.

Fenneman, N.M., 1938, Phsiography of the Eastern United States: McGraw-Hill Book Co., New York, 714 pp.

Fohs, 1913, Mineral Resources of Kentucky, U.S. Geological Survey Report.

Freeman, L.B., 1953, Regional Subsurface Stratigraphy of the Cambrian and Ordovician in Kentucky and Vicinity: Kentucky Geological Survey Series 4, Bulletin 12.

Fuller, Mossbarger and Scott, 1973, Soil Engineering and Geologic Report for Industrial Road: Kentucky Group Industrial Site, Georgetown, Kentucky.

Gibson, G., 1961, Life-Forms of Kentucky Flowering Plants: The American Midland Naturalist 66(1):1-60.

Giles, R.J., Jr. (Ed.), 1969, Wildlife Management Techniques, The Wildlife Society, Washington, D.C.

Hamilton, D.K., 1950, Areas and Principles of Ground-Water Occurrence in the Inner Blue Grass Region, Kentucky: Kentucky Geological Survey, Sec. 9, Bulletin 5, 68 pp.

Johnson, Victor E., 1977, Superintendent of Schools, Scott County, Kentucky, correspondence to T.E. Lohr, Irvin Industries, Inc.

Jones, A.R., 1968, Changes in the Black Bass Population of North Elkhorn Creek following the establishment of a size limit: Department of Fish and Wildlife Resources, Frankfort, Kentucky, Kentucky Fisheries Bulletin 56.

___________, 1973, Inventory and Classification of Streams in the Kentucky River Drainage: Dept. of Fish and Wildlife Resources, Frankfort, Kentucky, Kentucky Fisheries Bulletin 56, 108 pp.

___________, 1968, Changes in the Black Bass Population of Elkhorn Creek Following the Establishment of a Size Limit: Dept. of Fish and Wildlife Resources, Frankfort, Kentucky, Kentucky Fisheries Bulletin 45, 34 pp.

Keith, J.R., 1967, A Study of Vegetation in the Pleistocene Drift Region of Northern Kentucky: Thesis, University of Kentucky, Lexington, Kentucky.

Kendeigh, S.C, 1961, Animal Ecology, Prentice Hall, Inc., New Jersey.

Kentucky Academy of Science, 1973, A Preliminary List of Rare and/or Endangered Species in Kentucky: Seven Man Ad Hoc Committee (unpublished).

Kentucky Dept. of Commerce, 1973, Commuting Patterns of Kentucky Counties.

__________, 1973a, Financing Industry-The Kentucky Plan.

__________, 1973b, The Tax Climate in Kentucky.

__________, 1975, Kentucky Deskbook of Economic Statistics.

__________, 1975a, Kentucky Energy Consumption and Requirements.

__________, 1971, Kentucky Directory of Manufacturers.

__________, 1976, Kentucky Directory of Manufacturers.

__________, 1977, Kentucky Directory of Manufacturers.

__________, (undated), Industrial Land Use in Kentucky.

__________, (undated), Kentucky Manufacturing Developments in 1976.

Kentucky Dept. of Fish and Wildlife Resources, 1975, Endangered Fish and Wildlife Species: 301 KAR 3:060 Pursuant to KRS 13.082; related to KRS 150.025 and 150.183.

Kentucky Dept. of Human Resource, 1977, Kentucky Labor Force Estimates (Annual-1965, 1971-1976; Monthly-February 1977 and April 1977).

__________, (undated), Various Data on Employment/Unemployment on Workmen's Compensation-Covered Jobs.

Kentucky Dept. of Natural Resources and Environmental Protection, Division of Water Quality, 1975, Kentucky Water Quality Standards: 401 KAR 5:025.

__________, 1975, Ambient Air Quality Regulations in Kentucky Air Pollution Control Regulations; 401 KAR 3:020.

Kentucky Dept. of Revenue, 1974.

Kentucky Heritage Commission, 1971, Statewide Survey of Historic Sites: prepared by Spindletop Research for the Kentucky Heritage Commission.

Kentucky Program Development Office, 1972, Kentucky Population Projections, 1975-2020, Volume 1.

Laflin, B.D, 1970, Some Effects of Municipal Sewage Pollution Upon the Biota and Water Quality of Elkhorn Creek: Dept. of Fish and Wildlife Resources, Frankfort, Kentucky, Kentucky Fisheries Bulletin 55, 46 pp.

Lohr, T., 1977, Irvin Industrial Development, Inc., personal communication.

Lykins, B.W. and J.M. Smith, 1976, Interim Report on the Impact of Public Law 92-500 on Municipal Pollution Control Technology: Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA 600 2-76-018, 304 pp.

Matson, George C. and Chase Palmer, 1909, Water Resources of the Blue Grass Region, Kentucky, 223 pp.

McInteer, R.B., 1946, A Change from Grassland to Forest Vegetation in the "Big Barrens" of Kentucky: The American Midland Naturalist 35:276-282.

____________, 1947, Soil Preference of Some Plants as Seen in Kentucky: Castana 12(1):1-8.

Mull, D.S., 1968, The Hydrology of the Lexington and Fayette County Area: Lexington and Fayette County Planning Commission.

National Academy of Sciences and National Academy of Engineering, 1972, Water Quality Criteria: U.S. Environmental Protection Agency, Washington, D.C., 594 pp.

National Oceanic and Atmospheric Administration (NOAA), 1973, Local Climatological Data, Annual Summary with Comparative Data, Lexington, Kentucky (1941-1970): U.S. Dept. of Commerce.

Palmquist, W.N., Jr., and Hall, F.R, 1953, Public and Industrial Water Supplies of the Blue Grass Region, Kentucky, U.S. Geological Survey Circ. 199, 101 pp.

____________, 1960, Availability of Ground Water in Bourbon, Fayette, Jessamine, and Scott Counties, Kentucky: U.S. Geological Survey, Hydrological Inv. Atlas HA25.

____________, 1961, Reconnaissance of Ground Water Resources in the Blue Grass Region, Kentucky, U.S. Geological Survey, Water Supply Paper 1533, 39 pp.

Proctor, Davis and Ray, Inc., 1977, Georgetown, Kentucky, 201 Facilities Plan 1976-1996.

Reid, G.K., 1961, Ecology of Inland Waters and Estuaries: Rheinhold Publishing.

Ripley, S.D, 1974, Report on Endangered and Threatened Plant Species of the United States, Presented to the Congress of the United States of America by the Secretary, Smithsonian Institution, U.S. Government Printing Office, Washington, D.C.

Scruggs and Hammond, Inc., 1974, Georgetown-Scott County Physical Development Plan: Prepared for Georgetown-Scott County Planning Commission.

Southworth, J., 1977, Scott County Fire Dept., personal communication.

Transeau, E.N., 1935, Prairie Peninsula: Ecology 16:423-437.

U.S. Army Corps of Engineers Topographic Laboratories, 1974, Environmental Resources Inventory of the Lexington, Kentucky Urban Area: Louisville, Kentucky District, 137 pp.

U.S. Bureau of Census, 1972, Census of Population, 1940-1970.

____________, 1977, Current Population Reports Series P26, No. 7617: Estimates of the Population of Kentucky Counties and Metropolitan Areas; July 1, 1975 (revised) and 1976 (provisional).

U.S. Dept. of Agriculture, 1977, Soil Survey of Scott County, KY.

U.S. Dept. of Commerce, 1972, 1969 Census of Agriculture.

____________, 1977, 1974, Census of Agriculture.

U.S. Dept. of Interior, 1976, Endangered and Threatened Wildlife and Plants: Federal Register, Part IV, Vol. 41(208)(October 27).

U.S. Dept. of Labor, Manpower Administration, 1973, Population by Race, Ethnic Group, Sex and Age; Educational Attainment, Vocational Training, School Enrollment of Persons by Age and Race; Employment Status by Sex, Race, and Ethnic Group; Occupation by Sex and Race, 1970.

U.S. Geological Survey, 1977, Water Resources Data for Kentucky, 1976.

University of Louisville, 1977, Land Resources Policy Model.

Vance, R., 1977, Scott County Property Valuation Administration, personal communication.

Weisenberger, B.C, 1974, Soil Survey Interim Report of Scott County, Kentucky: U.S. Department of Commerce, SCS Series.

Wharton, Mary, 1977, Personal communication.

Wharton, Mary E. and Barbour, R. W., 1971, The Wildflowers and Ferns of Kentucky, University Press of Kentucky, Lexington, KY.

__________, 1973, Trees and Shrubs of Kentucky: University Press of Kentucky, Lexington, KY.

CHAPTER IV

LAND USE RELATIONSHIPS

A. Purpose

This chapter provides information describing existing or proposed land use relationships of the proposed industrial park tract and information on how these land use relationships conform or conflict with local, State, and Federal ordinances.

B. Methodology

Data on current and proposed land uses were obtained from an environmental report prepared by Dames and Moore (1977), from personal communication with members of the Scott County/Georgetown Zoning Commission, from literature review, and from site visitation.

C. Zoning

The proposed industrial park site was rezoned by the Scott County Fiscal Court on July 13, 1973 from Agriculture to Industry. (The change was in conformance with Scott County land use plans adopted in 1971 and was made on the recommendation of the planning commission.) Zoning ordinance for the site permits only light industry unless a conditional use permit is obtained from the Board of Adjustment. Heavy industry, as defined by the Scott County/Georgetown Zoning Ordinance, is industry whose processing operations result in the outdoor storage or processing of materials or products, the emissions of any atmospheric pollution, visible light flashes or glare, odors, or noise or vibrations which may be heard or felt off the premises or those industries which constitute a fire, explosion, or other hazard detrimental to the health and welfare of adjacent property owners. Light industry refers to those industries engaged in processing operations which result in none of the above conditions. If the coal storage pile at the gasifier lot is covered, a conditional use permit will not be required. The Board of Adjustment for Scott County/Georgetown has the responsibility of distinguishing between light and heavy industry upon application by the Enforcement Officer when the classification is in doubt.

Although the entire 173.6 acre park site has been zoned for industry, each lot and the construction plans for that lot must be reviewed by the Georgetown/Scott County Planning Commission before final approval to begin construction is given. To date, the seven lots nearest Lemons Mill Road have been tenatively approved for industrial development. Once a commitment to build has been made, planned construction activities must be reviewed before final approval is given by the commission.

Approval of the sale of the 7.1 acre proposed gasifier site to Irvin Industrial Development is contingent upon access to the lot. The current road must be extended and upgraded or bonded before approval of the sale is given by the planning commission. At a minimum the road back to the gasifier site would have to be 24 feet wide (2 lanes). However, the planning commission expects the road will be four lanes. Site plans for the park indicate a 120-foot right-of-way back to the site (2400 feet of road from Lemons Mill Road to the gasifier site).

The existing road which borders the 173.6 acre site to the north (Lemons Mill Road) is capable of supporting expected traffic loads to the gasifier site but could not support expected loads to the industrial park. Construction of a connector road between Interstate Route 62 and Interstate Route 25 would be needed to handle the anticipated industrial park traffic load. Such a road plan was developed as part of the 1974 Land Use Plan. Its construction is dependent upon development of the park. At this time, funds have not been allocated for construction of the road, no time frame for construction has been developed, and the road does not appear on any priority list.

D. Annexation

During 1976, Industrial Development, Incorporated requested that the proposed 173.6 acre industrial park site be annexed by the city of Georgetown (Mooney, 1977). Once the request was made the industrial park site was placed under city jurisdiction. Ordinance number 77-014 was presented to the City Council and the industrial park site was annexed by the City of Georgetown on September 1, 1977.

E. Prime and Unique Farmlands

In accordance with 7 CFR Part 657, the Soil Conservation Service (SCS) of Kentucky has made an inventory of prime and unique farmlands in Scott County. Results of this inventory indicate that Scott County has in excess of 58,000 acres of prime agricultural land, but no lands considered as unique farmlands. Of the 173.6 acres contained in the proposed industrial park site, 144 acres are considered as prime farmland (see Figure III-8).

Prime agricultural land is land that has the best physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops (7CFR657). It can be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water. However, inventories that designate land as prime farmland do not constitute a designation of the land to a specific land use. Such designations are the responsibility of the appropriate local and State officials. Therefore designation of the 144 acres of prime farmland within the proposed industrial park does not restrict these lands from other uses, but rather identifies areas with the best combination of soil, water, and climatic conditions for agriculture. Use of these lands for industry is in accordance with the current zoning of the Georgetown/Scott County area.

F. Sole or Principal Source Aquifer Areas

Section 1424(e) of the Safe Drinking Water Act of 1974 (P.L. 93-523) authorizes the Administrator of the Environmental Protection Agency (EPA) to designate an aquifer for special protection if it is the sole or principal drinking water resource for an area, and if its contamination would create a the sole or principal drinking water resource for an area, and if its contamination would create a significant hazard to public health. Federal financial assistance, through a grant, contract, loan guarantee or otherwise, may not be given for any project that the Administrator (EPA) determines may contaminate such a designated aquifer through a recharge zone so as to create a significant hazard to public health.

The Environmental Protection Agency has proposed regulations protecting sole source aquifers (42FR51620, September 29, 1977). Under these proposed regulations, a sole or principal source aquifer is defined as an aquifer which supplies 50 percent or more of the drinking water for an area, and a public water system is defined as a system which provides piped water for human consumption has at least fifteen service connections, or regularly serves an average of at least twenty-five individuals daily at least sixty days out of the year.

A sole or principal source aquifer area designation may be made by the Administrator of EPA on the basis of a citizen petition or upon EPA's own initiative. Where there is a significant public interest, the Regional Administrator of EPA may hold a public hearing on whether an area should be designated as a sole or principal source aquifer area under subpart B (40CFR148).

G. References

Council on Environmental Quality, 1976, Memorandum for Heads of Federal Agencies: Environmental Review Pursuant to Section 1424(e) of the Safe Drinking Water Act of 1974 and its Relationship to the National Environmental Policy Act of 1969, November 19.

Dames and Moore, 1977, Environmental Report, Kentucky Federal Energy Park, Georgetown, Kentucky for Irvin Industrial Development, Inc., September.

Scott County/Georgetown Zoning Ordinance, 1973.

U.S. Congress, 1974, Safe Drinking Water Act, PL 93-523, 93rd Congress.

U.S. Congress, 1974, Federal Nonnuclear Energy Research and Development Act of 1974, PL 93-577, 93rd Congress.

U.S. Department of Agriculture, 1977, Proposed Guidelines for Inventorying Prime and Unique Farmlands, 42FR42359, August 23.

U.S. Environmental Protection Agency, 1977, Proposed Regulations Protecting Sole Source Aquifer Areas, 42FR51620, September 29.

CHAPTER V

ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A. Purpose

This chapter presents and discusses the physical, biological, and socioeconomic impacts associated with the installation and operation of the low-Btu coal gasifier and the development of the industrial park planned for Georgetown, Kentucky. It considers the magnitude of the impacts, direct and indirect effects, and short- and long-term effects. The impact analysis is the key element of this report and provides the basis for the development of the remaining chapters including mitigating measures, irreversible and irretrievable commitment of resources, and the trade-off analysis.

B. Methodology

The impact analysis is performed on two levels. Those changes which would be brought about during the construction and operation of the gasifier are reasonably well known and are quantified as much as possible. On the other hand, the impacts from the industrial park are unknown because the occupants of the park are not yet identified. In order to remedy this and at least qualitatively evaluate the environmental impacts of the industrial park as well as the gasifier, it was necessary to construct a scenario in which the park was tenanted by energy intensive industries. This scenario is described in Chapter II, B. Methodology. The impacts expected from the construction and operation of the facilities depicted in the scenario were determined by examining manufacturing processes and pollution loads associated with existing similar plants. It was assumed that best practicable control technology currently available as defined by Federal regulations in accordance with the 1972 Amendments to the Clean Water Act (PL 92-500) and up-to-date air pollution control equipment would be installed at each of the user-facilities. It was further assumed that this equipment was achieving sufficient levels of pollutant reduction to meet Federal guidelines. Quantities and kinds of pollutants discharged and their effect on the existing environment were examined in detail. However, it must be remembered that as in the case of the scenario, the validity of the impacts will be reduced in proportion to the degree that the actual inhabitants of the industrial park are different from those chosen for the scenario. In both levels of analysis (i.e., the gasifier and the industrial park) impacts are evaluated by comparing the status of the environment before and after the proposed action.

C. Organization

Sections D and E deal with the potential modification to the physical and biological environments brought about by the construction and operation of the gasifier facility and the industries located in the park. Section D treats the impacts from the construction of the gasifier and the industrial park in a single discussion because construction procedures would be the same for both actions. Section E, however, treats the impacts from the gasifier and the industrial park separately. This is because manufacturing processes and wastes generated would be very different. Section F deals with the potential modifications to the socioeconomic environment during construction and operation of the gasifier and industrial park.

D. Construction

1. Potential Modification to the Physical and Biological Environment

a. Soils

Grading and site preparation prior to construction would result in soil disruption and displacement over most of the 173.6 acres. Surficial soils would be disrupted during site leveling and grading, and excavated soils would be permanently displaced. Since development of the industrial park is scheduled to occur over a 7- to 10-year period, impacts on soils would depend upon the extent and timing of construction. Development of the 7.1 acre gasifier site is assumed to occur initially with user-industry gradually beginning construction on the lots adjacent to the gasifier, until the entire park is occupied. Consequently, major upheavals of topsoil during site clearing and excavation will also proceed in this manner.

Once earth-moving equipment has graded and cleared a building lot for construction, the exposed soils would be subject to erosion during periods of rainfall. The extent of erosion would depend upon the number and intensity of rainfall events during the periods that the soils are exposed and upon erosion control and conservation practices used during the construction phase.

By applying the universal soil loss equation to the various soil types on each building site an estimate of soil displacement per lot can be derived. (Appendix D contains an explanation of the universal soil loss equation and its application to construction sites.) While actual tonnage of soil losses would vary depending upon erosion control practices, local climate events, and upon soil structure and slope-length on each lot, the total soil loss derived from the universal soil loss equation can be used as a worst case estimate. The total tonnage of soil lost from each lot is based on the assumption that during the first 6-month period no cover nor management controls are used and that during the following 12-month period each site has been seeded and fertilized. In addition, a downstream sediment basin without chemical flocculants was assumed to be in use during the entire 18-month period.

Based on the soil structure and the slope-length factor, McAfee silt loam (6-12 percent slope) and Lowell silt loam (6-12 percent slope) are the soil types most subject to erosion on the 173.6 acre site. McAfee silt loam soils occur on approximately 10 percent of the gasifier lot and lots numbered

6, 8, and 13; 20 percent of lot number 1; 30 percent of lot number 5; and 50 percent of lot number 14. Lowell silt loam soils (6-12 percent slope) occur on approximately 5 percent of lot number 5; 10 percent of lot number 4; 15 percent of lot number 7; and 30 percent of lot number 6. With the exception of Huntington silt loam which is considered to have minimal erosion potential, the remaining soil types found on the 173.6 acre park site have an equal potential for erosion. These soils include Lowell silt loam (2-6 percent slope), Maury silt loam (2-6 percent slope), and Nicholson silt loam (2-6 percent slope).

The results of applying the soil loss equation to the industrial park site are shown in Table V-1. Total soil lost per lot during the initial 18 months is estimated to range from 37 tons (lot 7) to 170.3 tons (lot 14). An estimated 53 tons of soil would be lost from the gasifier site due to erosion over the 18 months.

Since the actual amount of soil movement due to erosion would depend partially upon the area of soil exposed, a potential scheduling of development and soil losses resulting from this development are shown in Figure V-1. Data presented on Figure V-1 assume that development of the gasifier would be one year into completion before user-industry begins to develop the adjacent sites. After the first year subsequent lot development was assumed to follow at six-month intervals. Further, all soil movement due to erosion was assumed to follow the existing drainage patterns shown in Figure V-2. By estimating the percentage of each lot that drains in a particular direction and the percentage of the soils that would be lost from each lot in that direction, a worst case estimate of soil loss and direction of movement was determined for each year of construction.

The major effect of soil loss is the potential loss of the capacity of the lots to support plant growth. Since grading and site clearing would remove most of the topsoil from each lot, this topsoil would need to be either stockpiled and returned to each site, or replaced before soil stabilization and landscaping can occur. Minor impacts resulting from soil movement, either from erosion or construction equipment, would include some loss of vegetation and wildlife habitat in areas where soils were collected (erosion) or stockpiled (construction equipment).

b. Surface Water

Construction activities at the proposed industrial park site would have a minor effect on the quantity of water in North Elkhorn and Cane Run Creeks. Part of the precipitation which would normally have been absorbed by the soil and vegetation on site would be added to surface runoff from the site. During minor precipitation events, runoff from the site would be absorbed by the disturbed soils and lands adjacent to the park. Presently, minor runoff from the site infiltrates the soil and, to a lesser extent,

Table V-1. Potential Soil Losses from Proposed Site During Construction

Lot (Total Acreage)	Soil Type/% of Lot	Acreage	Total Soil Loss Per Lot During 18-Month Construction Period (6-Month Loss + 12-Month Loss)
Gasifier Lot (7.1 acres)	Maury silt loam (90%)	6.39	52.56 tons
	McAfee silt loam (10%)	0.71	
Miniature Light Bulb Site (15.6 acres)	Huntington silt loam[3] (40%)	6.2	170.3 tons
	McAfee silt loam (50%)	7.8	
	Maury silt loam (10%)	1.6	
Porcelainized Products (18.9 acres)	Maury silt loam (90%)	17.01	140.2 tons
	McAfee silt loam (10%)	1.89	
Wood Laminator (12.4 acres)	Maury silt loam (80%)	9.42	107.2 tons
	Lowell silt loam (20%)	2.48	
Ceramic Title Manufacturer (14.1 acres)	Maury silt loam (40%)	5.64	82.0 tons
	Nicholson silt loam (25%)	3.525	
	Lowell silt loam (25%)	3.525	
	Huntington silt loam (10%)	1.41	
Commerical Heat Treatment (12.9 acres)	Maury silt loam (40%)	5.16	75.1 tons
	Nicholson silt loam (30%)	3.87	
	Lowell silt loam (20%)	2.58	
	Huntington silt loam (10%)	1.29	
Stamping and Metal Fabrication (13.2 acres)	Nicholson silt loam (40%)	5.28	88.5 tons
	Lowell silt loam (40%)	5.28	
	Maury silt loam (20%)	2.64	
Glass Products Manufacture (14.1 acres)	Maury silt loam (30%)	4.23	204.8 tons
	Lowell silt loam (30%)	4.23	
	Lowell silt loam (30%)	4.23	
	McAfee silt loam (10%)	1.41	
Warehouse (Lot 8) (6.7 acres)	McAfee silt loam (60%)	4.02	51.5 tons
	Lowell silt loam (30%)	2.01	
	McAfee silt loam (10%)	0.67	
Warehouse (Lot 7) (6.0 acres)	Maury silt loam (75%)	4.5	49.3 tons
	Lowell silt loam (15%)	0.9	
	Lowell silt loam (10%)	0.6	
Commercial (1) (12.3 acres)	Maury silt loam (70%)	8.61	110.3 tons
	McAfee silt loam (20%)	2.46	
	Lowell silt loam (10%)	1.23	
Warehouse (2) (7.2 acres)	Maury silt loam (70%)	5.04	44.8 tons
	Lowell silt loam (30%)	2.16	

Table V-1. Potential Soil Losses from Proposed Site During Construction (Concluded)

Lot (Total Acreage)	Soil Type/% of Lot	Acreage	Total Soil Loss Per Lot During 18-Month Construction Period (6-Month Loss + 12-Month Loss)
Warehouse (3) (8.1 acres)	Maury silt loam (100%)	8.1	48.1 tons
Commercial (4) (15.3 acres)	Lowell silt loam (80%)	12.24	
	Lowell silt loam (10%)	1.53	124.8 tons
	Maury silt loam (10%)	1.53	
Commercial (5) (8.0 acres)	Maury silt loam (60%)	4.8	
	McAfee silt loam (30%)	2.4	
	Lowell silt loam (5%)	0.4	89.0 tons
	Lowell silt loam (5%)	0.4	

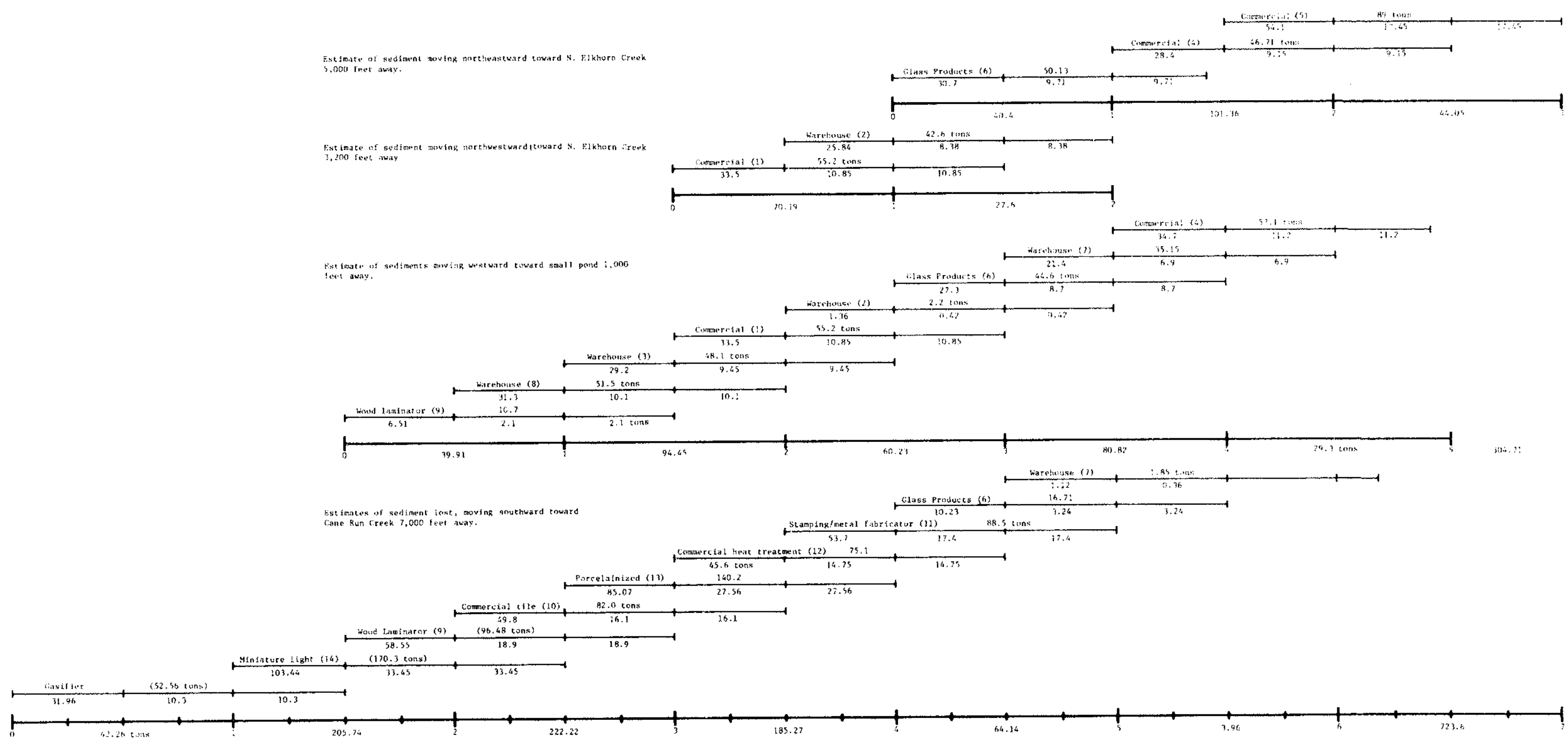


FIGURE V-1
ESTIMATES OF SEDIMENT MOVEMENT FROM THE INDUSTRIAL PARK
SITE DUE TO CONSTRUCTION ACTIVITIES

flows into farm ponds or enters sinkholes before reaching either North Elkhorn or Cane Run Creeks. During major storms, however, all of the precipitation falling on the site cannot be absorbed and some surface runoff does reach these creeks.

Based on the present topography of the 173.6 acre site, surface runoff would move in the general direction indicated on Figure V-2. Since development of the industrial park would occur over a 7- to 10-year period, increases in surface runoff due to site development would vary from year to year. All of the lots within a given area of the park would not contribute runoff at the same rate since some would still be undisturbed and vegetated while others would be under construction.

During the 7- to 10-year construction period, there would be short-term increases in turbidity and in associated dissolved and suspended solids in North Elkhorn and Cane Run Creeks, particularly during and immediately after periods of heavy rainfall. Potential pollutants released from the construction sites and access roads would include sediments, inorganic and organic matter from decayed material, leachates from construction materials, and oils and grease from construction equipment and roadways. Sediment would be the major pollutant.

In order to determine the potential increase in sediment loading to North Elkhorn and Cane Run creeks, a distance factor was applied to the estimated soil losses from each site. With the exception of the sediment controls indicated in the soil loss equation (see Table V-1), no other sediment controls were assumed. Therefore, the amount of sediment reaching each receiving stream would represent a worst case condition. Table V-2 presents the potential amount of sediment that would reach Cane Run and North Elkhorn creeks from each of the natural drainage areas on site, and an estimate of the worst case sediment increase for each stream at various flow rates.

During low flow, i.e., 50 cubic feet per second (cu ft/sec), the sediment load carried by North Elkhorn Creek would increase by 0.32 milligrams per liter (mg/l) due to sediment entering the stream from the northeastern corner of the industrial park. The sediment load of North Elkhorn Creek would also increase by 0.24 mg/l due to sediment entering the stream from the northwestern portion of the park site. Assuming both basins were contributing sediment at the maximum rate at the same time, the North Elkhorn Creek sediment load would increase by 0.6 mg/l. When compared to the total suspended solids load measured by Dames and Moore during July 1977 (11.0 mg/l), this would represent an increase of approximately 5 percent. At higher flow rates, the dispersion rate of the sediment in the water column would increase and the suspended sediment load contributed from construction would be lower.

There are no flow data or suspended sediment data for Cane Run Creek. However, based on the calculated worst case increase of sediment loading (see Table V-2), the normal sediment load of Cane Run Creek would increase by a maximum of 3.2 mg/l during flows of 10 cfs at a sediment input of 174.1 lbs per day. This combination of factors, however, is unlikely during most of the year.

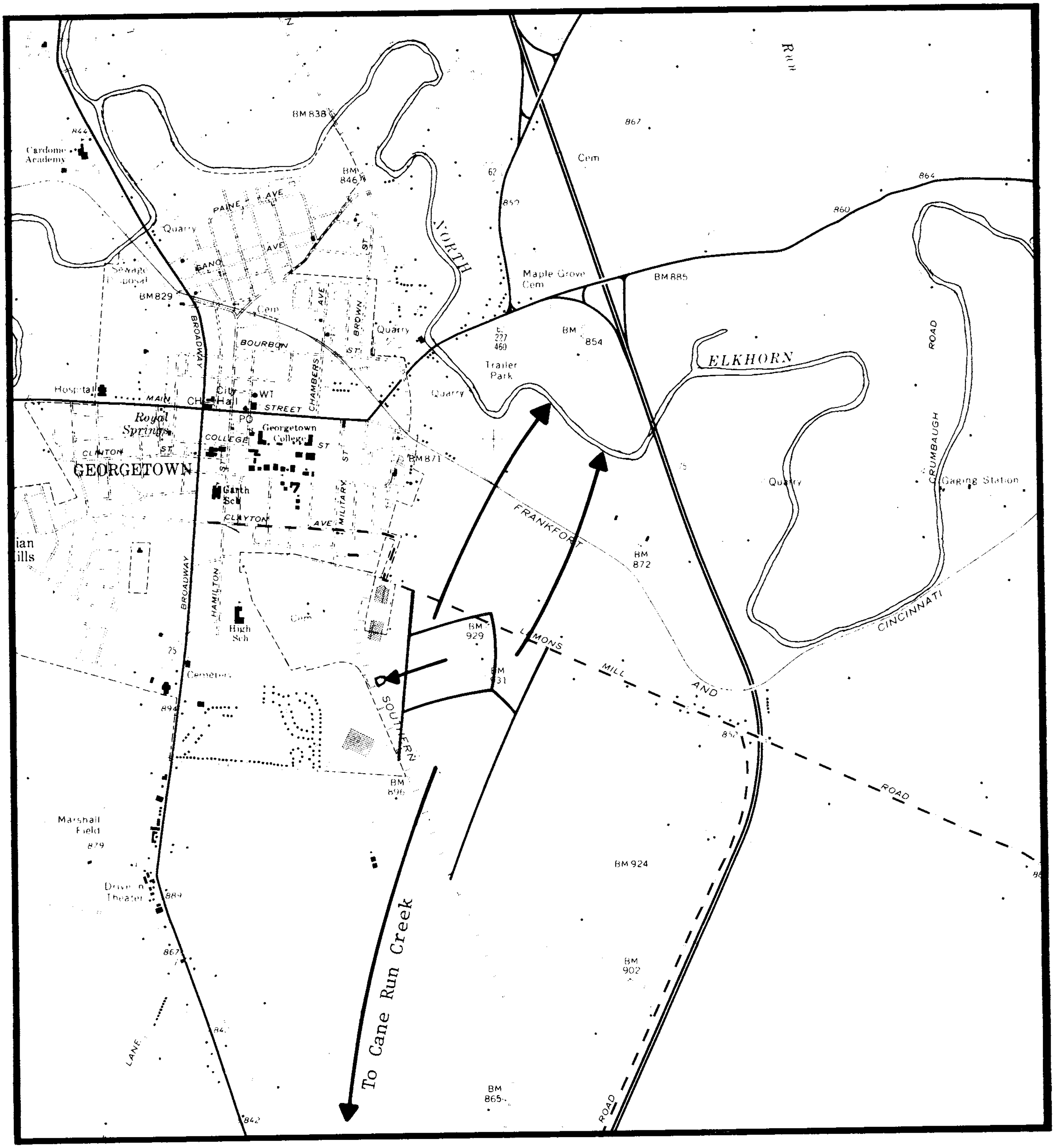


FIGURE V-2
DIRECTION OF RUNOFF FLOW
DURING RAINFALL EVENTS

Table V-2. Sediment Entering Surface Waters

YEAR	At Northwestward End (3200 feet $D^{-0.22}$ = .169)					FLOW		SEDIMENT INCREASE
	TONS	$D^{-0.22}$	TONS/YEAR	LBS/DAY	MG/DAY	CFS	LITERS/DAY	
1	70.19	0.169	11.9	64.9	29,438,640	50	122,342,400	0.24 mg/l
						100	244,684,800	0.12 mg/l
						250	611,712,000	0.05 mg/l
						500	1,223,424,000	0.02 mg/l
2	27.6	0.169	4.7	25.6	11,612,160	50	122,342,400	0.09 mg/l
						100	244,684,800	0.05 mg/l
						250	611,712,000	0.02 mg/l
						500	1,223,424,000	0.009 mg/l

YEAR	At Northeastward End (5000 feet $D^{-0.22}$ = 0.154)					FLOW		SEDIMENT INCREASE
	TONS	$D^{-0.22}$	TONS/YEAR	LBS/DAY	MG/DAY	CFS	LITERS/DAY	
1	40.1	0.154	6.2	33.8	15,331,680	50	122,342,400	0.12 mg/l
						100	244,684,800	0.06 mg/l
						250	611,712,000	0.025 mg/l
						500	1,223,424,000	0.012 mg/l
2	101.36	0.154	15.6	85.5	38,782,800	50	122,342,400	0.32 mg/l
						100	244,684,800	0.16 mg/l
						250	611,712,000	0.06 mg/l
						500	1,223,424,000	0.03 mg/l
3	44.05	0.154	6.8	37.2	16,860,746	50	122,342,400	0.14 mg/l
						100	244,684,800	0.07 mg/l
						250	611,712,000	0.03 mg/l
						500	1,223,424,000	0.01 mg/l

YEAR	Sediment to Cane Run Creek (7000 feet away)					FLOW		SEDIMENT INCREASE
	TONS	$D^{-0.22}$	TONS/YEAR	LBS/DAY	MG/DAY	CFS	LITERS/DAY	
1	42.26	0.143	6.043	33.1	15,014,160	10	24,468,480	0.6 mg/l
						50	122,342,400	0.1 mg/l
						100	244,684,800	0.06 mg/l
						250	611,712,000	0.02 mg/l
2	205.74	0.143	29.42	161.1	73,074,960	10	24,468,480	2.98 mg/l
						50	122,342,400	0.6 mg/l
						100	244,684,800	0.3 mg/l
						250	611,712,000	0.1 mg/l
3	222.22	0.143	31.8	174.1	78,971,760	10	24,468,480	3.2 mg/l
						50	122,342,400	0.6 mg/l
						100	244,684,800	0.3 mg/l
						250	611,712,000	0.1 mg/l
4	185.27	0.143	26.5	145.2	65,862,720	10	24,468,480	2.7 mg/l
						50	122,342,400	0.5 mg/l
						100	244,684,800	0.3 mg/l
						250	611,712,000	0.1 mg/l
5	64.14	0.143	9.2	50.3	22,816,080	10	24,468,480	0.9 mg/l
						50	122,342,400	0.2 mg/l
						100	244,684,800	0.1 mg/l
						250	611,712,000	0.04 mg/l
6	3.96	0.143	0.6	3.1	1,406,160	10	24,468,480	0.06 mg/l
						50	122,342,400	0.01 mg/l
						100	244,684,800	0.006 mg/l
						250	611,712,000	0.002 mg/l

Due to the distance involved between the closest points from the park site and either Cane Run Creek or Elkhorn Creek, increases in sediment loading and transport of other potential construction related pollutants are unlikely to have a major impact on these streams. Increases in turbidity and suspended sediment loading would be temporary and related to major rainfall events. The overall quality of water in both streams is expected to remain in its present state as a result of construction.

If allowed to go uncontrolled, sediment eroding from the western portion of the park site and moving towards a small pond approximately 1000 feet away from the site (see Figure V-2) could cause this pond to fill (worst case) or be reduced in size due to sedimentation. Since there is no constant "downstream" current in this small pond, any sediment entering the water would be deposited rapidly.

c. Groundwater

The major impact on groundwater during construction would be increases in the sediment load of Royal Spring. This would occur during rainfall events and be a function of how much earth had been disturbed on the site at that time. Removal of ground cover would increase this effect.

As a worst case, it is possible to assume that 30 percent of the disturbed sediment would be lost to groundwater through runoff into sinkholes and recharge to Royal Spring from flow captured from Cane Run Creek. Because there are numerous sinkholes located in the area, it is not possible to apply a distance factor and calculate the amount of sediment entering each sinkhole. Consequently, the figures calculated for amount of sediment entering North Elkhorn Creek, Cane Run Creek and the pond to the southwest will be used in this calculation. Results of this exercise are shown in Table V-3.

Table V-3. Sediment Entering Groundwater Systems

Year	Lbs of Sediment/Day	mg of Sediment/Day	Flow of Royal Spring mgd	Flow of Royal Spring 10^6 liters/Day	Sediment Increase mg/l
1	131.8	59,837,000	0.5	1.9	31.5
			10.0	38.0	1.6
			55.0	208.0	0.3
2	272.2	123,578,000	0.5	1.9	65.0
			10.0	38.0	3.3
			55.0	208.0	0.6
3	211.3	95,930,000	0.5	1.9	50.5
			10.0	38.0	2.5
			55.0	208.0	0.5
4	145.2	65,920,000	0.5	1.9	34.7
			10.0	38.0	1.7
			55.0	208.0	0.3
5	50.3	22,836,000	0.5	1.9	12.0
			10.0	38.0	0.6
			55.0	208.0	0.1
6	3.1	1,407,000	0.5	1.9	0.7
			10.0	38.0	0.04
			55.0	208.0	0.01

If Royal Spring were at low flow conditions, 0.5 mgd, there would be very significant increases of suspended solids. During the first four years of construction Royal Spring would be in violation of water quality standards for total suspended sediment.

If spills of liquids were to occur during construction of the gasifier or other facilities to be housed in the park, it is probable that these substances would appear in Royal Spring. Whether or not these substances would have a detrimental effect on Royal Spring as a source of drinking water depends upon their chemical composition, concentration in the water supply, and capability of water treatment plant to remove them.

An unlikely but possible occurrence would be blockage of drainage channels during construction. If a major channel does exist under the industrial site, it is deeper than 830 feet above mean sea level (Thrailkill, 1977). This is 40 feet below the lowest part of the site. Consequently, blockage could occur only if excavations were deeper than 40 feet.

d. Air

The construction of the gasifier and other facilities in the park would create the same air pollutants as any large scale construction activity. Changes in ambient air quality would occur as a result of two major activities; transporting construction materials to the site and movement of heavy equipment on the site during construction. The major emissions would include fugitive dust and vehicle and construction equipment exhaust. The magnitude of the dust emissions would depend upon the time of year, amount of construction going on at once, construction methods employed, and type of control measures used. The duration of emissions would depend upon construction time and could be prolonged for 7 to 10 years.

Table V-4 shows the estimates that have been made as to the kinds and quantities of materials needed to construct the edifices scheduled for the industrial park. It is assumed that all materials would be brought in by truck.

Table V-4. Construction Materials Required

Formed Concrete	730,000 cubic yards
Structural Steel	6,000 tons
Metal Doors and other Metal Products	12,000 tons
Wood	1,136,000 square feet
Roofing	1,172,000 square feet
Glass	1,200,000 square feet
Plaster	1,120,000 square feet
Tile and Resilient Flooring	2,326,000 square feet
Acoustical Ceiling	1,278,000 square feet
Paint	2,300 gallons
Plumbing and Sprinkling System	2,275,000 linear feet
Heating, Ventilation, Air Conditioning Systems	215 tons
Electrical Wiring	1,125,000 linear feet

Source: Information extrapolated from data in Engineering News Record, September 22, 1977.

Based on a general truck capacity of 20 tons or 40 cu. yds. and a cement truck with a capacity of 30 cu. yd., it is estimated that 26,100 truck trips would be necessary. This would be 10-15 trucks per day based upon a 50 week/yr, 5 day/week, 7-10 year schedule. Emission factors for heavy-duty, diesel-powered equipment are given in Table V-5 . Assuming that all trucks make the round trip from Lexington to the industrial site, approximately 50 miles would be traveled per truck per day. If each truck averages 5 miles per gallon of fuel, each truck would use 10 gallons of fuel per day. This would amount to a daily consumption of 100 to 150 gallons of fuel. Based on a 7-10 year construction time, the resulting emissions would range from 20 to 30 lbs of carbon monoxide, 3.3 to 4.3 tons of hydrocarbons, and 33 to 43 tons of nitrogen oxides. These emissions would occur at a constant rate during the round trip between Lexington and Georgetown.

Table V-5. Emission Factors for Heavy-Duty, Diesel-Powered Equipment

	Factors for Given Equipment				
POLLUTANT	Heavy Truck (lb/1000 Gallons)	Wheeled Tractor (lb/hour)	Wheeled Dozer (lb/hour)	Off-Highway Truck (lb/hour)	Miscellaneous (lb/hour)
Carbon Monoxide	225	2.15	0.74	1.34	0.41
Hydro-Carbons	37	0.15	0.23	0.44	0.16
Nitrogen Oxides	370	0.99	5.05	7.63	2.27

Source: U.S. Environmental Protection Agency, 1976, Compilation of Air Pollutant Emission Factors, Second Edition (revised through 1977), AP-42. Research Triangle Park, North Carolina.

Bulldozers, trucks, cranes, backhoes, and welding equipment would be used during construction. Gaseous emissions from this equipment would be primarily carbon monoxide, hydrocarbons, and nitrogen oxides. These emissions would be inevitable and uncontrollable. The actual impact on air quality would be a function of prevailing meteorological conditions and the numbers and types of equipment in operation at one time. Approximate emissions were calculated in the following way. It is assumed that three pieces of heavy-duty equipment (one bulldozer, one truck, and one miscellaneous vehicle) would be on the site daily. Their engines would be running eight hours per day, 5 days per week during the construction period. Daily emissions would be 17.1 lbs of carbon monoxide, 6.6 lbs of hydrocarbons, and 120 lbs of nitrogen oxides. Total emissions over the construction period would be 15-22 tons of carbon monoxide, 5.5-8.2 tons of hydrocarbons, and 105-150 tons of nitrogen oxides. It should be realized, however, that the first set of figures represents average emissions only. True emissions would be higher than these figures during early stages of construction when site preparation, excavation, grading, etc., are in progress. During the later periods of construction, the focus would have moved to inside the building and emissions would decrease.

If incineration of the vegetation existing on the site is necessary this too would contribute to uncontrolled air emissions. These emissions would occur subsequent to clearing of each lot and would be of short duration. It has been estimated that 49 tons of vegetation would be cleared from the entire site. Incineration of this vegetation would result in emissions of 833 lbs of particulate, 6860 lbs of carbon monoxide, and 1176 lbs of hydrocarbon.

e. Noise

The Occupational Safety and Health Administration (OSHA) has published regulations to provide protection against effects of noise exposure in the work place (29 CFR 1910.95). Noise levels of 90 dBA are permissible during an eight-hour period. Dames and Moore measured ambient noise levels during the summer of 1977 (see Chapter III). They also estimated noise levels that would result from construction of the coal gasification facility. By estimating the type of construction equipment to be used, noise emission levels, and usage factor (percentage of time equipment is in noisiest mode), a noise level of 74 dB at 1000 feet from the center of the site was computed. The effect this would have on the ambient noise levels measured at the five sites is shown in Table V-6. The greatest changes would be at sites 2 and 3 where an increase of 7 dBA is expected. At no time would the OSHA standards be violated.

Table V-6. Construction Sound Levels

Location	Background Ambient (dBA)			Construction Ambient (dBA)			Change in Ambient (dBA)		
	L_d[1]	L_n[2]	L_{dn}[3]	L_d	L_n	L_{dn}	L_d	L_n	L_{dn}
1	60.5	52.0	61.1	64.0	52.0	63.3	+3.5	0	+2.2
2	54.1	52.0	58.8	61.2	52.0	61.7	+7.1	0	+2.9
3	50.2	47.0	54.0	57.2	47.0	57.1	+7.0	0	+3.1
4	63.0	45.0	61.3	67.2	45.0	65.3	+4.2	0	+4.0
5	68.5	54.0	67.2	69.8	54.0	68.4	+1.3	0	+1.2

L_d = day averages
L_n = night averages
L_{dn} = 24-hour averages

Source: Dames and Moore, 1977

It is expected that construction of other facilities in the industrial park would create similar noise levels. These noise levels would continue as long as construction lasts, or approximately 7-10 years.

f. Solid Waste

There would be two sources of solid waste, cleared vegetation and construction rubble. The former would be generated at the beginning of construction activities and amount to a small volume. It would consist of some trees on the site and residual crop growth such as cornstalks. It would be disposed of by incineration. Air emissions resulting from this incineration are discussed above.

Construction rubble would consist of wrapping paper, nuts and bolts, boxes and cans, broken and leftover materials, etc. Construction of the gasifier would require 21 persons working 66 weeks. Each worker would generate approximately seven pounds of refuse per day (Anderson, 1972) or approximately 24 tons during the construction of the gasifier. Rubble generated over the construction lifetime of the entire industrial park was calculated using the same building rate figures as those derived from construction of the gasifier, i.e., 257 sq. ft. of building area per man-year. The total building area in the park would be approximately 700,000 sq. ft. Two hundred sixty five man-years would be needed to construct the specified buildings. This rate of construction would require 27-38 people/ day over the 7-10 year period. This work force would generate approximately 235 tons of refuse.

g. Terrestrial Ecosystem

Impacts to the terrestrial ecosystem resulting from construction activities would include vegetation removal and subsequent loss of wildlife food, cover, and habitat. During the 7- to 10-year park development period, most of the existing vegetation would be removed from the 173.6 acres as the lots are cleared and graded for building sites, parking lots, and access roads. While landscaping efforts after construction would partially mitigate impacts to the terrestrial ecosystem, the resulting vegetation would be less favorable to a diverse wildlife fauna.

Site clearing and preparation is expected to occur on the 7.1 acre gasifier site initially and then to proceed in a general northward direction as user-industry occupies the remaining acreage. Since development of the entire park would span a 7- to 10-year period, all of the area would not be subjected to construction activity at one time. During stages of park development, some lots may be under construction (cleared), untouched (in natural vegetation), or replanted (landscaped). While most of the existing vegetation would be removed during the construction phase, some woodlot and fencerow vegetation may be retained as a buffer by lots which border lands adjacent to the park.

The proposed gasifier lot is composed of approximately 5.8 acres of cropland and 1.3 acres of woodlot. Site preparation (grading and clearing) would remove approximately 90 percent of the existing vegetation which includes all 5.8 acres of cropland vegetation (remnant crop species and weeds) and 0.6 acres of woodlot vegetation (overstory trees such as black cherry, hackberry, black walnut, locust, and understory shrubs). The remainining 0.7 acres of woodlot vegetation would be left undisturbed as a buffer along the southern and western boundaries of the gasifier lot.

The 5.8 acres of cropland on the proposed gasifier lot has been planted in corn in past years. Assuming that this acreage is capable of meeting the 1975 countrywide production figure of 69.5 bushels of corn per acre, then approximately 403 bushels of potential corn production would be lost. If the 5.8 acres had been allowed to remain fallow for several years prior to construction, natural succession would result in a variety of grasses and weed species. Assuming an annual productivity of 3.0 tons per acre for this type of vegetation, approximately 17.4 tons of primary plant production would be lost as potential food, cover, and habitat for wildlife. In addition, removal of 0.6 acres of woodlot vegetation would result in an additional loss of 2.1 tons of hardwood and shrub productivity.

Table V-7 gives a description of current land use and acreage by type of use for the 173.6 acres of the proposed industrial park. It was assumed that all vegetation would be removed during clearing and grading activities except for 9.7 acres of fencerow and 3.5 acres of woodlot vegetation along the western, southern, and eastern boundaries. In addition, Table V-7 estimates the amount of acreage that would be permanently removed due to building construction, parking lots, and roads (64.1 acres) and the amount of acreage that would be revegetated (landscaped) once construction has been complete (96.3 acres). The estimate of acreage that would be lost to impervious surface was based on the assumption that 40 percent of each lot would be covered by buildings and paved areas.

Once development of the industrial park has begun, it is likely that agricultural activity would cease. Agricultural productivity lost to total park development is shown in Table V-8. Annual production losses would include 4,879 bushels of corn, 95 tons of hay, and 3.6 tons of burley tobacco.

Assuming that the total acreage of cropland (129 acres) is allowed to undergo succession and returns to old field type vegetation, net primary production is estimated to be 387 tons (3.0 tons per acre). This productivity would be lost incrementally over the 7- to 10-year development period. In addition, 49 tons of mixed shrub (woodlot and fencerow vegetation) would be lost due to construction activities (see Table V-9).

Table V-7. Land Use and Estimate of Acreage Affected by Construction

Current Land Use	Acreage	Acreage Disturbed Due to Construction	Acreage Lost to Impervious Surface*	Vegetated Acreage (Landscaped)	Acreage Left in Natural Vegetation
Corn Fields	76.4	76.4	30.5	45.9	-
Pasture/ hayfields	50.3	50.3	20.1	30.2	-
Fencerow	24.3	14.6	5.8	8.9	9.7
Woodlots	8.7	5.2	2.1	2.1	3.5
Farmstead	5.2	5.2	2.1	3.1	-
Roads	5.2	5.2	2.1	3.1	-
Tobacco fields	3.5	3.5	1.4	2.1	-
Total	173.6	160.4	64.1	96.3	13.2

*Based on the assumption that 40 percent of the acreage disturbed during construction activity will be covered by impervious surfaces.

Source: Adapted from Dames and Moore, 1977.

Table V-8. Annual Agricultural Production Lost by Potential Conversion to Industrial Development

Crop	Acreage	Production Rate	Total Production Lost
Corn	76.0	69.5 bushels/acre-year	4,879 bushels/year
Hay	50.0	1.9 tons/acre-year	95 tons/year
Burley tobacco	3.0	1.2 tons/acre-year	3.6 tons/year

Source: Dames and Moore, 1977

Table V-9. Net Primary Productivity Lost Due to Site Clearing and Grading

Vegetation Type	Total Acres	Acreage Disturbed	Production Rate	Productivities Lost
Old Field[1]	129	129	3.0 tons/acre	387 tons
Mixed Shrub[2]	33	19.8[3]	3.5 tons/acre	49 tons

[1]Land formerly in corn, hay and tobacco (Table V-7) was assumed to have been abandoned for two years, and allowed to follow natural successional pattern.

[2]Mixed shrub includes woodlot and fencerow vegetation.

[3]13.2 acres of woodlot/fencerow are estimated to be left as buffers along the industrial park boundaries.

Source: Odum, E.P., 1960.
Whittaker, R.H., 1961.

Table V-10. Estimate of Wildlife Forced to Emigrate from the 173.6 Acres of the Proposed Industrial Park Site

Carry Capacity	Acreage	Number of Migrants
10 small mammals/acre	173.6	1740
1 rabbit/acre	173.6	174
1 squirrel/acre	8.7*	9
6 songbird/acre	173.6	1042
0.25 gamebirds/acre	173.6	44

*Woodlot

Source: Kendeigh, 1961.
Giles, 1969.

The major effect of vegetation loss would be the subsequent loss of living space, food, cover, nesting and breeding areas for wildlife species. Despite the absence of highly diversified fauna on the industrial park site due to the limited quantity and diversity of vegetative cover and the site's urban location, wildlife species found on site would be adversely affected by vegetation removal. Species of recreational and commercial importance that would be adversely affected include fur bearers (oppossum, skunk, raccoon, and fox) and small game species (mourning dove, quail, rabbit, and squirrel).

An estimate of the number of individuals that would be forced to migrate due to loss of habitat once all lots have been developed is presented in Table V-10. These estimates are based on average carrying capabilities of the mixed habitat of the 173.6 acres.

Because most suitable habitats on lands adjacent to the park site are likely to be occupied at or near their carrying capacities, the level of competition for space, food and other life requirements would be high. In addition, once forced into occupied, unfamiliar territories, the animals may be more susceptible to predation, disease, and adverse weather conditions. Habitat loss, increased competition, and stress would result in fewer attempts by the displaced animals to nest and raise young.

Increased noise and human disturbance may result in the disruption of predator-prey relationships, mating behavior, and reproduction success of wildlife species inhabiting the park site area (U.S. Senate, 1972). These impacts would decrease in severity as the distance from the disturbance increases. Development of the industrial park site would create favorable habitat for urban-tolerant species of wildlife including the rock dove (pigeon), starling, norway rat, and house mouse.

h. Aquatic Ecosystem

Impacts to the aquatic environment from construction activity on the proposed industrial park site would be minor and temporary. There would be short-term increases in turbidity and associated dissolved and suspended solids in North Elkhorn and Cane Run Creeks, particularly during periods of heavy rainfall. However, the anticipated worst case conditions are not severe enough to cause a major change in either the water quality or in the aquatic fauna of either stream.

Water quality in North Elkhorn Creek has been cited as remaining the same, or slightly deteriorating when compared to data collected in previous studies. Cane Run Creek has been stressed by residential and industrial pollution (Dames and Moore, 1977). While no data are available on the aquatic fauna of Cane Run Creek, it is expected to be similar to the fauna found in North Elkhorn Creek.

Samples collected from North Elkhorn Creek indicate a macroinvertebrate fauna composed principally of fly larvae (Diptera) (28 percent) and Oligochaete worms (Annelida) (66 percent)*. While individuals

*Note: Percent composition based on total number of Diptera (416) and Oligochaetes (974) collected from all three stations.

of both of these types of organisms are found in a variety of situations ranging from clean to heavily polluted water, their dominance generally suggests stressed water quality. Organisms generally indicative of clean water conditions such as mayfly (Ephemeroptera), some damselflies (Odonata), and some beetles (Coleoptera) are poorly represented in North Elkhorn Creek. The amounts of sediment calculated as a worst case condition would not alter this community composition or result in loss of macroinvertebrates as food items for fish.

Good to moderate fisheries can be maintained in water that normally contains 25-80 mg/l suspended solids. Waters that contain less than 25 mg/l or between 80 to 400 mg/l are unlikely to support good freshwater fisheries (Federal Water Pollution Control Administration, U.S. Department of the Interior, 1968). Increases in suspended solids from sediment resulting from site construction would not be significant enough to cause an increase or decrease in the number of fisheries of either Cane Run or North Elkhorn Creeks.

i. Endangered and Threatened Species

There are no known endangered or threatened species of plant or animal life (as classified by the Department of Interior) which occur on the proposed 173.6 acre industrial park site. Therefore, construction activity would have no impact on Federally protected species.

The turkey vulture is the only species considered by the National Audubon Society as threatened that has been reported from the site. While the open fields of the site provide a portion of the feeding range of this species, no nesting sites occur. Construction activity over the proposed 7-10 year period would eventually remove the entire 173.6 acre tract from the feeding range. This would result in a minor impact to the turkey vulture since its feeding range extends over several hundred square miles.

2. Potential Modification to the Socioeconomic Environment

Construction of the gasifier would require 21 persons for approximately 1.5 years. Construction of the industrial park would require 35 persons for 7-10 years. Persons with varying skills would be required including heavy equipment (cranes, bulldozers, backhoes) operators, bricklayers, electricians, plumbers and carpenters. Individuals with these skills exist within the Georgetown/Scott County labor force. The extent that their skills are unutilized or underutilized and their willingness to undertake new jobs cannot be determined. However, estimates as of April, 1977 indicate that the available labor supply numbers approximately 3600. Additionally, 47 percent of Scott County's residents are employed outside the county. Assuming 50 percent of these out-commuters would prefer to work in Scott County, approximately 1000 more persons would become available. These two sources of labor are more than adequate to meet the labor demands which would be imposed during the construction of the gasifier and the industrial park. Since the labor demands could be met by in-county residents, no additional stress would be placed on town or county services or utilities. No socioeconomic impacts are expected to result from construction of the gasifier and industrial park.

E. Operation

1. Potential Modification to the Physical and Biological Environment

a. Soils

The industrial park has been zoned as light industry and outside storage of materials would not be allowed. However, an additional use permit may be issued by the Board of Adjustment to permit outside storage. To the degree that outdoor storage would be permitted soils may be affected. The clay component of soils may undergo ion exchange and take up contaminants from materials (especially metals) which they contact. The extent of this uptake would depend upon the type of substance stored outside and the protective measures taken to prevent its contact with the soil.

b. Surface Water

The buildings and associated paved areas would increase the amount of surface runoff by reducing infiltration. Present plans are to divert all runoff from impervious surfaces to storm sewers and ultimately into North Elkhorn Creek. This diversion of runoff would result in a decrease in the amount of runoff to adjacent areas, and a minor loss of potential recharge to groundwater and ponds within the drainage area. Presently, areas around some sinkholes (particularly in the southern portion of the industrial part) flood during major precipitation events due to slow infiltration. Redirection of surface water runoff would decrease the potential for "ponding" around these sinkholes during periods of heavy precipitation.

The increased hard surface runoff from the park which would be directed to North Elkhorn Creek is not expected to create a major impact on the creek. Runoff from the site eventually flows to North Elkhorn Creek either by direct surface runoff into North Elkhorn or Cane Run Creeks, or by subsurface drainage. By channeling the runoff (storm sewers), a direct route to North Elkhorn Creek would be provided and the implied impact would be a more rapid increase of water into the creek. During minor storm events, stream flow may increase slightly, but this is not expected to cause any impact. During major storm events the channeled runoff would act as a source of increased flow below Georgetown. Since the amount of hard surface area (69 acres) is only a small part of the entire drainage basin, the redirection of runoff from the park is not expected to create a change in the flooding potential.

Runoff from the industrial park would contain pollutants typical of urban runoff which includes higher concentration of BOD (biological oxygen demand), nutrients, and suspended and dissolved organic and inorganic solids. This runoff would be diverted to storm sewers and eventually discharged into

North Elkhorn Creek. During periods of heavy rainfall, pollutants which have collected on the paved surfaces would be flushed rapidly into North Elkhorn Creek. Concentrations would be highest during the first few hours of precipitation and would gradually decrease with time. While it is not possible to calculate the concentration of pollutants entering the waters from this source, potential impacts to the water include decreased dissolved oxygen [oxygen in water used for chemical (COD) and biological (BOD) reactions], increases in suspended solids and dissolved organic and inorganic materials, and increases in heavy metals. The amount actually entering the waterway would depend upon rainfall events (frequency and duration) and amount of materials available to be flushed. The impact of these inputs would depend upon dilution rate of the receiving stream and upon deviation of the input. Rapid dilution (high flow condition) may result in the input having no noticeable impact.

Treatment and discharge of these wastewaters may be handled in one of two ways. Application may be made by each user-industry to the Environmental Protection Agency for an NPDES permit. This permit would require the industry to install best practicable control technology and meet new source performance standards as designated for each manufacturing process in regulations promulgated in accordance with PL 92-500. If the permit is granted the user-industry would be allowed to discharge treated wastewaters directly into surface waters.

The second possible way to handle industry wastewaters is to discharge them into the Georgetown municipal wastewater treatment system. The level of pollutant reduction which would be required in this case would be imposed by the Georgetown sewer authority. The Georgetown system, which has a rated capacity of 3 million gallons per day (mgd) currently handles about 1 mgd during dry weather flows. Although the rated capacity of the plant is 3.0 mgd, actual treatment capacity is approximately 2.0 mgd (Proctor, Davis, & Ray, 1977). Influent of more wastewater than 2.0 mgd would result in the discharge of wastewater that would not comply with Public Law 92-500. During wet weather flows, the rate of wastewater passing through the system may be as high as 2.7 mgd. The gasifier is expected to return 75 percent of the raw water used to the wastewater treatment facility. This would result in an increase of approximately 54,000 gallons of wastewater per day. In addition user-industries are expected to return 1,036,000 gallons of industrial wastewater and 25,000 gallons of sanitary wastes per day for treatment. While the total increase from the industrial park plus gasifier (1,115,000 mgd) would not exceed the plant's capacity during dry weather flows, it would exceed rated capacity during wet weather flows.

Other potential impacts to surface water would result from accidental spills of the coal pile retention pond, a rupture in the gasification system and spills of industrial wastes. The possibility of contamination of North Elkhorn Creek due to retention pond leakage was assessed using the following assumptions: 1) a low flow condition in the creek of 10 cfs (0.5 mgd); 2) a catastrophic event causing discharge of all water in the retention pond (14,000 gallons) in one day; and 3) the retention pond water reaching the creek at the highest concentrations of elements characteristic of coal pile drainage as listed by Chu and others, 1976.

The predicted concentration of pollutants in North Elkhorn Creek after a spill are shown and compared to State and Federal water quality standards in Table V-11. While manganese is the only constituent which would exceed Federal standards, it is likely that the iron concentration would also create a nuisance condition. Both iron and manganese impart an objectionable taste to water and stain laundry and plumbing fixtures.

A rupture in the gasification system was also assessed on the basis of low-flow conditions in North Elkhorn Creek and the occurrence of a catastrophic event when all pollutants were released simultaneously. If this rupture were to occur, ash (8640-14,400 lbs/day), sulfur (1920-3840 lbs/day), tar (567-1200 gal/day), and cyanide and ammonia compounds (288 lbs/day) would be released to the environment. Ash and sulfur are insoluble, and their addition to a water body would represent an increase in suspended solids. Tar and oil would not disseminate vertically through the water column but spread out as a thin layer on the surface of the stream. They may also coat surface debris or plants or come to rest on the stream bank. If sodium cyanide should form, it is highly soluble and cyanide would be released into the water column. Ammonia and ammonium compounds are generally quite soluble and because ammonia is a little more basic than water, pH changes may occur.

If sulfur and ash were added to North Elkhorn Creek the suspended solids content would increase by 197-324 mg/l. The projected oil and tar release would result in a concentration of 88-186 ppm. Cyanide and ammonium compounds together would result in total dissolved solids increase of 5.11 mg/l. If they are present in the same ratio as in the untreated product gas, 3.14 mg/l may be attributed to cyanide compounds and 1.97 mg/l may be attributed to ammonia compounds. Both the suspended solids water quality standard of 80 mg/l and the cyanide water quality standard of 0.025 mg/l would be violated. Although no standard exists for ammonia, existing levels, 0.26 mg/l, would be increased by an order of magnitude.

An accidental spill of untreated waste from user-industries would cause minor impacts to existing water quality in North Elkhorn Creek (see Table V-12). These predicted increases would occur only if all industrial wastewaters were released at once. While such an event is unlikely it does present a worst case estimate. A spill of untreated wastewater from the industrial park would result in pollutant concentrations shown in Table V-12. Since no ambient data were available for the concentration of

BOD, oil, zinc, cyanide, nickel, copper, nitrogen or phenols in North Elkhorn Creek, no resulting concentrations were calculated. Both State and Federal standards would be exceeded for barium, iron and lead, State standards for total dissolved solids and fluoride would be exceeded, and Federal standards for total suspended solids would be exceeded.

All user-industries and the gasifier would be required to comply with Kentucky Law 401 KAR 5:015 in the event of an accidental spill, and would be required to give point of discharge, nature of the material discharged, quantity of material discharged and an assessment of possible environmental impacts. While the values calculated in the previous table assume a worst case situation in that the entire volume of wastewater from all industries was assumed to spill at the same time, it is more likely that an accidental spill would involve only one industry.

Since water in North Elkhorn Creek is used to supplement the Georgetown drinking water supply (Royal Spring), accidental spills or discharges into the Creek above the supply intake could result in contamination of the drinking supply. Similarly, since Cane Run Creek loses water to groundwater which flows eventually into Royal Spring aquifer, contamination of Cane Run Creek would potentially result in contamination of Royal Spring. Under normal circumstances and planned drainage systems, neither wastewater nor runoff would be expected to create any significant level of contamination in Georgetown's water supply. In the event of an accidental spill, however, the water supply could be contaminated by increased phenols, oils, fluorides, both chemical and biological oxygen demanding materials, metals and nutrients.

c. Groundwater

There are two major concerns about the effect of the gasifier and the industrial park on the groundwater. They are loss of recharge volume to Royal Spring and contamination of Royal Spring. The following discussion assumes that the entire industrial park lies within the recharge area. In reality the northeast and northwest corners drain into North Elkhorn Creek.

Paved areas such as parking lots would intercept precipitation to the aquifer and divert it to storm sewers. It has been estimated (Thrailkill, 1977) that if 25 percent of the site is paved or in some other manner removed from interaction, the yearly volume of water to the spring would be reduced by 0.1 cfs. Assuming an average spring flow of 25 cfs this would be a reduction of 0.4 percent. Mason Hanger-Silas Mason Co. (1976), assuming a 4 mgd flow of the aquifer, estimated that a reduction of 50,000 gpd (1 percent) would result under the same circumstances. Both of these estimates indicate a negligible effect of removing 25 percent of the land surface in the industrial park from the recharge area.

At the gasifier site, potential sources of contamination are coal storage and handling. Spillage of coal is expected, but daily cleanup would lessen the potential contamination of runoff. Runoff

Table V-11. Potential Pollutant Concentrations in North Elkhorn Creek After an Accidental Spill of the Retention Pond Containing Coal Pile Drainage

Parameter	Ambient Concentrations in North Elkhorn Creek[1] (mg/l)	Potential Concentrations of Coal Pile Drainage[2] (mg/l)	Potential Concentrations in Creek After Spill (mg/l)	Standards for Water Quality (mg/l)
Calcium	72.7	350	73.8	N.L.[3]
Dissolved Solids	338.0	3200	377.3	750[4]
Chloride	33.18	0	33.1	250[6]
Hardness	220.0	600	220.8	N.L.
Magnesium	16.31	1.2	16.3	N.L.
Potassium	-	0.5	0.00005	N.L.
Silicon	-	91	0.01	N.L.
Sodium	50.0	4.1	49.9	N.L.
Sulfate	23.0	2600	27.0	250[6]
Suspended Solids	16.0	810	17.7	80[6]
Aluminum	-	190	0.022	5.0[6]
Arsenic	0.0086	.010	0.0087	0.05[4]
Barium	0.0080	.100	0.0082	1.0[6]
Cadmium	0.0013	.006	0.0013	0.01[5]
Chromium	.0033	.005	0.0033	0.05[5]
Copper	-	0.56	0.00006	1.0[6]
Iron	-	830	0.09	0.3[5]
Lead	0.0031	.023	8.8	0.05[5]
Manganese	0.1660	110	0.2544	0.05[6]
Mercury	<0.00001	.027	0.00007	0.002[6]
Selenium	0.00001	.030	0.00007	0.01[5]
Titanium	-	1	0.0001	N.L.
Zinc	-	3.7	0.0004	5.0

[1]Dames and Moore, 1977. July 1977 Water Quality Results from Station 3.

[2]Chu and others, 1976.

[3]No maximum limits by any standards.

[4]Kentucky Department of Natural Resources and Environmental Protection, 1975.

[5]Both Federal and State Standards.

[5]U.S. EPA, 1975.

Table V-12. Potential Pollutant Concentrations in North Elkhorn Creek Resulting from an Accidental Spill of Pretreated Industrial Waste[1]

Parameter	Concentration in Waste (mg/l)	Ambient Concentration in North Elkhorn Creek (mg/l)	Resulting Concentration in North Elkhorn Creek (mg/l)	Standards for Water Quality (mg/l)
Total Suspended Solids	3.12	16.0	14.11	80.0[3]
Oil	1.07	-	-	N.L.*
COD	1.50	-	-	N.L.
Fluoride	1.97×10^{-3}	0.43	0.37	1.0[2]
Ammonia	5.88×10^{-3}	<0.26	<0.22	
Lead	6.17×10^{-2}	.0031	.0112	0.50[4]
Zinc	9.08×10^{-2}	-	-	5.0[3]
Barium	4.2×10^{-2}	.011	.153	1.0[4]
Cyanide	4.86×10^{-3}	-	-	0.0025[2]
Iron	1.07×10^{-1}	.1090	.1086	0.3[4]
Nickel	3.84×10^{-2}	-	-	-
Copper	3.84×10^{-3}	-	-	1.0[2]
Phosphate	1.68×10^{2}	1.02	.88	N.L.

[1]Assumes a low flow condition of 10 cfs (6,462,720 gal/day) and all pretreated wastewater reaching North Elkhorn Creek without any loss during transfer.
[2]Kentucky Department of Natural Resources and Environmental Protection, 1975.
[3]EPA, 1975.
[4]Both Federal and State Standards.
*N.L. = No limit

Table V-13. Potential Pollutant Concentrations in North Elkhorn Creek Resulting from an Accidental Spill of Untreated Industrial Waste[1]

Parameter	Concentration in Waste (mg/l)	Ambient Concentration in North Elkhorn Creek (mg/l)	Resulting Concentration in North Elkhorn Creek (mg/l)	Standards for Water Quality (mg/l)
Total Suspended Solids	300	16.0	55.2	80.0[3]
Oil	127	-	-	-
COD	605	-	-	-
Fluoride	1164	0.43	160.4	1.0[2]
Ammonia	3.6	<0.26	2.08	-
Total Dissolved Solids	35	338.0	296.13	750.0[2]
Barium	26	.011	10.48	1.0[4]
Iron	4.2	.1090	94.5	0.3[4]
Lead	0.6	.0031	2.8	0.05[4]
Zinc	2.4	-	-	5.0[3]
Cyanide	6.5	-	-	0.025[2]
Nickel	0.7	-	-	-
Copper	0.8	-	-	1.0[2]
Nitrogen	3.0	-	-	-
Phosphorus	0.7	-	-	-
Phenols	70	-	-	N.L.*

[1]Assumes a low flow condition of 10 cfs (6,462,720 gal/day) and all pretreated wastewater reaching North Elkhorn Creek without any loss during transfer.
[2]Kentucky Department of Natural Resources and Environmental Protection, 1975.
[3]EPA, 1975.
[4]Both State and Federal Standards.
*N.L. = No limit.

from these paved areas would be diverted to the retention pond. Water sprayed on the coal for dust control would also be impounded in the retention pond.

As a worst case of retention pond leakage, it was assumed that Royal Spring would be at its lowest measured flow (0.5 mgd), that the entire volume (14,000 gal) of the pond was released in one day, and that water in the retention pond contained the highest known concentrations of elements from coal pile drainage (Chu, et al., 1976). If this combination of conditions existed, the resulting concentrations of these elements in Royal Spring would be those shown in Table V-14.

Only iron and manganese would exceed water quality standards (EPA, 1975; Kentucky Department of Natural Resources and Environmental Protection, 1975). The unpleasant effects of the increased levels would be aesthetic rather than toxicological. Iron in concentrations greater than 1 or 2 mg/l can cause staining of laundry and porcelain and a bittersweet taste. Manganese causes stains to plumbing and laundry fixtures (American Public Health Association, et al., 1976).

If the gasification system ruptured and the entire volume of untreated wastes was discharged to Royal Spring during low flow conditions, the following concentrations of pollutants would result: 2117 to 3670 mg/l TSS (resulting from sulfur and ash), 1009 to 2101 ppm oil, 36 mg/l cyanide compounds, and 22 mg/l ammonia compounds. These levels would violate all pertinent water quality standards and would severely contaminate Royal Spring, rendering it unpotable.

The greatest potential source of contamination to Royal Spring from the park industries would be spills and accidental release of untreated wastes. Calculated raw waste loads of each of the user-industries are shown in Table V-15. The final potential concentrations of the pollutants if all wastewaters from all facilities were released untreated are shown in Table V-16. Assuming a low flow of 0.5 mgd, the added volume of the untreated wastewater (1.04 mgd) would increase the daily flow of Royal Spring three times or to 1.5 mgd. Resulting concentrations are shown in Table V-17. Total suspended solids, barium, iron, lead, and zinc would exceed water quality standards.

d. Air

(1) Coal Gasification Plant

It is expected that flaring from the coal gasification plant would occur for approximately three consecutive hours per year. The flaring would not be visible, but sulfur oxides (SO_x), nitrogen oxides (NO_x) and trace elements would be released. During these times particulate emissions would amount to approximately 60 lb/hr or 0.09 tons/yr. Based on a NO_x content of 30 lbs per ton of coal NO_x emissions would amount to approximately 0.1 tons/yr. The SO_x emissions would be approximately 0.2 tons/yr based on a sulfur content of 1.25 percent.

Table V-18 presents the results of the concentration calculations for short-duration (10-minute) sampling times as a function of downwind distances. The maximum ground-level concentrations for each

Table V-14. Potential Pollutant Concentrations in Royal Spring After an Accidental Spill of the Retention Pond Contents

Parameter	Ambient Conditions at Royal Springs[1] (in mg/l)	Potential Concentrations of Coal Pile Drainage[2] (in mg/l)	Predicted Concentrations of Water at Royal Springs if Leaked (in mg/l)	Standards for Water Quality (in mg/l)
Calcium	84.4	350	91.6	N.L.**
Dissolved solids	376	3200	452.9	750[4]
Chloride	32.5	0	31.6	250[6]
Hardness (as $CaCo_3$)	251.5	600	261.0	N.L.
Magnesium	2.5	1.2	2.4	N.L.
Potassium	2.8*	0.5	2.7	N.L.
Silicon	6.9	91	9.2	N.L.
Sodium	20.85	4.1	20.4	N.L.
Sulfate	50.3	2600	119.8	250[6]
Suspended solids	1.0	810	23.0	80[6]
Aluminum	1.5	190	6.6	5.0[6]
Arsenic	0.0004	0.01	0.0006	0.05[4]
Barium	0.08	0.1	0.08	1.0[5]
Cadmium	0.0014	0.006	0.002	0.01[5]
Chromium	0.0037	0.005	0.004	0.05[5]
Copper	-	0.56	0.015	1.0[6]
Iron	0.099	830	22.7	0.3[5]
Lead	0.022	0.023	0.022	0.05[5]
Manganase	0.032	110	3.0	0.05[6]
Mercury	0.0009	0.027	0.002	0.002[6]
Selenium	0.00001	0.03	0.0008	0.01[5]
Titanium	0.09*	1	0.11	N.L.
Zinc	0.01*	3.7	0.11	5.0

**No maximum limits by any standards.
[1] Source: Dames & Moore, 1977 except (*) from Faust, 1977, p.20
[2] After Chu and others, 1976
[3] See text for explanation of assumptions and basis of calculations.
[4] Source: Kentucky Department of Natural Resources and Environmental Protection, 1975.
[5] Source: Both Federal and State Standards.
[6] Source: U. S. EPA, 1975.

Table V-15. Raw Wasteloads of User-Industries

Raw Wasteloads (mg/l)	INDUSTRY						
	Glass Products	Light Bulb	Ceramic Tile	Porcelain Products	Heat Treatings	Metal Stampings	Wood Laminator
pH	7.5	8.6	5-12		9.0	8.8	
COD	50	50	30-150		2360	2830	1000
TSS	24	125	500-1000	500-1000	716	1030	838
Oil	10				681	600	
F^-		2800					
NH_3		650					
TDS			20-320				508
Ba			300-500	0.1-12			
Fe			0.04-0.87		14.5	29.3	
Pb			0.55-12.0	0.2-3	2.8	2.8	
Zn			2-400	1-15		10.8	
CN					67.2		
Ni					1.3	5.8	
Cu						8.5	
N							44
PO_4						6.5	1.0
Phenols							1028
Flow Gallons/ Day	300,000	430,360	5,760	29,300	100,000	100,000	No Discharge

Table V-16. Pollutant Concentrations of Combined Volumes of Untreated Wastewaters from Projected User-Industries

Pollutant	Concentration (mg/l)
BOD	605
TSS	300
Oil	125
F^-	1150
NH_3	3.6
TDS	3.5
Ba	2.6
Fe	4.2
Pb	0.6
Zn	2.4
CN	6.5
Ni	0.7
Cu	0.8
N	3.0
P	0.7
Phenols	7.0

Table V-17. Potential Pollutant Concentrations in Royal Spring After an Accidental Spill of Untreated Wastewater from Industrial Park

Parameter	Ambient Conditions Royal Springs[1] (mg/l)	Potential Concentrations of Untreated Wastewater from Industrial Park (mg/l)	Predicted Concentrations in Royal Spring if all Untreated Volumes Discharged (mg/l)	Standards for Water Quality (mg/l)
Dissolved solids	376[1]	35	122	750[4]
Suspended solids	1.0[1]	300	215	80[4]
Barium	0.08[1]	2.6	2.5	1.0[5]
Copper		0.8	0.55	1.0[4]
Iron	0.099[1]	4.2	2.9	1.0[5]
Lead	0.022[1]	0.6	0.45	0.05[5]
Zinc	0.01[2]	2.4	2.5	5.0[4]
COD		605	408	
Oil		127	81	
Fluoride	0.68[1]	1164	785	
Ammonia	0.19[1]	3.6	2.5	
Cyanide		6.5	4.4	
Nickel		0.7	0.46	
Nitrogen		3.0	2.0	
Phosphorus	0.59[1]	0.7	0.66	
Flow (l/day)	1,895,000	3,924,421	5,819,421	

[1] Dames and Moore, 1976

[2] Faust, 1977

[3] Kentucky Department of Natural Resources and Environmental Protection, 1975

[4] U.S. EPA, 1975

[5] Federal and State Standards

pollutant would occur approximately 5 kilometers (km) downwind of the release point. Comparisons of the predicted maximum concentrations with the ambient air quality standards and prevailing air quality in the region indicate that the contribution of the gasification facility to ambient air quality would be well within the standards.

Table V-18. Ground Level Concentrations Under Stable Low Wind Conditions

Downwind Distance (m)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	Particulates ($\mu g/m^3$)
500	0	0	0
1100	0	0	0
5000	106.0	63.6	87.8
10,000	91.4	54.9	75.7
20,000	55.2	33.2	45.7

Source: Dames and Moore, 1977

(2) Emissions from User-Industries

Gas Combustion. Combustion of the low-Btu gas by the user-industries would result in the emission of 1.21 gm NO_x per second. The emission of heavier hydrocarbons (non-methane) would be negligible. Sulfur and particulate emissions would be non-existent. The predicted maximum NO_x concentrations as a function of downwind distances are shown in Table V-19. The predicted maximum concentration of NO_x is less than the Kentucky air quality standard of 100 $\mu g/m^3$ (annual average) (See Appendix E for methodology.)

Table V-19. Annual Average of Ground Level Concentrations of NO_x Under Stable Low Wind Conditions

Downwind Distance	NO[1] Concentrations
(m)	($\mu g/m^3$)
100	2.41×10^{-10}
500	8.02×10^{-8}
1000	7.64×10^{-8}
5000	5.34×10^{-8}

Source: Dames and Moore, 1977a.

(3) Process Emissions. The Environmental Protection Agency (EPA, 1976) has determined emission factors for some industrial processes. These processes were compared with the projected industrial processes which might be inhabiting the park. The closest possible match of processes was determined and the emission factors applied to the expected production of the various plants.

In that way daily process emissions were derived. These estimates are low because factors are not available for all processes. The total uncontrolled daily emissions from the industrial facilities are shown in Table V-20. It is reasonable to assume that air pollution control techniques would be used which would reduce emissions by eighty percent. Emissions resulting from this level of control are also shown in Table V-20.

Table V-20. Potential Daily Emissions From User-Industries

Substances	Uncontrolled (lbs/day)	Assuming 80% Removal (lbs/day)
Particulates	12,336	2467
Fluorides	12,865	2573
Carbon Monoxide	3.4	0.68
Hydrocarbons	1.7	0.34
Nitrogen Oxides	12.8	2.56
Condensibles	252	50.4
Volatiles	147	29.4

(4) Vehicular Emissions

Estimates of vehicular emissions have been calculated using EPA (1974) methodology (See Appendix E). It was assumed that one large parking lot with one gate admitting 1000 vehicles per hour was the sole access to the park; total number of incoming vehicles was 1044; receptor site was 10 meters from gate; wind speed was 1 meter/sec and acted at right angles to the flow of traffic; and CO background concentration was 0 ppm. Under these conditions carbon monoxide concentrations at 10 meters and 15 meters would be 28 ppm and 23 ppm respectively. These values are below the NAAQS standards of 35 ppm.

(5) Air Quality Summary

Table V-21 summarizes the computed maximum ground-level concentration levels for each pollutant expected from the major activities of the proposed development. Included in the presentation are the likely background concentration levels, the appropriate air quality standards, and a composite picture of the development's impact on regional air quality.

A comparison of the resultant ambient concentration levels with the air quality standard suggests that no standard would be exceeded by the development of the proposed project. With regard to significant deterioration regulations, the proposed project would not violate either the particulate matter or the sulfur dioxide allowable concentration levels.

e. Noise

The coal preparation facility and the gasification plant operating 24/hr day would be the major noise sources. At the coal preparation facility the predominant sources would be the crushing and screening of coal. The crushing operation would create noise levels of 89 A-weighted decibels (dB(A)) at 30 feet and the screening operation would create noise levels of 96 dB(A) at 15 feet. Sound levels 1000 feet from the coal handling facility would be 53 dB(A). The projected increase of 53 dB(A) was added to the baseline data at the five locations. Little degradation of background ambient sound levels would result.

The gasification plant itself would be enclosed and the outdoor noise level from this source would be negligible. Also, the noise during flaring would be negligible because of the low pressures associated with the flaring process. Trains bringing coal to the gasifier site twice a month would emit a sound level of 72 dB(A) at 50 feet during unloading. Although the duration of this operation would be short, individuals at nearby residences would be affected.

Since manufacturing processes in the industrial park would be enclosed, noise levels outside the buildings would not significantly alter. Traffic noises along arterial roads would increase as a result of delivery vehicles and employee cars.

f. Solid Waste

Dust and ashes, sulfur, and tars and oils are the three kinds of solid wastes that would be generated by the coal gasification plant. Ashes from the gas producers and fly ash from the dust collectors would amount to 2.2 to 3.6 tons per day. These materials have been approved by the state for disposal in closed containers at the Scott County landfill. They would be removed by a contract hauler.

The sulfur cake from the Holmes Stretford process would contain 50 percent elemental sulfur and 50 percent water. It could be landfilled or sold. However, at this time, no customer has been found nor has a permit been issued by the state for disposal at a landfill.

Tars would represent those substances most hazardous to human health. Several components would be carcinogenic. These materials would be containerized in drums. If a spill occurs, it would be contained by a diked concrete pad. Ultimate disposition of these tars has not been determined. It is possible they may be sold or reinjected into the gasifier.

Table V-21. Air Quality Impact Summary

	Pollutant[1]				
Activity	SO_2 ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	TSP ($\mu g/m^3$)	CO (ppm)	HC ($\mu g/m^3$)
Coal Gasification	59.5	7.2	32.5	-	-
Industrial Park	0.5	23.5	-	0.007	0.7
Indirect Sources	-	-	-	3.1	-
Composite	60.0	30.7	32.5	3.1	0.7
Background[2]	~10.0	~20.0	~40.0	NA	NA
Total	~70.0	~50.7	~72.5	~3.1	~0.7
Standard[3]	1300	100	150	35	160

[1]Because the computed ambient concentration levels are derived on the basis of very short averaging time (10 minutes), these values must be modified to longer averaging time for comparison with the ambient air quality standards. Turner (1970) provides a technique to accomplish this task; the estimate for longer averaging time is obtained from:

$$X_s = X_k \, (P_k/T_s)^P$$

where: X_s is the desired estimate for the longer sampling time: X_k is the concentration estimate for the shorter time: T_s is the time for the shorter sampling period; P_k is the time for the longer sampling period; and P is an empirical constant having a value of 0.2.

[2]It was assumed that the air quality monitored in the vicinity of Frankfort and at the fish hatchery during 1976 are most representative of the background air quality within the area of the site.

[3]The more restrictive short-term standard for each pollutant was selected.

Facilities which would inhabit the industrial park would generate solid wastes from three sources: wastage of raw materials, non-specification products, and sludge and oil from treatment of wastewaters. The kinds and quantities of these wastes are listed in Table V-22.

Table V-22. Kinds and Amounts of Solid Wastes Generated by Occupants of Industrial Park

Waste	Amount (tons/day)
Solids from Wastewater	
Treatment	4.8
Oil	0.530
Ceramic Products	
Raw material and grit	6.8×10^{-4}
Porcelain and tile products	2.5×10^{-4}
Glass Products	
Containers and envelopes	1.9×10^{-3}
Wood Laminator	
Wood chips and logs	7.3×10^{-4}
Hardboard	2.7×10^{-4}
Heat Treatment	
Metal Product	1.3×10^{-4}
Metal Fabricator	
Metal Cuttings	3.3×10^{-3}
Product	1.3×10^{-3}
Total	5.3

Solids and oils from treatment of the wastewaters are responsible for 99 percent of the solid wastes generated. The gasifier would generate 5.3 to 9.1 tons of solid waste/day compared to the 5.3 tons/day generated by the industrial park.

g. Terrestrial Ecosystem

The major impact to the terrestrial ecosystem would have occurred during the construction phase as a result of vegetation removal and subsequent wildlife habitat loss. During the operational stages of the industrial park impacts to vegetation and wildlife would be minor and related to air pollutants and noise produced by industry and vehicle operation.

Landscaping would offset some of the net primary productivity lost during site clearing and grading. Approximately 96 acres would be grassed and planted with shrubs to cover areas exposed during construction. Assuming that the resulting lawn ecosystem is capable of producing approximately 1 ton per acre per year net primary productivity (Falk, 1976), landscaping efforts would result in as much as 96 tons per year of plant production being returned to the park site.

Since the vegetation used in landscaping would be largely controlled grasses and shrubs, its value as wildlife habitat would be limited. Major benefits derived from landscaping would be in its aesthetic value and in reduction of soil losses due to erosion. Benefits to animal populations would include providing habitat for arthropod species and soil organisms, and feeding areas for small mammals (mice, moles, rabbits) and birds, particularly during periods of industry inactivity.

Air emissions would have a minor effect on vegetation and wildlife on and immediately near the industrial park. Pollutants emitted by vehicular traffic and industry would include sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxides (CO), and hydrocarbons. Small amounts of lead may also be emitted to the atmosphere from vehicles.

While some vehicle emissions would likely occur throughout the day, peak traffic loads are expected during a one-hour period during the morning and again during the afternoon. If 500 vehicles (400 passenger cars, 100 diesel trucks) enter the industrial park during peak traffic periods, sulfur emissions (SO_x) would reach levels of 0.03 $\mu g/m^3$ and nitrogen emissions (NO_x) would reach levels of 0.49 $\mu g/m^3$ within 50 meters of the roadway during peak traffic (see Table V-23). Sulfur emissions at this level would have no noticeable effect on roadside vegetation. Nitrogen levels, however, could cause reduced growth and leaf lesions on vegetation within 50 meters (see Table V-24). Hydrocarbon emissions (0.05 $\mu g/m^3$ and particulate emissions (0.015 $\mu g/m^3$) would not be expected to produce noticeable or adverse effects on vegetation, and carbon monoxide (0.33 $\mu g/m^3$) would be used in photosynthetic activity.

Lead concentrations in soils (related to vehicle emissions) usually decrease to background soil levels within 50 meters of a roadway and apparently have no major adverse effect on natural ecosystems. Lead tends to be strongly bound to the soils (particularly clay particles) and is not effectively passed through the food chain (Smith, 1976; Tidball, 1976). As the number of vehicles using unleaded fuels increases, lead levels in soils near roadways should decrease.

Wildlife species that adapt to the industrial setting would not be significantly affected by vehicle emissions. Activity periods for wildlife (feeding and movement) would likely be altered to minimize exposure to peak periods of human activity.

Gasifier flaring is expected to occur an average of 3 hours per year. Air pollutants emitted during flaring would include 0.09 tons per year particulates, 0.2 tons SO_2, and 0.1 tons NO_x. Because

Table V-23. Vehicle Emission Estimates for 1000 Vehicles of the Type Indicated at 50 Meters

Source*	CO ($\mu g/m^3$)	HC ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	Particulates ($\mu g/m^3$)	SO_x ($\mu g/m^3$)
1976 Average	5.4	0.5	0.6	0.05	0.02
Light duty gasoline	0.2	0.03	0.2	-	-
Heavy duty gasoline	15.8	1.6	1.1	-	-
Heavy duty diesel	2.5	0.4	4.1	0.14	0.3

*Based on 1000 vehicles of each type indicated at windspeeds of 6 meters per second. Emission levels for pollutants measured at 50 meters away from sources.

Source	CO ($\mu g/m^3$)	HC ($\mu g/m^3$)	NO_x ($\mu g/m^3$)	Particulates ($\mu g/m^3$)	SO_x ($\mu g/m^3$)
400 cars	0.8	0.01	0.08	-	-
100 diesel trucks	0.25	0.04	0.41	0.015	0.03
Totals*	0.33	0.05	0.49	0.015	0.03

*Assumes 400 light duty passenger cars and 100 large diesel trucks enter park during a one-hour period in the morning. Similar emissions would occur during a one-hour period in the afternoon.

Table V-24. Effects of Sulfur Oxide and Nitrogen Oxide on Vegetation

	SO_x (as SO_2)		
PLANT	SO_2 level	Exposure time	Effect
Ryegrass	0.17	46-81 days	reduced yield
Trees (15 species)	0.14	10 hours	injury
Plants (unspecified)	0.29	continuous	injury threshold
	NO_x (as NO_2)		
PLANT	NO_2 level	Exposure time	Effect
Unspecified	0.14	long time	depressed growth
Unspecified	0.30	several hours	leaf lesions

Source: Stern, A.C. 1968.

of stack height (50 feet above gasifier) and frequency (3 hrs/year), air emissions at these low levels will have no effect on vegetation or wildlife. Since air emissions from normal gasifier operation and from the user-industries would also be emitted from stacks, and at low levels, no adverse effects on the terrestrial ecosystem are anticipated.

Since the probable wildlife species that would colonize the park are those adapted to urban/industrial settings, noise produced at the indicated levels would have little effect on wildlife populations of the industrial park. Since noise levels tend to decrease with distance from the source, offsite populations should also be unaffected.

h. Aquatic Ecosystems

Potential impacts to the aquatic environment are related to surface water runoff, coal pile runoff, and discharge of thermal and process wastewater. Any industry, including the gasifier deciding to locate within the proposed industrial park would be required to pretreat its wastewater whether it discharged into the Georgetown municipal treatment system or into surface waters in order to be in compliance with Public Law 92-500. Because of this requirement, wastewater discharged during normal operating conditions should have no impact on the aquatic environment. In the event of an accidental spill of industrial wastewater, including coal pile runoff, the impacts to the aquatic system would depend upon the concentration and constituents of the wastewater, diluting capabilities of the receiving creek, and duration of the spill. Since it is impossible to predict these conditions beforehand, the potential adverse effects are largely unknown. In an effort to estimate worst case events should an accidental spill occur, a description of adverse effects for the various pollutants that could reach the North Elkhorn Creek has been included.

While general surface runoff would result in an increased concentration of dissolved and suspended solids, oxygen-demanding substances, and nutrients, the resulting concentration would not be expected to be significant enough to cause any major impact on the aquatic biota. Runoff from the industrial park would be temporary (associated with rainfall events). While water quality may decrease slightly during the runoff period, mixing with stream water would buffer the runoff and lessen adverse effects.

Major threats to aquatic life would result from accidental spills which allowed industrial toxicants or coal pile runoff to reach North Elkhorn Creek via the stormwater or sewage treatment system. Impacts to aquatic biota would also result from increased wastewater flow to the treatment system which exceeded actual treatment capacity and caused untreated wastewater or improperly treated wastewater to be discharged. All three cases would impact water quality in the receiving stream and could potentially damage the aquatic system. While continous flow from upstream would dilute the contaminants in time and with distance, a slug of untreated industrial waste particularly from a gasifier rupture would result in fish kills and loss of lower food organisms. Potential pollutants reaching North Elkhorn Creek as a result of an accidental industrial spill would include oils, suspended solids, chemical oxygen-demanding materials, nitrates, phosphates, cyanide and metals. Depending upon the actual concentration reaching the creek effects on the aquatic ecosystem may range from no noticeable changes to significant population losses.

Ammonia is a biologically active compound which is highly soluble in water. When dissolved in water, ammonia establishes a chemical equilibrium involving ammonia (NH_3), ammonium ions (NH_4^+), and hydroxide ions (OH-). The concentration of ammonia increases with increasing pH and temperature and decreases with increasing ionic strength (Committee on Water Quality Criteria, 1972). Ammonia reacts synergistically with cyanide (Environmental Protection Agency, 1973). However, dissolved oxygen and carbon dioxide reduce the toxicity of aqueous ammonia solutions (Committee on Water Quality Criteria, 1972). Ammonia is toxic in various concentrations to different fishes. Sublethal effects on fish include progressive gill hyperplasia, reduced oxygen-carrying capacity of the blood, abnormal liver functioning, changes in urine production and tissue disintegratin various organs.

Free oil and emissions discharged into North Elkhorn could coat the gills of fish and interfere with respiration. They may also coat algae and other plankton, thus removing fish food items, and result in flesh tainting. Settleable oily substances may coat the bottom sediments and destroy benthic organisms and interfere with spawning areas. While tolerance levels vary from species to species, protection of aquatic life is considered to be achieved if the quantity of oil entering the water body produces no visible color film on the surface, does not coat the banks and bottom of the stream, imparts no oily odor to the water or oily taste to edible organisms, or does not break down into toxic materials such as naphthenic acid (Federal Water Pollution Control Administration, Department of Interior, 1968).

Similar impacts would occur with settleable solids (both inorganic and organic material). As the materials settle, they may coat aquatic organisms, thus interfering with respiration, consume oxygen in decomposition or chemical changes, and if in significant concentration, may blanket spawning areas. Concentration of 25 mg/l to 80 mg/l of suspended solids (with potential to settle) are considered optimal for fisheries, while concentration of 25 mg/l or less and 80 mg/l to 400 mg/l are unlikely to support good fisheries (Federal Water Pollution Control Administration, Department of Interior, 1968).

Reduction of the water dissolved oxygen concentration below 4 mg/l as a result of a rapid influx of oxygen-demanding materials would eliminate immobile organisms such as benthos and larval stages of fish. Increases in nitrogen and phosphorus significant enough to trigger an algal bloom would also effect the biota by oxygen reduction during algae respiration and decomposition. Decreases in dissolved oxygen would be most severe during summer months when the capacity of the water to hold oxygen is lowest.

Cyanide, as hydrogen cyanide (HCN) or metallo-cyanide complexes, is toxic to aquatic life; particularly in cases where the metallo-cyanide complexes cause a pH reduction. Slight changes in pH from 7.8 to 7.5 have been shown to cause a ten-fold increase in toxicity of a nickel-cyanide complex (Doudoroff, 1956).

Metals which could be introduced into North Elkhorn Creek from a spill of industrial wastewater include lead, zinc, barium, iron, nickel, and copper. The identification of potential toxic effects for metals is complicated by the synergistic and antagonistic effects among various metals, and between metals and other environmental parameters such as temperature, pH, and organic substances.

Copper is more toxic when present with other bivalent metal ions such as zinc. Copper is toxic to invertebrates, especially in soft waters. Nickel is especially toxic to plants and other freshwater life. It also reacts antagonistically with other essential metal ions and may reduce their effectiveness (Environmental Quality Systems, Inc., 1976). Water soluble and acid soluble barium salts are toxic to aquatic life. Concentrations of 10 mg/l have been reported to kill the aquatic plant *Elodea canadenis* (Britt and Hushon, 1976).

Iron may impact the aquatic biota in two ways. Ferric (iron) salts form gelatinous hydroxides which flocculate and settle to the bottom. As they settle, benthic organisms, fish eggs and sessile plants may be smothered. The hydroxides also destroy the respiratory epithelium, block the gills and cause capillary congestion in fish (Environmental Quality Systems Inc., 1976). The lethal threshold for several species of freshwater insects has been reported to be 0.32 mg/l iron.

Sublethal effects of lead on freshwater organisms include delayed sexual maturity, abnormal behavior, and reduction of growth (Environmental Quality Systems, Inc., 1976). In freshwater it has been recommended that the concentration of lead not be higher than 0.03 mg/l to protect aquatic life (Britt and Hushon, 1976).

Zinc is essential in small quantities, but forms highly toxic complexes in aqueous solution which are poisonous in small concentrations to most aquatic biota. Zinc is much more toxic in soft than in hard waters, and it reacts synergistically in solution with copper. An acute lethal toxicity level to fathead minnows in soft waters has been reported to be 0.87 mg/l zinc (Britt and Hushon, 1976).

i. Endangered and Threatened Species

There would be no impact to Federally or State protected endangered or threatened species of wildlife or flora since none occur on the proposed industrial park site.

Impacts to the turkey vulture (considered as threatened by the National Audubon Society) would be removal of a portion of the feeding range of this species. However, since this removal would have occurred during the construction phase, no additional impacts would be anticipated during operation.

2. Potential Modification to the Socioeconomic Environment

a. Demography

The major demographic impact of the gasification facility and development of the industrial park would be on population size. The population of Georgetown/Scott County would be affected primarily by the number of jobs which would be created by installation of the gasification facility and development of the proposed industrial park. It is difficult to accurately project the number of new jobs which would be created in the absence of definitive information as to the ultimate makeup of the industrial park and the number of employees for each occupant-industry. Moreover, industrial developments vary considerably in the number of employees per acre of facility space, and there is similarly considerable variation across industries in the number of secondary jobs created by basic industry activity. Given these constraints, for population projections this analysis uses as an estimated minimum base the upper limits (in terms of employees for facility) of the potential makeup of the industrial park. This minimum base is 532 new basic industry jobs. The estimated maximum base (an approximate worst case) is the Kentucky State average of 6.27 employees per acre for industrial/manufacturing activities (Kentucky Dept. of Commerce, 1973). Given 173.6 acres, this estimated maximum base is 1091 new basic industry jobs.

Jobs created in basic industries (which produce goods and services for consumption beyond the area of production) have a multiplier effect in that they stimulate employment in the nonbasic sector (as money is spent from income earned in basic jobs for the consumption of local goods and services). In 1974 the Scott County ratio of nonbasic (2491) to basic (3541) jobs was 0.70 (Dames and Moore, 1977). Using a multiplier of 0.7 for each basic job created, the number of nonbasic or secondary jobs likely to be created is 373 using the estimated minimum base (0.7 x 532), and 764 using the estimated maximum base (0.7 x 1091). Hence, the total number of new jobs to be created by the installation of the gasification facility and development of the industrial park ranges from an estimated low of 905 to an estimated high of 1855.

The creation of 1855 jobs does not mean a comparable increase in the local population. These new jobs would likely be absorbed by shifts in place of employment, employment of unemployed persons and shifts in type of employment by underemployed persons. Currently, the Scott County labor market area experiences a significant pattern of inter-county commuting. As of 1973 Scott County provided place-of-residence employment for approximately 52.4 percent of its population with an estimated 47 percent employed elsewhere. Scott County also provided 10 percent of local jobs to commuters from outside of Scott County. It is reasonable to assume that a major proportion of persons commuting out of Scott County do so because of the relative unavailability of attractive employment opportunities within the county. It is difficult to determine precisely how many persons presently commuting out of Scott County would choose to work within the county if given the option. Assuming that 50 percent of out-commuters would select this option, approximately 1000 new jobs would theoretically be absorbed by Scott County residents (using the Department of Commerce 1973 figure of approximately 2000 commuters out of Scott County). Although the absorption of new jobs within Scott County by present Scott County out-commuters would "create" jobs in other parts of the Scott County labor market area, a positive impact would accrue to Scott County in that the inflow of new population would be lessened.

As of April, 1977 the Scott County labor market area had a total of 4056 persons unemployed. Present commuting patterns suggest that unemployed persons within the labor market area are available for employment in Scott County. If one assumes that 10 percent of unemployed persons are unemployable, (due to lack of skills, unsuitability to manufacturing work, etc.), the projected available labor supply totals approximately 3600 persons, adequate to meet the estimated labor demands of the gasification facility and industrial park development. It is difficult to project how many of these persons from counties within the Scott County labor market area would choose to establish residence in the Georgetown/ Scott County area.

It is estimated that between 110 and 150 middle to upper management and highly skilled craftspersons would migrate to Scott County from other areas to work at the industrial park (Dames and Moore, 1977). This number constitutes the only definitive estimate of in-migrants to the Scott County area. Using the upper limit of 150 persons and assuming that each person represents a head of household, and assuming an average family size of 3.37 persons (U.S. Bureau of Census national average), this would result in a "certain" increase of 506 persons to the Scott County area over the period of development of the industrial park. This would constitute roughly a 2.7 percent increase in Scott County's population.

b. General Economic Conditions

(1) Employment and Unemployment

The installation of the gasification facility and development of the proposed industrial park would further reduce unemployment in the Scott County labor market area. It is impossible to precisely project the impact of creation of basic industry jobs on unemployment given the impossibility.

(2) Labor Market Area Commuting Patterns

Assuming that Scott County residents who currently commute out of the county to work would be attracted by opportunities for place-of-residence employment, and that unemployed persons throughout the Scott County labor market area would take advantage of job opportunities in Scott County, Georgetown/ Scott County would likely emerge as a larger employment center with commuting patterns shifting in the direction of a Georgetown/Scott County locus.

(3) Industry, Agriculture, and Livestock Production

The installation of the gasification facility and development of the proposed industrial park would increase the concentration of industrial activity in Georgetown/Scott County, which presently employs 51.6 percent of the Georgetown labor force. Aside from the loss of 173.6 acres of land previously devoted to agricultural usage (129 are currently under cultivation), there would be no major adverse impacts on agricultural and livestock production.

(4) Income

Assuming that the gasification facility and industrial park development would create 1091 basic jobs, a considerable boost in local incomes and spending power would be realized. Given an average manufacturing industry hourly wage of $5.60 (an average yearly income of $10,752), an additional $11,730,432 in wages would accrue to the local economy from basic jobs alone. Secondary income generated by nonbasic employment would be substantial, approximately $5,000,000 annually. Hence, a total of approximately $17,000,000 in annual income will be added to the local economy.

c. Taxes

The installation of the gasification facility and development of the industrial park would have a positive impact on the local tax base in addition to generating tax revenue for the state of Kentucky. If the industrial park site is annexed into the city, all developments within the park would become subject to Georgetown taxes, including property tax, taxes on business furniture and fixtures, taxes on finished products, and city payroll taxes. The industrial park facilities would also generate revenue for Scott County through County property taxes and vehicle taxes. Revenue would accrue to the state through a state-levied corporate income tax, general property taxes, sales and use taxes, and ad valorem taxes on real estate and tangible property. The amount of these taxes is of course difficult to project in the absence of actual development of the industrial park (the applicable tax base).

d. Land Use

Although zoned industrial, the proposed industrial park site is completely surrounded by prime agricultural land and a major portion of the site is currently under cultivation. The Physical Development Plan issued by the Georgetown-Scott County Planning Commission proposes significant expansion (from 2.5 percent to 14.2 percent) of land devoted to industrial use and corresponding reductions in agricultural land use within a 1-mile radius of the immediate impact area. Hence, the proposed industrial park would be in congruence with future land use plans for the area.

e. Public Sector Infrastructure

(1) Schools and Libraries

The major impact of the gasification facility and industrial park development on public sector infrastructure would be on the local public school system. A minimum of 150 new residents (management and highly skilled personnel) to Scott County are expected to be attracted by the gasification facility and development of the industrial park. Assuming that each of these persons is a head of household and given the national per family average of 1.13 children under 18, an estimated minimum of 170 school-age children would enter the local population. The Scott County school system presently has an excess capacity of 950 spaces. Assuming that approximately 50 percent of jobs created would be absorbed by Scott County residents who currently commute out of Scott County for employment, 545 (assuming the worst case of 1091 jobs being created) jobs would potentially be absorbed by nonresidents of Scott County. With 150 of these being absorbed by migrants to the area, then 395 jobs would theoretically be available to persons within the Scott County labor market area. The number of persons employed from the Scott County labor market area that would choose to seek residence in Scott County is of course difficult to project. However, with present excess capacity, after accommodating the estimated school-age children of the minimum estimate of new migrants (150 families and approximately 170 school-age children), the Scott County school system would accommodate approximately 780 more school-age children. There would likely be no adverse impact on local libraries or institutions of higher education.

(2) Health Care and Medical Facilities

Scott County is presently served by a small, 45-bed hospital and relies significantly on more extensive facilities in nearby Lexington. The current ratio of physicians to population is 1 physician for roughly every 1875 persons. With the projected increased population directly attributable to development of the industrial park, the physician-population ratio would remain significantly below the Federal standard for primary health care (one physician per 3500 persons).

(3) Police and Fire Protection

The impact of installation of the gasification facility and development of the industrial park on police and fire facilities would in part be a function of the size of any increase in population and resulting population density. Presently the Georgetown/Scott County/Stamping Ground area has a combined police force of 28 full-time staff and 5 part-time staff members. The Georgetown/Scott County fire department is staffed with a total of 46 volunteers. As the population increases and given increases in urbanization and industrialization occur, a volunteer fire department would likely prove inadequate.

f. Housing

Housing in Georgetown and Scott County is in short supply with a less than 1 percent vacancy rate for the Georgetown area and a 2.5 percent vacancy rate for the remainder of Scott County. Given current population trends (with no new, induced population), Scott County is projected to need an additional 302 housing units by 1980 (Dames and Moore, 1977). Increases in local population would likely result in a serious housing shortage unless offset by a major housing construction program.

g. Water Treatment and Wastewater Treatment

The current treatment capacity of the plant is 4.0 mgd. The current demand on the system averages 1.4 mgd. It has been projected that the population to be serviced by this system would reach 15,000 in 1990 and the demand for water would be approximately 2.0 mgd (Mason, 1968). The same projection estimates that Royal Spring supplies during drought conditions (0.5 mgd) and the reservoir supplies (64 million gallons) would not be sufficient to meet 1990 demands. This is about the time frame that all user industries would be on-line. It has been estimated that the industrial park would demand approximately 1,100,000 gal/day. Clearly, this demand could not be met during drought conditions. In order to meet daily demands, the flow of Royal Spring would have to continue at approximately 3.5 mgd.

It is probable, however, that the industrial park and gasifier would obtain their water supply from the Kentucky-American Water Company instead of the Georgetown Municipal Water and Sewer Service. The source of water would no longer be Royal spring but the Kentucky River and impoundments. Kentucky-American Water Company has a treatment plant capacity of 40 mgd and an average daily consumption of 27 mgd. Even with a peak consumption of 37 mgd, this company would be able to meet daily park demands of 1.1 mgd.

The rated capacity of the existing wastewater treatment system is 3.0 mgd but actual capacity is approximately 2.0 mgd. Current treated volume is 1.12 mgd. It is expected that sanitary wastes from the industrial park would amount to approximately 25,000 gal/day. This additional volume representing a 2.2 percent increase would be easily handled by the existing facilities.

This estimate assumes that the user-industries would treat their wastewaters to "best practicable" levels and discharge them to surface waters. If the user industry waters were directed to the municipal treatment system, it would be overtaxed. Daily discharges from the industrial park would double the existing volume to 2.2 mgd to be treated. It is doubtful that this increase could be adequately handled. See Section E-1-6, Impacts to Surface Water-Operation, for more detailed description.

h. Transportation

Trucks bringing in materials and supplies would probably approach Georgetown on Interstate 75 and exit at the Route 227 interchange. However, this interchange is northeast of the proposed site and vehicles would have to double back via city and county roads. The road system accessing the proposed site is comprised mainly of two-lane, wandering country roads. Lemons Mill Road, which is the sole access to the park itself, is particularly narrow and winding. It is unlikely that these roads could support the additional traffic without their being improved and widened. The county is tentatively committed to the construction of a suitable access road to the site from I-75 if plans for the industrial park and gasification site receive approval and construction is imminent.

If a spur line is built off the Southern Railway track which is adjacent to the park, coal may be brought in this way. To the extent that the rail system is used instead of the road system the burden on the road system would be reduced.

i. Historical Sites

There are two buildings of historical significance near the proposed site. These are the Aulick House directly across from the site on Lemons Mill Road and the James Thorn House located on the parcel of land adjacent to the proposed site. The Aulick House is a brick Victorian house which will be documented in the Victorian and Twentieth Century Building Survey planned for 1979. The James Thorn House is an eighteenth century brick house with original woodwork and mantels. Neither structure is listed in the National Register.

Although neither of these structures is located on the proposed site itself, they would be impacted by the development of the industrial park and gasifier. Due to their proximity to the park, they would be less desirable private residences. Purchase and restoration of these structures with the goal of making them available to the public as historical sites would probably not occur for the same reason. A nearby industrial park would not encourage tourist investigation.

j. Social Ambience

The proposed installation of the gasification facility and development of the industrial park have provoked expressions of serious concern by the citizenry of Georgetown and Scott County. In addition to concerns about potential impacts on the physical environment, citizens have expressed concern about potential impacts on the social ambience of Georgetown in particular. These concerns have focused primarily on potential problems developing around labor-management relations, potential work stoppages and associated problems, and the influx of new migrants to the city.

The installation of the gasification facility and development of the industrial park would not set a precedent in terms of introducing labor unions to Georgetown/Scott County. Labor unions are currently present throughout Kentucky, including the Georgetown/Scott County area. Georgetown is the locus of all industrial activity in Scott County. Labor-management relations in Scott County have in the past been very good and work stoppages due to union activity have been infrequent. For the period January 1976 to October 1977, Scott County experienced one work stoppage involving 208 employees with a loss of 416 man hours. This suggests a single work stoppage of 2 hours' duration.

It is impossible to predict with precision how many persons associated with the industrial park development would seek to establish residency in Georgetown/Scott County. On the other hand, given the proximity of Georgetown to Lexington and given the national trend of more rapid growth outside of metropolitan and highly urbanized areas, it is likely that Georgetown/Scott County may begin to experience growth from these forces rather than from any single or specific industrial development. Again it is impossible to project with precision any significant impact new migrants would have on the social ambience of the community. However, it is reasonable to assume that persons choosing to migrate to an area such as Georgetown do so as an expression of preference for the particular lifestyle that the area offers.

K. References

American Public Health Association and others, 1976, Standard Methods for the Examination of Water and Waste-Water: American Public Health Assoc., Washington, D. C., 14 ed.

Anderson, L.L., 1972. Energy Potential from Organic Wastes: A Review of the Quantities and Sources. Information Circular 8549, U.S. Department of the Interior, Bureau of Mines, Washington, D.C.

Britt, D.L. and J.M. Hushon, Biological Effects, Criteria and Standards with Energy Technology, MTR 7283, August 1976.

Chu, T.J., and others, 1976, Characteristics of Waste Water Discharges from Coal Fired Power Plants: Proceedings, 31st Annual Purdue Industrial Waste Conference, West Lafayette, Indiana.

Dames and Moore, 1977, Correspondence from Dean Deharpporte to Robert Heck of Mason and Hanger/Silas Moore Co., Inc. (July 20).

__________ 1977a, Correspondence from J. Knauss to E.P. Krajeski of the MITRE Corp. (Dec. 15).

Engineering News Record, "Rising Costs Loom for Construction," September 22, 1977, pp. 67-132.

Environmental Protection Agency, 1974, Interim Guidelines for the Review of the Impact of Indirect Sources on Ambient Air Quality: Office of Air and Waste Management, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, p. 65 (July).

Environmental Protection Agency, 1975, Natural Interim Primary Drinking Water, Regulations: Federal Register, Part 4 (December 24).

Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, 2nd ed. (revised through 1976), AP-42 Research Triangle Park, North Carolina.

Environmental Quality System, Inc., Report to the National Commission on Water Quality on the Environmental Impact of the Disposal of Wastewater Residuals, Volume 2, National Commission on Water Quality, Washington, D.C., March 1976.

Falk, J.H., 1976, Energetics of a Surburban Lawn Ecosystem, Ecology 57:141-150.

Faust, R. J., 197, Groundwater Resources of the Lexington, Kentucky area: U.S. Geological Survey, Open-file Report.

Federal Water Pollution Control Administration, 1968, Report of the Committee on Water Quality Criteria, U.S. Department of the Interior.

Giles, R.J., Jr., 1969, Wildlife Management Techniques. The Wildlife Society, Washington, D.C.

Kendeigh, S.C, 1961, Animal Ecology. Prentice Hall, Inc., New Jersey.

Kentucky Department of Commerce, 1973, Commuting Patterns of Kentucky counties.

Kentucky Department for Natural Resources and Environmental Protection, Division of Water Quality, 1975, Kentucky Water Quality Standards: 401KAR 5:025 (June 2).

Mason, Clyde P., 1968, Water Study for the City of Georgetown, Kentucky.

Mason & Hanger-Silas Mason Co., Inc., 1976, Environmental Assessment for the Kentucky-Federal Energy Park, Georgetown, Kentucky.

Occupational Safety and Health Administration, Occupation Safety and Health Standards, (29CRF 1910.95), 1974.

Odum, E.P., 1960, Organic Productivity and Turnover in Old Field Succession. Ecology 41:34-49.

Proctor, Davis and Ray, Inc., 1977, Georgetown, Kentucky, 201 Facilities Plan, 1976-1996.

Smith, Robert L., 1976, Ecology and Field Biology, Harper and Row, New York.

Stern, A.C., Air Pollution, 2nd ed., Academic Press, N.Y., Vols. I and III.

Tidball, 1976. "Lead in Soils," Lead in Environment, U.S. Geological Survey Professional Paper A57.

Thrailkill, J., 1977, Preliminary Report of Project: Hydrogeology of Georgetown Area: Prepared for Dames and Moore.

U.S. Congress, 1972, Amendments to the Clean Water Act, PL92-500, 92nd Congress, 1972.

U.S. Senate, 1972, Report to the President and Congress on Noise. Senate Document 96-63. U.S. Government Printing Office, Washington, D.C.

Whittaker, R.H., 1961, Estimate of Net Primary Production of Forest and Shrub Communities. Ecology 42:177-183.

CHAPTER VI

MITIGATION OF POTENTIAL ADVERSE EFFECTS OF PROJECT IMPLEMENTATION

A. Purpose

Low-Btu coal gasification poses potential environmental problems peculiar to the conversion process as well as problems associated with the combustion of the resulting fuel gas. Although there is a pressing need to develop additional sources of energy available to this nation, such development cannot proceed at the risk of loss of environmental quality. This chapter identifies and explains mitigating measures and techniques which would be applied during construction and operation of the gasification and user-industries facilities.

B. Methodology

Mitigating measures are considered in terms of pollution treatment equipment, solid waste disposal procedures, monitoring programs, and soil management techniques. Each of these was investigated in terms of construction activities and operation of the gasifier and industrial park facilities.

C. Organization

Discussion of potential environmental problems and their reduction or elimination has been broken into two categories. Section D covers those arising from construction, and section E covers those arising from operation of the low-Btu coal gasifier and industrial facilities. These sections are further broken down into mitigation of impacts from air emissions, discharge of wastewaters, and solid wastes, and socioeconomic concerns.

D. Mitigation of Impacts Resulting from Construction Activities

1. Air Emissions

The major sources of air emissions from construction activities would be fugitive dust and vehicle exhaust emissions. Construction equipment and vehicles bringing materials to the site would be outfitted with control devices to comply with Emission Standards for Moving Sources (42USC1857). Diesel vehicles would be required to comply with regulations promulgated in 40CFR85, Control of Air Pollution from New Motor Vehicles and New Vehicle Engines. Also, the Environmental Protection Agency has the authority to prescribe standards to protect the public health and welfare for any new vehicle which might appear.

2. Runoff and Soils Displacement

Construction sites would be subject to erosion after removal of ground cover has occurred. Engineering design of erosion control structures would mitigate most potential sedimentation problems. These control structures would include dams, site basins, hay bales, and mulches. Revegetation of exposed areas would be undertaken as soon as possible so as to minimize loss. Oils and waste products would be isolated and not permitted to become part of the runoff volume.

Mulching would be used to increase infiltration, reduce erosion and evaporation and increase potential of revegetation success. Mulch composed of plant residues or other organic materials would be used as part of the seedbed preparation. Grass, hay, manure, or straw would be suitable for this purpose. Approximately two tons of mulch would be applied per acre. It would be anchored to a depth of two inches by discing or by a cotter-type machine.

Revegetation in the form of grass seeding and shrubbery plantings would occur as soon as possible. The species selected for planting would be adapted to local soil and climatic conditions. Native species would be planted, if possible, because they are best suited to local conditions. If rapid re-establishment of ground cover is required, nonnative species capable of strong, quick growth would be used. During periods of insufficient rainfall, vegetation in the park would be irrigated. If fertilizer were necessary to ensure adequate plant growth, it would be applied in the proper manner.

E. Mitigation of Impacts Resulting from Operation of Gasifier and User-Industries

1. Air Emissions

Impacts from air emissions from the industrial park would be mitigated by adherence to both Federal and State regulations. Kentucky law KRS chapter 224 prohibits air pollution in violation of emission standards or ambient air standards adopted by the Department of Natural Resources. Also, Federal regulations for compliance with the Clean Air Act Amendments of 1974 have enacted ambient air quality standards and emission standards for stationary sources. This Act was again amended in 1977, and further regulations will be forthcoming in accordance with new mandates.

a. Coal Gasifier

Air emissions would result from fugitive dust generated during coal handling and storage. The coal storage pile would be covered, and emissions from this source would be minimal. Coal conveyors would be covered, and spills would be cleaned up immediately. Coal crushing would be carried out in an enclosed area equipped with sub-ambient pressure controls and bag filters. This enclosure would also reduce the noise levels. Coal dust generated during crushing would be collected and disposed of in an acceptable landfill.

It is possible that spontaneous combustion could also occur if the coal pile is improperly compacted. If combustion occurred, gases may be emitted at very low levels (approximately 0.10 ppm). In order to prevent this, coal pile temperatures would be monitored at all times, and fire fighting equipment would be available.

Drying the coal would generate particulates and nitrogen oxides. To minimize this effect, the flame temperature would be kept low, and oxygen content of the drying gas would not be greater than 10 percent. Inert gases (nitrogen or carbon dioxide) would be added to the dryer gas to regulate flame temperature and moisture content.

No major continuous gaseous emissions are expected from the gasification process. The only air emissions occurring would be from intermittent flaring at the vent pipe located in the main gasifier chamber. The burn would occur at approximately 1600°F which is sufficiently high to degrade any organic components. To prevent visibility of the flame and promote complete combustion, a refractory-lined shroud would be placed around the burner.

If the product gas underwent direct combustion, several varieties of air pollutants would be released to the atmosphere. In order to mitigate this effect, air pollutant control devices would be incorporated into the gasification process. Eighty percent of the dust and ash would be removed by a tar trap and an open scrubbing tower. Removal of the condensible materials would be accomplished by reducing the temperature of the gas at various stages. After each temperature reduction, the condensed fraction would be bled off from the tar trap and skimmed or raked off in the scrubbing tower. Any remaining dust, soot or tar, and oil droplets would be removed when the product gas is passed through an electrostatic precipitator.

Approximately 98% sulfur removal would be accomplished by a Holmes Stretford unit. This unit would also remove ammonia and hydrogen cyanide. The process would produce a filter cake with a moisture content of approximately 50%.

It is possible that leakage of product gas would occur at some time during the life of the system. Operation of the system at near atmospheric pressure would reduce the possibility of explosion. The gas producers would be equipped with pressure relief vents, one in the producer and one in the coal hopper. If these vents were to discharge, flow would be directed away from personnel to the exterior of the building. Ventilation of the building would be designed to prevent accumulation of flammable concentrations. The distribution pipeline would be monitored for gas leaks.

b. Industrial Park

The two facilities engaged in the manufacture of glass products would emit air pollutants from glass melting operations. Emissions would consist of fluorides and particulates only a few microns in diameter. The effects of these air emissions would be mitigated by installation of baghouse control devices. Ammonia emissions from the light bulb manufacturer would be eliminated to the odor threshold by steam strippers.

Air emissions from the two clay products industries would result from grinding of raw material and from furnace exhausts and vents. Emissions would be mostly particulates and fluorides. The emission of fluorides would be reduced by operating the kilns at temperatures below 2000°F and by choosing clays of low fluoride content. Particulates and fluorides would be reduced by installation of wet cyclone scrubbers.

The primary source of air pollution from the metal heat treatment process would be oven exhaust gases. Stack gas scrubbers would be used to mitigate the effect of this exhaust. The metal stamping process would contribute to the air pollution problem from fuming of plating baths. This would primarily constitute a worker safety hazard. The hazard would be mitigated by providing good ventilation in work areas.

Air emissions resulting from the wood laminator would come from resin drying and sanding operations. Impacts from condensibles (resins and wood sugars) and volatiles (terpenes and methane) would be partially mitigated by a scrubber. Particulate emissions would be negligible if baghouses are installed.

2. Water

The Federal Water Pollution Control Act as amended in 1972 (PL 92-500) and in 1977 (PL 95-217) to the Clean Water Act empowers the Environmental Protection Agency to regulate wastewater discharges from industrial facilities. To this end, the agency has promulgated standards for existing sources, new source performance standards, and pretreatment standards for a number of industries. It has designated appropriate technologies which would achieve these levels of reduction. In the scenario, it was assumed that best practicable control technology would be installed at the plants and new source performance standards would be achieved. It is these technologies that are described in the ensuing section, and it is these technologies that would mitigate impacts from the industrial park facilities.

a. Coal Gasifier

Sources of water pollution would be the runoff from the coal storage pile and paved or covered areas, and wastewater from the tar trap and spray tower, and cooling water. The volume of coal storage pile runoff would vary depending on rainfall. It is possible that the rain would react with the coal to release organics, sulfur, and metals and form acids. At the very least, suspended solids would be increased.

The effects from the runoff would be mitigated by collecting the runoff and routing it to a retention pond. Residence time in the settling basin would be long enough to allow the suspended matter to settle out. If the runoff is sufficiently low in dissolved solids, it would be used as makeup water for the cooling tower. If not used as cooling water, it would be released as effluent to be treated by the municipality.

Cooling water blowdown would amount to approximately 5 gpm. It would contain nonpolluting and biodegradable corrosion inhibitors and biocides. It would be emitted directly to the municipal treatment system. Wastewaters originating from tar traps and spray towers would have flows of approximately 5-10 gpm each. The combined waste streams from the tar trap and spray towers would be treated biologically by a Peabody treatment system and then released to the municipal system.

b. Industrial Park

Wastewater from the glass container facility would result from cullet quenching and noncontact cooling of batch feeders, melting furnaces and forming machines. In plant control measures would do much to mitigate impacts from wastewater discharge. These types of practices would include spray collection of forming machine shop oil, good housekeeping, shear spray recycle, collection of oily runoff, and use of nonliquid cleaners.

The volume of water discharged would be reduced by segregating the cullet quench water from the cooling water. Noncontact cooling water would be discharged untreated. The cullet would be passed through a gravity oil separator and recycled back to the process. Blowdown from the separator would be directed to a dissolved air flotation system and then to a diatomaceous earth filter. Those two systems would reduce oil and suspended solids of the waste stream to about 0.016 lbs/ton of product. Approximately 13 gal/day of 15 percent solids sludge would be produced.

Impacts from cullet quench water from the light bulb manufacturer would be mitigated in the same way as in the glass container facility. Acid solutions from the etching of light bulbs would be the greatest problem at this facility. The waste stream would first undergo precipitation, flocculation, and sedimentation. This treatment would remove fluorides and suspended solids. To remove ammonia, the waste stream would undergo recarbonization and steam stripping. Further reduction of fluorides and suspended solids would occur as the wastewater is passed through the final steps of sand filtration and activated alumina filtration.

Wastewater associated with the ceramic tile manufacturer would result from mixing of batches and glazes, cooling, clean-up, dust control, and boiler feed. Volumes discharged would be small, and the major constituent would be suspended solids. Effects of these wastewaters would be largely eliminated by evaporation/settling ponds. If sufficient reduction of suspended solids is not realized through these practices alone, chemical flocculants would be added to further reduce the suspended solids content.

Process water in porcelain products manufacture would be used for slip preparation, clean-up, glaze spray booth dust control, cooling, and boiler feed. To achieve permissible discharge limits, only rudimentary control practices would have to be instituted. These would include a sump, clarifier, settling tank, and perhaps a sand bed filter.

Wastewaters from the metal heat treatment plant and the metal fabricator would be very similar and treated in the same manner. They would be segregated into three streams. One stream would contain emulsified oils which would be broken by sulfuric acid and steam. The freed oil would rise to the surface and be removed by a skimmer. The second segregated stream would contain free oils and be treated directly by the skimmer. These two waste streams would be combined and fed into an equalization tank. The third stream, consisting of dilute acid and/or alkali wastes and suspended and dissolved solids, would directly enter the equalization tank. The equalization tank would provide a mixing basin for the oily waste streams and the dilute acid/alkali wastes. Also, any spills or batch dumps would be bled into the waste stream at a rate that would not overtax the system. From the equalization tank, the combined waste stream would undergo precipitation, coagulation, and clarification or filtration. These mitigating measures would be sufficient to remove 60-98 percent of the dilute oils, suspended solids, metals, fluorides, and phosphates.

Impacts from wastewaters that would be discharged from the wood laminator would be entirely mitigated because no discharge of pollutants would be achieved. This would be the case whether a wet process or dry process system became operational. In the dry process, no discharge of wastewater would be achieved by recycling log wash water and using the solids as boiler feed; closing the resin system by using the wash water as make-up in the resin solution; eliminating discharge from humidification by careful in-plant controls; and neutralization of caul water and disposal by impoundment or spray irrigation. In the wet process no discharge of pollutants would be achieved by recycling process water as fiber dilution water after treatment by heat exchangers to reduce the temperature, gravity settling, screening, and filtration.

3. Solid Wastes

The largest volume of solid wastes created by the gasifier and industrial park would be sludges from treatment of wastewaters. The impacts resulting from these sludges would be mitigated by enforcement or regulations enacted by the State of Kentucky in 1976 (KRS Chapter 224 and 401 KAR 2:010). These regulations cover the construction and operation of landfills and licensing of haulers. Provisions have been made for the operation of landfills to handle hazardous wastes. Subtitle C of the Resource Conservation and Recovery Act of 1976 (RCRA) empowers the Environmental Protection Agency to issue regulations controlling the disposal of solid wastes. Regulations requiring strict monitoring of hazardous wastes and licensing of secure disposal sites are currently being considered by the Agency. A manifest will be required of each producer for each shipment of a waste classified as hazardous.

a. Coal Gasifier

Solid wastes would be generated as char and ash from the dust collector; oils and tars from the tar trap, spray tower, and the electrostatic precipitator; and the sulfur cake and system purges from the Holmes Stretford process. The char and ash would be inert because of the high temperatures at which pyrolysis takes place. Therefore, it would be acceptable material for landfilling, and a permit has been issued by the Kentucky Department of Natural Resources and Environmental Protection Agency for disposal in the Scott County landfill. To keep the ash from becoming airborne during transit, it would be covered and the moisture content increased.

Disposal of oils and tars would present a greater problem. Although IID is planning on selling the tars and oils to a company engaged in reclamation, it may be difficult to find a customer. Alternatively, they may be reinjected into the gasifier for extraction of the heat value. However, some carcinogens may be volatilized and released at elevated temperatures. The most likely means of disposal would be containerization and landfill. Except in the case of a major spill resulting in the release of these materials, the health of the general public would not be jeopardized. The greatest hazard would be to workers at the gasifier and those involved in handling the tar. The American Conference of Governmental and Industrial Hygienists has recommended that a threshold limit of 0.2 milligrams per cubic meter be used as a general index of health hazard for coal-tar-pitch volatiles, i.e., the benzene-soluble fraction of total particulates, including polycyclic aromatic compounds (Fruendenthal, et al., 1975). The chance of inhalation or dermal contact with the tars has been minimized by the design of the coal trap. In the past, poke holes used by operators for temperature depth readings have been the major exposure point to carcinogenic materials. However, at the proposed gasifier these poke holes would be shut and thermocouples installed to monitor such information.

A purge of the Holmes Stretford system would occur periodically which would produce sodium salts of anthraquinone disulfonate, metavanadate, citrate, thiosulfate and thiocyanate (Magee, 1976). Both the tars and the purge components would be considered hazardous materials. They would be containerized and disposed of in a secure landfill for hazardous materials after a permit had been issued by proper State authorities.

The Holmes Stretford process would generate approximately 645 tons of sulfur cake per year. This cake may be sold for use in the production of sulfuric acid, but it may be difficult to find a customer. A possible alternative would be to dispose of the cake in a sanitary landfill. An analysis would have to be submitted to the proper State authorities and a permit issued.

b. Industrial Park

There would be three major sources of solid wastes from the industrial park. These would be wastage of raw materials, generation of bad quality products and solid wastes from treatment of wastewaters. Impacts from wastage of raw materials would be reduced by careful handling and storage techniques. Inferior products would be fed, as much as possible, back into the process. By far the largest volume of solid wastes would be the sludge and oil resulting from treatment of wastewaters. The sludge would be landfilled, and the oils and tars incinerated, landfilled, or sold in accordance with Federal and State regulations.

4. Socioeconomic Environment

There would be three major potential impact areas related to socioeconomic conditions. These are lack of an adequate fire department, water treatment, and wastewater treatment plants; housing shortages; and an insufficient supply of water. The existing fire department is composed entirely of volunteers. In order to adequately protect the existing and incoming population from fire hazards, it would be prudent to improve the fire fighting capacity of existing facilities. The existing force would have to be expanded and upgraded to full-time employment status. New facilities and equipment would have to be purchased. These improvements would result in increased expense to the county.

There could be an acute housing shortage resulting from the influx of new employees to Scott County. However, given sufficient lead time, the demand could be met by local builders and contractors. There is no building moratorium in Scott County.

The problem of insufficient water supplies and inadequate water treatment facilities would be mitigated if the industrial park occupants bought their water from Kentucky-American Water Company. Since this company derives its water from the Kentucky River, local resources would not be stressed. Impacts to the municipal sewer system would be greatly reduced if user-industries were to operate under an NPDES permit and become surface discharges. In this case, only the volume of sanitary wastes (approximately 25,000 gpd) would be handled by the municipal system. If the Kentucky River became the source of water and user-industries became surface discharges, the flow to North Elkhorn would increase by approximately 10 percent. This increase, however, should have no adverse effects.

F. References

Environmental Protection Agency, 1974, Emission Standards for Moving Sources, 42USC1857.

Environmental Protection Agency, 1976, Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines, 40CFR85.

Freudenthal, R.I., and others, 1975, Carcinogenic Potential of Coal and Coal Conversion Products, Battelle Columbus Laboratories.

Kentucky Department for Natural Resources and Environmental Protection, 1975, Kentucky Solid Waste Regulations, 401 KAR 2:010.

Kentucky Legislature, 1976, Environmental Protection, KRS Chapter 224.

Magee, E.M., 1976, Evaluation of Pollution Control in Fossil Conversion Processes, EPA-600 12-76-101, 1976, 311p.

U.S. Congress, 1972, Federal Water Pollution Control Act Amendments of 1972, PL92-500, 92nd Congress.

____________, 1977, Clean Air Act Amendments of 1977, PL95-95, 95th Congress.

____________, 1974, Energy Supply and Environmental Coordination Act of 1974 PL93-319, 93rd Congress.

____________, 1976, Resource Conservation and Recovery Act of 1976, PL94-580, 94th Congress.

CHAPTER VII

UNAVOIDABLE ADVERSE EFFECTS OF PROJECT IMPLEMENTATION

A. Purpose

Although mitigating measures described in the previous chapter would be applied, they would not entirely eradicate adverse impacts created by the development of the gasifier and the industrial park. This chapter concisely summarizes these unavoidable adverse effects in a qualitative way.

B. Methodology

The unavoidable adverse effects were identified by examining the impacts discussed in Chapter V. Favorable impacts and those which could be mitigated are not presented in this chapter. In order to pinpoint ideas for the reader, detailed descriptions of the unavoidable adverse effects and methods by which they were identified are not included in this chapter.

C. Unavoidable Adverse Effects

1. Construction

The duration of those adverse effects associated with construction activities would occur only during the time of actual construction or approximately 7-10 years.

a. Soils

Construction activities would result in soil disruption and displacement over most of the 173.6 acres in the industrial park site. Applying a worst case estimate, approximately 1440 tons of soil would be lost from the site during the 7-10 year construction period. Of this, approximately 53 tons would be lost from the 7.1 acre gasifier lot. The major effect of soil loss would be loss of ability to support plant growth. Minor impacts would include some loss of vegetation and wildlife habitat.

b. Surface Waters

During the period of construction, there would be slight increases in the sediment loading to North Elkhorn and Cane Run Creeks. At a low flow of 500 cfs, the sediment entering North Elkhorn Creek from runoff from the industrial park would increase the sediment load by 0.6 mg/l (5 percent) on the basis of a worst case calculation. Current suspended sediment loads are approximately 11.0 mg/l. There are no flow or suspended sediment data for Cane Run Creek. However, on the basis of a worst case calculation, the sediment load of Cane Run Creek would increase by a maximum of 3.2 mg/l during flows of 10 cfs at sediment inputs of 174.1 lbs per day. None of these increases would exceed water quality standards.

Erosion from the western end of the industrial park site may result in the filling of a pond located approximately 1000 feet from the site. There is no outlet from this pond, and any sediment entering the water would be deposited rapidly.

c. Groundwater

Royal Spring would experience temporary increases in suspended solids. It has been estimated that a maximum increase of 65 mg/l would be experienced during low flow periods (0.5 mgd).

d. Air Emissions

Major air emissions during construction would be fugitive dust and vehicle and construction equipment exhaust. Emissions from vehicles bringing materials to the site over the 7- to 10-year construction period would amount to 20-30 tons of carbon monoxide, 3.0-4.3 tons of hydrocarbons and 33-43 tons of nitrogen oxides. These emissions would not occur at the park site but on the roads in and around Georgetown.

Total emissions from equipment working on the site during the construction period would be 15-22 tons of carbon monoxide, 5.5-8.2 tons of hydrocarbons, and 105-150 tons of nitrogen oxides. This would amount to daily emissions of 17.1 lbs of carbon monoxide, 6.6 lbs of hydrocarbons, and 120 lbs of nitrogen oxides.

One temporary source of air pollution could result from incineration of cleared vegetation. Emissions would occur as each site is cleared and be of short duration. Incineration of 49 tons of vegetation would result in 833 lbs of particulates, 6860 lbs of carbon monoxide, and 1176 lbs of hydrocarbons.

e. Noise

Construction activities would increase noise levels a maximum of 7dB(A) at distances of approximately 1000 feet from the noise source. Workplace standards would not be violated, and degradation of noise level quality would be slight.

f. Solid Wastes

Solid wastes from construction activities would consist of cleared vegetation and construction rubble. Approximately 49 tons of cleared vegetation would be produced. This may be landfilled or incinerated. Approximately 235 tons of construction refuse (wrapping paper, nuts and bolts, boxes and cans, broken and leftover materials) would be generated during the 7- to 10-year construction period.

g. Terrestrial Ecosystem

Eighty-four percent of the land area in the industrial park site (144 acres) has been designated as prime farmland by the Soil Conservation Service, in accordance with Federal directives. Construction of the gasifier and concomitant industrial park would remove this acreage from agricultural uses. An additional unknown amount of acreage surrounding this site would be affected and possibly removed from agricultural production due to the proximity of industrial activities.

It is estimated that 160.4 acres of the 173.6 parcel would be disturbed by construction activities. Sixty-four acres would be paved and be lost to drainage. Ninety-six acres would be revegetated and landscaped with ornamentals. Production annual losses of potential food and forage corps are 4879 bushels of corn, 95 tons of hay and 3.6 tons of burley tobacco.

The major effect of vegetation loss on wildlife species would be loss of living space, food, cover, nesting and breeding areas. Species which would be adversely affected are oppossum, skunk, racoon, fox, mourning dove, quail, rabbit and squirrel. It is estimated that approximately 1700 small mammals and 1100 song and gamebirds would be forced to relocate. Suitable habitats adjacent to the park site are probably fully occupied already. The level of competition for space, food and other life requirements would be keen for new residents. Increased noise levels and human disturbances may disrupt predator-prey relationships, mating habits and success of reproduction.

h. Aquatic Ecosystem

Impacts to the aquatic environments of North Elkhorn and Cane Run Creeks from construction activities would be minor and temporary. Anticipated worst case conditions are not severe enough to cause major changes in either water quality or aquatic fauna. Judging from the types of organisms found in these streams, stressed water quality conditions already exist. Addition of estimated sediment loads would not alter the existing community composition (fly larvae and Oligochaete worms) or cause loss of macroinvertebrates as food items for fish.

i. Threatened and Endangered Species

There are no species inhabiting the proposed park site classified as endangered or threatened by the Department of Interior. The turkey vulture, considered by the National Audubon Society as threatened, has been reported on the site. The open fields on the site probably serve as a portion of the feeding range of this species. Removal of this 174-acre tract from vegetated habit would result in a minor impact on the turkey vulture.

2. Operation

a. Surface Waters

Adverse effects to surface waters would be minor. The major impact would be increases in surface runoff from paved areas to surface water bodies. Runoff that currently acts as recharge to groundwater or ponds would be redirected through storm sewers to North Elkhorn Creek. Since the amount of paved area is a small percentage of the total drainage area, the redirection of this amount of runoff would not create a change in the flooding potential. Runoff from the industrial park would contain pollutants typical of urban runoff. Receiving streams would experience higher levels of COD, BOD, suspended solids, oils and greases, and metals.

b. Groundwater

Groundwater may suffer degradation from the same possible causes as surface water. The diverted runoff which would go to increase the flows of streams would decrease the flow of Royal Spring. Removing 40 percent of the land area in the industrial site from the recharge zone would result in a yearly volume reduction of 0.1 cfs. At an average spring flow of 25 cfs, this would be a reduction of 0.4 percent. This would have a negligible effect on the flow of Royal Spring.

c. Air Emissions

Air emissions from the gasifier and the user-industries would be slight after installation of air pollution control equipment. Flaring at the gasifier would occur for approximately three consecutive hours per year. Particulate emissions would amount to approximately 0.09 tons/year; NO_x emissions would amount to approximately 0.1 tons/yr; and SO_x emissions would amount to 0.2 tons/yr.

Emissions from combustion of the product gas by the user-industries would be negligible. Nitrogen oxide emissions would amount to 38 tons/year. Other process emissions from user-industries would amount to approximately 225 tons/yr of particulates, 470 tons/yr of fluorides, 0.124 tons/yr of carbon monoxide, 0.026 tons/yr of hydrocarbons, 0.474 tons/yr nitrogen oxides, 9.0 tons/yr of condensibles. and 5.4 tons/yr volatiles.

d. Noise

Ambient sound levels due to operations of the industrial facilities in the park would increase somewhat. The major noise increase would result from crushing and grinding operations at the gasification plant and from incoming trains that would emit sounds twice a month that would be an irritant to those nearby.

e. Solid Waste

Potential adverse impacts of solid waste generation would be mitigated by a permit designating proper disposal of the sulfur cake and tars and oils. The former would be suitable for sanitary landfilling. The latter contain carcinogenic components and would have to be disposed of in a special landfill capable of handling hazardous wastes. Provisions for such landfills have been made by the State of Kentucky.

f. Terrestrial Ecosystems

Air emissions would have a minor effect on vegetation and wildlife in and near the industrial park. Emissions from vehicular traffic would have the greatest effect. Hydrocarbon, particulate, and sulfur oxide emissions would not produce any noticeable effect on vegetation. Projected nitrogen oxide levels would cause reduced growth and leaf lesions. Lead concentrations from vehicle emissions would tend to be bound to the clay fraction of soils and not to enter the food chain.

CHAPTER VIII

ALTERNATIVES TO THE PROPOSED ACTION

A. Purpose

This chapter identifies reasonably available alternatives to the construction of the low-Btu coal gasifier. Possible alternatives include no action, building the gasifier at a different site in the Georgetown area, building the gasifier at a different site outside of the Georgetown area, and developing the industrial park without the gasifier.

B. Method

The methodology of this chapter is to describe and examine each of the alternative actions and identify the changes in impacts which would result from each action.

C. Organization

Section D describes the no action alternative. Section E describes the alternative of building the gasifier at another site in the Georgetown area. Section F describes the construction of the gasifier at a site beyond the Georgetown area. Section G covers the alternative of development of the industrial park without the gasifier as a source of energy.

D. No Action

The no action alternative assumes that neither the industrial park nor the gasifier would be constructed. In this instance, the status quo would be maintained. None of the impacts identified in previous chapters would occur.

The greatest impacts in the no action alternative would be to the developer and the Department of Energy. Agreements between DOE and Irvin Industrial Development would be cancelled. Irvin Industrial Development's option to purchase the land from Industrial Development, Inc. would expire.

However, the no action alternative does not mean that the area would not at some time in the future be developed in an industrial fashion. The acreage would still be zoned industrial and be owned by Industrial Development, Inc. They may choose to develop the land at any time in accordance with local zoning and land use criteria.

The Department of Energy is vitally interested in the development of new technologies which could provide new sources of environmentally acceptable fuel. Low-Btu coal gasification is one such technology. If this gasifier is not built, much knowledge that would be gained as to the feasibility of this technology would not be generated. Also, studies and experiments which would be performed by the Kentucky Center for Energy Research would be eliminated. Consequently, a valuable data base would be lost.

In response to the PON, several proposals besides the one prepared by IID were submitted. The most promising sites were visited. If the no action alternative were to be realized it is possible that DOE could select one of the other plans. However, the time, effort, and monies already expended on the Georgetown project would be lost.

E. Construction of Gasifier and Industrial Park at an Alternate Site in the Georgetown Area

In accordance with the Council on Environmental Quality (CEQ) memorandum, this alternative must be examined in detail because of the prime farmland issue. The areas zoned industrial in Georgetown are shown in Figure VIII-1. Another industrially zoned area (Delaplain) exists to the north of Lemons Mill Road (herein known as Area 1) and along Interstate 75 (herein known as Area 2).

The developer of the Delaplain area can offer several attractions to industries which do not exist at other industrially zoned parcels of land. This park does not get its water from the Georgetown Municipal Water and Sewer Service but from the Kentucky-American Water Company. Also, the developer owns and operates his own sewage treatment plant. However, county officials believe this plant is inadequate to meet current demands, and Little Eagle Creek, its discharge point, is experiencing severe degradation (Moody, 1978).

Relocation of the proposed action to the Delaplain area would lessen some impacts and heighten others. Since the recharge zone of Royal Spring lies to the south of Lemons Mill Road, impacts to Royal Spring during construction and operation of the gasifier would be eliminated. However, North Elkhorn Creek flows between Area 1 and Area 2. Due to its proximity to the park, the possibility of contaminating its waters would be greatly increased (Moody, 1978).

This other industrial park also contains prime farmland; 55 percent of the more than 400 acres has been so designated. (This is a smaller percentage than the 83 percent found in the proposed site south of Lemons Mill Road.) Moreover, most of this acreage is found in the middle of the Delaplain park. It is possible that IID could purchase 174 contiguous nonprime farmland acres in the Delaplain industrial area.

The ease with which Irvin Industrial Development could relocate the gasifier in the other industrial park area depends upon whether they could purchase sufficient acreage at a price equal to or below that of the 7.1 acre tract which they have an option to buy. IID would lose the ability to determine what industries would inhabit the industrial park. Proper coordination with the developers of the other park and industries that would be using the product gas would be necessary to ensure optimum use of the fuel.

Alternatively, Irvin Industrial Development, Inc. could choose to purchase an equivalent amount of land (174 acres) as that contained in the present site and develop it much along the same lines as now envisioned.

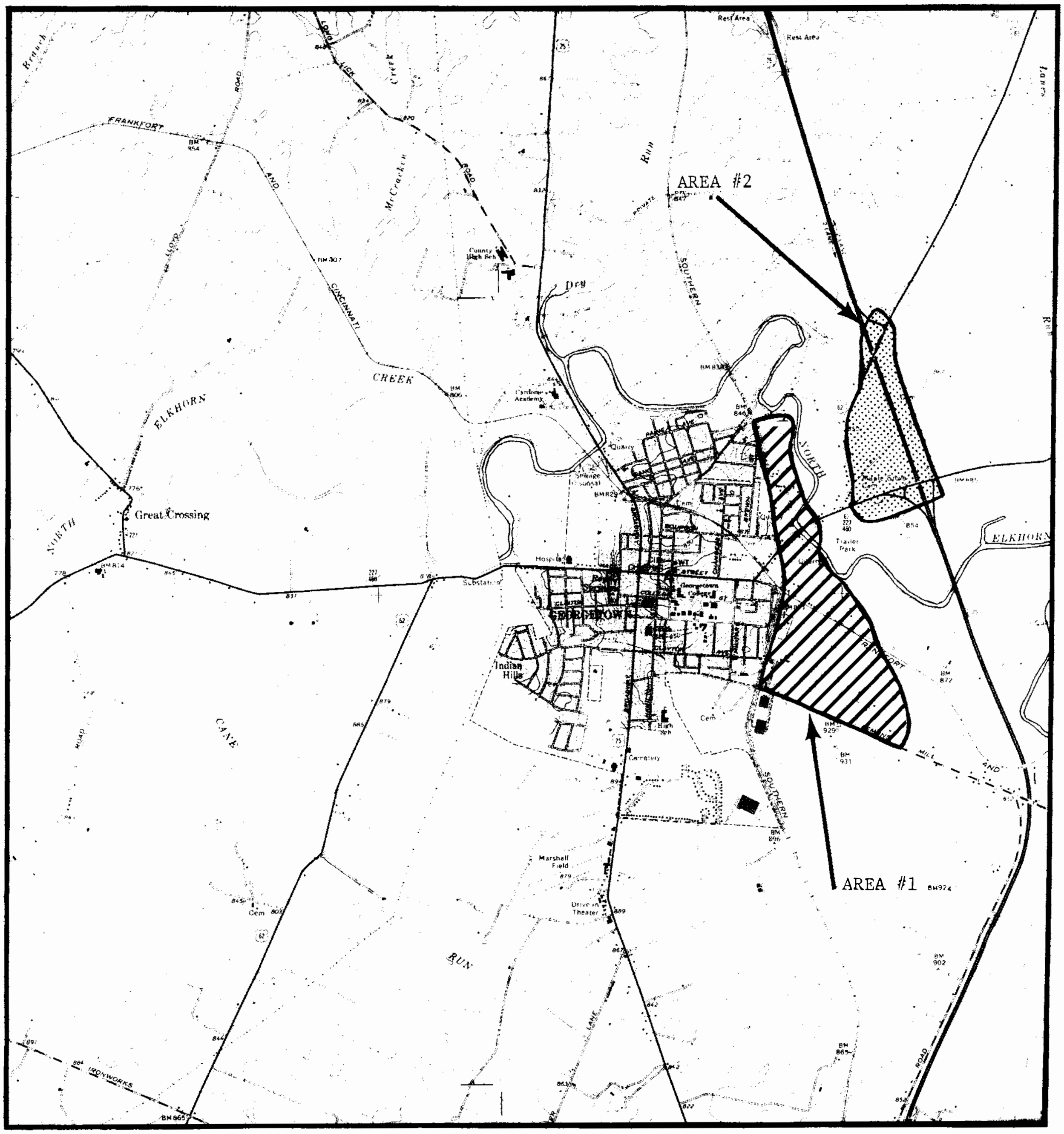


FIGURE VIII-1
ALTERNATIVE SITES WITHIN GEORGETOWN AREA

This possibility would depend upon availability of 174 contiguous acres and the willingness of the current owner to sell the land at a price acceptable to Irvin. Because of advantages to potential industrial occupants (assured water supply from Kentucky-American Water Co., existing wastewater treatment facility, and tax breaks) this acreage is selling at a price five times greater than other areas (Moody, 1978).

The Southern Railroad line runs adjacent to industrial Area 1 north of Lemons Mill Road and Interstate 75 runs through the middle of Area 2. Highway transportation problems would be about the same as those encountered in constructing the industrial park on the site presently under consideration if the gasifier were located in Area 1. They would be nearly eliminated if the gasifier were located in Area 2. All construction materials, heavy equipment and coal supplies could be brought in via the interstate highway and access road, and traffic patterns in Georgetown would suffer little or no disruption.

F. Construction of Gasifier and Industrial Park at Site Beyond the Georgetown Area

The coal that would feed the gasifier would come from Breathitt County, Kentucky. Many argue that the gasifier should be located at a site which is much closer to the source of fuel. Transportation of the coal over the 200 miles would be eliminated. However, that coal used for experimentation would still have to be transported via truck or railroad.

The major barrier to the construction of the gasifier at any site is the existence of customers within a small radius. Low-Btu gas cannot economically be pumped more than a few miles. Consequently, all users of the gas must be located within two or three miles of the gasifier. It is this limitation which makes low-Btu gas a good fuel for the members of an industrial park.

Two alternatives would exist if it became necessary to relocate the gasifier nearer the source of fuel. The first would be to locate the gasifier within an existing industrial park. It is almost certain that existing manufacturers in areas close to coal mines have been designed to derive their energy from direct combustion of coal. Retrofitting of these facilities so that they may burn low-Btu gas would be costly and time consuming.

An optimum situation would exist if the industries can be outfitted to use the gas initially. The second alternative would be to recreate the gasifier and make-up of the industrial park at the new location. The feasibility of this would depend mostly upon the availability of land at a price acceptable to the developer and the developer's willingness to relocate.

G. Development of Industrial Park Without Gasifier

If the gasifier is not built, the industrial park would develop anyway. The area in question has been zoned industrial since 1973. Industrial Development, Inc. purchased the land with that knowledge,

Table VIII-1. Park Make-Up Without Coal Gasifier

	Typical Company	Area Requirements	Number Employees	Energy Requirements
1.	Seat Belt Manufacturer	70,000 sq. ft.	400	Electric for heating, air conditioning, lighting and power.
2.	Garment Manufacturer	100,000 sq.ft.	520	Same as Seat Belt Manufacturer
3.	Soft Drink Bottling Plant	125,000 sq. ft.	80	*Coal-fired steam boilers 200 billion Btu/year plus electric for lighting and power equipment.
4.	Commercial Warehousing	225,000 sq. ft.	10 - 15	*Fuel oil or propane 18 billion Btu/yr. plus electric for lighting and office air conditioning.
5.	Lumber Yard and Custom	7 Acres Total (including sheds, mill and offices)	20 - 25	Electric for heating office, air conditioning, lighting and power equipment.
6.	Commercial Electric Parts and Service	20,000 sq. ft. 5 acres required for storage and trucks.		Electric for heating, air conditioning and power tools.
7.	Truck and/or Farm Implement Dealer, 10 acres required for show room, service and outside storage.		20 - 25	Electric for heating, air conditioning and power tools.
8.	Paper Products Manufacturer	250,000 sq. ft.	100 - 150	*Coal-fired steam boilers 300 billion Btu/yr. plus electric for air conditioning, lighting and equipment.
9.	Remaining 17 lots would be sold for light manufacturing and assembly operations		100 - 150	*Electric for air conditioning, and equipment, fuel oil or propane for heating and processing (136 Btu/year).
	TOTALS		1660 - 1930	a. Electric - undefined b. Coal-fired boilers 500 Billion Btu/year c. Fuel Oil or Propane 154 Billion Btu/year

*Most economical fuel with gas not available.

Source: T.E. Lohr, 1977.

had it platted, and constructed a main road through the park. Industrial Development, Inc.'s actions, the location of the park adjacent to the railroad and near an interstate highway and the presence of three other plants make the chances of changing the zone back to agricultural remote (Snyder, 1977). Cancellation of plans to build the gasifier would only delay start-up time of the park.

In the event that the gasifier is not built, Irvin Industrial Development has compiled a list of probable inhabitants of the park. This list is shown in Table VIII-1. IID maintains that if the gasifier does not provide energy to the industries the character of the industries would change substantially, becoming more employee intensive and less energy dependent. The number of employees would be four to five times greater (1660-1930 persons) than the number if the park is developed with the gasifier (426-532 persons). However, the energy needs of the nongasifier park postulated by IID show no great increase over that required by the gasifier park; 500 billion Btu/yr for the park with the gasifier and 600 billion Btu/yr for the park without the gasifier. Electrical requirements are undefined in both cases. Energy needs would be supplied by coal-fired boilers and fuel oil or propane. To the extent that coal would be used, it would still have to be transported from coal producing areas.

No analysis has been conducted to confirm or deny the postulated increase in park employees, however, if this increase were realized, it would have a greater socioeconomic impact on Georgetown. Impacts identified in previous chapters would be heightened. The fire department would have to be upgraded to a full-time work force and new fire-fighting equipment and trucks purchased. The housing shortage would be even more acute. Whether local builders could keep up with the influx of people would depend upon the rate at which the industrial park filled. The eighteen month lead time provided by construction of the gasifier would be eliminated. The school system, which would be marginally adequate for the 500 employees projected for the industrial park with the gasifier would be overburdened with the additional 1000 employees slated for the non-gasifier park.

H. References

Council on Environmental Quality, Directive for Heads of Federal Agencies: Consideration of Prime Farmland in Environmental Impact Statements, 1977.

Lohr, T.E., 1977, Irvin Industrial Development, Inc., Correspondence October 11.

Moody, S., 1978, Georgetown Planning and Zoning Commission, personal communication.

Snyder, Robert L., 1977, Georgetown Planning and Zoning Commission, personal communication.

CHAPTER IX

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A. Purpose

This chapter summarizes the trade-offs between short- and long-term effects of the proposed action. This summary includes a description of the extent to which future options may be foreclosed.

B. Methodology

"Short-term" and "long-term" do not refer to any specific period of time but are viewed in terms of the relative time spans appropriate to environmentally significant consequences of the proposed action. Implications of the proposed action are considered in the context of long-term changes that are likely to occur in environmental systems. Impacts identified in Chapter V were reviewed, and their effects were extrapolated on future generations.

C. Organization

Sections D and E discuss the short- and long-term effects on the physical and biological environment and the socioeconomic environment, respectively.

D. Effects on the Physical and Biological Environment

1. Soils and Land Use

Currently, most of the industrial site is under cultivation. However, in 1973 the Georgetown-Scott County Planning Commission rezoned the acreage from Agricultural-1 to Industrial. Continued crop-growing on the site is not in keeping with the plans and goals specified in the Physical Development Plan (Scruggs and Hammond, Inc., 1974).

However, there has been a recent surge of concern about the loss of farmland. Farmers are now cultivating 367 million acres and approaching the 385 million acres ultimately available for cultivation. The nation is losing approximately 2.7 million acres per year to increased urbanization and industrialization. Approximately 1.3 million acres per year are being added to agriculture through expanded irrigation, drainage, land-clearing, and development of dryland farming. Thus, there is a net loss of 1.4 million acres of cropland annually (Cotner, 1977).

In response to this concern, the Council on Environmental Quality (CEQ) has required that all environmental impact statements written for Federal actions include agricultural land considerations. In conjunction with this, CEQ has stated that those farmlands should not be "irreversibly committed to other uses unless other national interests override the importance of preservation or otherwise outweigh the environmental benefits derived from their protection."

Also, the Department of Agriculture has been directed to perform an inventory of farmlands and determine which are prime or unique. Criteria for these categories were published in the Federal Register on August 23, 1977. Accordingly, the Kentucky Soil Conservation Service classified 58,000 acres in Scott County as prime farmland. One hundred forty-four acres in the park, including the 7.1 acre gasifier site, fall into this classification. An unavoidable long-term effect, if the gasifier and the industrial park are developed, would be that the option to use these lands for agricultural purposes would be foreclosed. Also, an unknown amount of additional prime farmland acreage surrounding the industrial park would be removed from agricultural uses due to indirect effects of the industrial park.

Additionally, that land area required for landfilling would be removed from other uses during its lifetime. That landfill which accepted the hazardous wastes (carcinogenic oils and tars) could not be used for residential or agricultural purposes after closure. Public access would be restricted. These represent long-term effects. However, the industrial park would not be solely responsible for the existence of these landfills. The Scott County landfill accepts wastes from many sources in the area and the hazardous waste landfill would accept wastes from other manufacturers in Kentucky. Both of them would exist whether or not the gasifier and industrial park did.

2. Water

Over 1,000,000 gallons of water would be required by the gasifier and the industrial park each day. This volume of water would not be available for agricultural, industrial, commercial, or residential uses for the lifetime of the park. However, most of this water would not be consumed by the industrial processes and would be returned to the hydrosphere. Consequently, its use by the industrial park represents only a short-term effect to the natural environment in the question of water availability.

If the industrial park were to not use water from the Kentucky-American Water Company, the water supply and water treatment facilities of Georgetown would be severely overtaxed by the demand put on them by the industrial park. However, the need could be met by building another reservoir and by upgrading the existing treatment facility. It has already been realized that these represent potential problems with or without park demands. The construction of another reservoir has been recommended and is in the early planning stages. A 201 study (Proctor, Davis and Ray, 1977) on the area has been completed and the most appropriate avenue for upgrading the water treatment plant identified. Thus, the water demand of the industrial park would not create the problem but cause attention to be focused on it and perhaps hasten remedial action. Any stress created by the demand would be short-term.

Both surface and groundwater quality would be degraded. Although the best available wastewater treatment technology would be installed by each user-industry, complete removal of each pollutant would not be possible. Those which are not removed would be discharged to surface waters. Water quality degradation would continue as long as the park is in existence. However, even if all aqueous emissions from the park were to cease, that mass of pollutants already emitted would still be in the system. The period of time required for the hydrosphere to return to a pristine condition is unknown. This represents a long-term effect. It is not foreseen that water quality would be so impaired that Royal Spring or North Elkhorn Creek could not serve as drinking water supplies.

3. Air

Despite the installation of the most up-to-date air emission control equipment, degradation of air quality in the local area would occur. Some damage to plants is certain. Humans may experience degradation of health including increased risk of contacting cancer from long-term exposure to polycyclic aromatic hydrocarbons and trace elements which would be emitted during the gasification process.

However, of the possible kinds of emissions, carbon dioxide, carbon monoxide, trace elements, sulfur dioxide, nitrogen oxide, hydrocarbons and respirable particulates, only carbon monoxide would remain in the atmosphere for an extended period of time. The other constituents would be oxidized or combined with water vapor and return to the earth's surface as precipitation. These reactions would preclude any significant long-term effects on the atmosphere.

There is some evidence (Massachusetts Institute of Technology, 1970) that the world's supply of carbon dioxide is on the increase. The implications of this increase are not known. However, the quantity of carbon dioxide that would be contributed by the gasifier and user-industries would be only a minor percentage of that contributed by other sources.

4. Terrestrial Ecosystem

There are several short- and long-term effects to the biota at the proposed site. Almost all existing vegetation would be removed. Wildlife inhabiting the area (squirrels, rabbits, mice, quail) would be forced to relocate. Those botanical species which would be planted during landscaping activities would not provide suitable wildlife habitat. Thus, the use of this acreage by species currently existing there would be foreclosed. The repopulation of the area by city-dwelling species such as pigeons would be a long-term effect.

As individuals inhabiting the proposed site relocated there would be, at first, crowding, greater competition for food, interruption of breeding patterns, and interruption of predator-prey relationships. This, however, would be a short-term effect, and these patterns would be reestablished after integration of the individuals into the community.

Air emissions would have a continuing long-term effect on nearby vegetation. Vehicle emissions would increase levels of SO_x, NO_x, and carbon monoxide. The NO_x emissions would cause reduced growth of and leaf lesions on roadside vegetation.

5. Aquatic Ecosystem

Long- and short-term effects would be directly related to water quality. Although concentrations of pollutants discharged from facilities in the industrial park would not harm aquatic organisms, it is possible that some of the organisms and fish could bioaccumulate some of the metals or other substances. If these fish were consumed by humans on a regular basis, they might represent a threat to health.

E. Effects on the Socioeconomic Environment

None of the anticipated effects on the socioeconomic environment would be long-term or irreparable. Those facilities which would have to be upgraded, i.e., the fire department and housing, are barely adequate for the existing population. It is unlikely that Georgetown would experience zero growth in the next few years even without the gasifier and the industrial park. These social services would have to be improved to accommodate normal growth rates.

It is not expected that construction of the industrial park would cause the increase in population to occur suddenly. Seven to ten years would be required for construction and the growth in population would occur over this time frame. Any loss of social ambience would be short-term and would occur at the start-up of each facility. The profile of this "loss" would drop off after an initial period of stabilization and integration of the newcomers into the society.

Energy is not a renewable resource. Loss of the energy consumed annually by the occupants of the industrial park would be permanent. However, this energy would be used to fuel plants that would be producing goods to be ultimately consumed by the national population.

F. References

Cotner, Melvin L., 1977, "Land Use Policy and Agriculture: A State and Local Perspective," U.S.D.A., ERS-650, February.

Massachusetts Institute of Technology, 1970, Man's Impact on the Global Environment, Report of the Study of Critical Environmental Problems, MIT Press, Cambridge, Mass.

Proctor, Davis and Ray, 1977, Georgetown, Kentucky, 201 facilities plan, 1976-1996.

Scruggs and Hammond, Inc., 1974, Georgetown-Scott County Physical Development Plan: prepared for Georgetown-Scott County Planning Commission.

CHAPTER X

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES THAT WOULD OCCUR AS A RESULT OF THE PROPOSED ACTION

A. Purpose

This chapter qualitatively and quantitatively assesses the irreversible and irretrievable commitment of resources that would occur as a result of the development of the industrial park and the low-Btu coal gasifier.

B. Methodology

The resources used during the construction and operation phase of this project were identified. The main areas examined were materials, manpower, commitment of land, and feedstocks. Commitment of these resources was quantified as much as possible.

C. Organization

Section D describes the consumption of materials during construction. Section E discusses the commitment of raw materials including coal. Section F discusses labor needs. Section G covers commitment of land. Section H addresses loss of water quality. Section I examines loss of biota. Section J addresses loss of socioeconomic status quo.

D. Commitment of Building Materials

Construction of buildings and pavement of roads and parking lots would commit materials; between 25 and 50 percent (43 to 87 acres) of the park would be paved. The total amount of building area in the park would be approximately 720,000 square feet. Kinds and amounts of materials that would be expended in the construction of the gasifier and industrial park are quantified in Table V-4. For convenience the information is repeated below:

Construction Materials Required

Formed Concrete	730,000 cubic yards.
Structural Steel	6,000 tons
Metal Doors and Other Metal Products	12,000 tons
Wood	1,136,000 square feet
Roofing	1,172,000 square feet
Glass	1,200,000 square feet
Plaster	1,120,000 square feet
Tile and Resilient Flooring	2,326,000 square feet
Acoustical Ceiling	1,278,000 square feet
Paint	2,300 gallons
Plumbing and Sprinkling System	2,275,000 linear feet
Heating, Ventilation, Air Conditioning Systems	215 tons
Electrical Wiring	1,125,000 linear feet

Construction materials committed to the facility would include concrete, both cast in place and precast, electrical wire and switch gear, instruments, glass for windows and doors, asphalt paving materials, rubber and mastic caulking, light fixtures, and interior and exterior paint.

E. Commitment of Raw Materials

The major nonrenewable resource that would be consumed by the gasification facility would be coal. An estimated 26,280 tons of coal would be consumed each year by the facility. The source of coal would be the Elkhorn #3 seam in Breathitt County, Kentucky. At the current rate of consumption, there is a 200-year supply of coal available from that area.

Total national reserves of coal are estimated to be more than 400 billion tons. Of this, 280 billion tons are considered to be recoverable. In Appalachia, the national reserve of coal amounts to 105 billion tons with 67 billion tons being recoverable (ERDA, 1977). If the gasifier operates for fifty years approximately 1,300,000 tons of coal would be used, 0.0003 percent of the total national reserve and 0.0005 percent of the total recoverable reserve.

Coal used at the facility would not be lost in the strictest sense. It would be converted to another fuel; gas with an energy content of 150-165 Btu/scf. The conversion efficiency of the entire gasification process is approximately 80 percent. Use of coal in this manner would conserve approximately 59,320 barrels of #2 fuel oil/ year or 290,000 million cubic feet (mcf) natural gas/year.

Other raw materials consumed by the gasification process would be 10 tons/year of soda ash, 0.5-0.75 tons/year of glycerine inhibiters, and 114 gallons/hour of make-up water. Actually, 72,000 gallons of water would be required by the process each day. However, the bulk of this would not be consumed but treated and discharged.

Raw materials that would be consumed in the production processes of the two glass products manufacturers (glass container and miniature light bulb facilities) would include glass, sand, soda ash, limestone, and feldspar. A small amount of nonrecoverable water (2.75 gal/ton of product) would be used by the glass container manufacturer for batch dust suppression.

The ceramic tile manufacturer would use talc, ball clay, and kaolin. Other possible raw materials would include soapstone, feldspar, silica, pyrophyllite, nepheline syenite, wallastonite, dolomite, whiting and stratite. Some nonrecoverable water would be added to the batch to increase plasticity.

In the metal heat treating and fabricating facilities, the major raw materials would be the workpieces and sheet stock to be acted upon. These pieces would be composed mainly of steel, copper, or aluminum. Other raw materials would be components of the baths. In the wood facility, the major raw material would be the wood pulp, round wood, or wood chips.

F. Commitment of Manpower

Construction of the gasifier would require approximately 21 persons for 66 weeks. This is equivalent to 28 man-years. Construction of the industrial park would require approximately 35 persons working for 7-10 years. This amounts to a labor commitment of 265-350 man-years. Operation of the facilities in the industrial park would require between 426 and 532 employees (Lohr, 1977). Operation of the gasifier would require 14 full-time employees for a total of 440 to 546 employees. If the life of the park is 50 years this amounts to 22,000 to 27,300 man-years expended.

G. Commitment of Land

The land which would be used by the gasifier and the industrial park (173.6 acres) would be removed from other uses for the lifetime of the park or approximately 50 years. Razing the buildings and tearing up the pavement would be required if it was necessary to return the land to agricultural use. This action would result in considerable expense.

One hundred forty-four acres on the site have been declared prime farmland. Construction of the gasifier and the park would remove this acreage from agricultural uses. Approximate annual crop and forage production losses from the site would be 4880 bushels of corn, 95 tons of hay, and 3.6 tons of burley tobacco. This would amount to 244,000 bushels of corn, 4800 tons of hay, and 180 tons of burley tobacco over the lifetime of the industrial park (50 years).

Also, an indeterminable amount of land surrounding the industrial park would be lost to agricultural purposes. This would be due to the indirect effects of the proximity of industrial operations. The amount of crop production lost from these adjacent areas cannot be quantified.

H. Loss of Water Quality

It is undeniably true that surface and groundwater quality would be affected by the construction and operation of the proposed gasifier and industrial park. However, degradation of water quality would not occur during normal operations of the gasifier and user-industries so long as their effluent discharges did not exceed State and Federal regulations. It is anticipated that North Elkhorn Creek and Royal Spring could continue to serve as drinking water supplies to Georgetown.

Severe degradation of Royal Spring would occur if an accidental release of the entire volume of untreated wastewaters occurred. In this eventuality, total suspended solids, iron, lead, and zinc would exceed water quality standards. The length of time that would be required to flush the contaminants from the system is not known. If the gasification system were to rupture, all Federal and State water quality standards would be exceeded. The spring could no longer serve as a source of drinking water.

An accidental spill of the entire volume of untreated wastes into North Elkhorn Creek would result in levels of iron and manganese that exceeded water quality standards. The effects of these increases would be entirely aesthetic. Objectionable tastes imparted in drinking water and stains to porcelain plumbing fixtures would result. The length of time that would be required to return the system to its pre-spill state is not known.

I. Loss of Biota

Clearing of the industrial park site would result in permanent loss of the existing vegetation which would be incinerated, landfilled, or plowed under. Forty-nine tons of woodlot and fencerow vegetation would be removed, and 387 tons of old-field type vegetation would be plowed under.

It has been estimated that 1700 small mammals and 1100 songbirds and gamebirds would be forced to migrate. Relocated individuals would experience increased competition for space, food, and other life requirements and would be more susceptible to predation, disease, and adverse weather conditions. These effects would cause a higher mortality rate than normal.

J. Loss of Socioeconomic Status Quo

Georgetown, Kentucky has existed since revolutionary times. The inhabitants want to preserve its colonial, old-world charm, and small town atmosphere. Citizen opposition is not directed so much to the gasifier as to the industrial park. Many believe that the additional population resulting from implementation to the proposed action would impair these qualities of Georgetown; many hold a no-growth attitude. However, due to its proximity to rapidly growing population centers, Georgetown cannot hope to maintain a no-growth policy.

It is true that the population of Georgetown would increase with the additional job market offered by the proposed manufacturing facilities. Social services (especially the fire department) and housing would have to be upgraded. However, these amenities are barely adequate for the existing population, and the proposed action serves to identify these problem areas rather than create them. The population growth related to the industrial park development would occur over a 7- to-10 year period. This would provide time to improve lacking social facilities. Additional revenues would be available for preserving historic areas and maintaining a colonial atmosphere in old town Georgetown.

K. References

Energy Research and Development Administration, 1977, Coal Research, Development and Demonstration Program, ERDA-1557-D.

Lohr, T., 1977, Irvin Industrial Development, Inc., Personal Communication.

CHAPTER XI

ENVIRONMENTAL TRADE-OFF ANALYSIS

A. Purpose

This chapter compares environmental implications of the proposed action and the available alternatives which were identified in Chapter VIII. It identifies relative environmental impacts associated with each option.

B. Methodology

The approach used in this section seeks to derive a qualitative representation of the relative merits of alternative options identified in Chapter VIII based on their anticipated impact on environmental features. The reasonably available alternatives identified in Chapter VII are no action (Alternative A), relocation of gasifier and industrial park at industrial area 1 (Alternative B), relocation of gasifier and industrial park at industrial area 2 (Alternative C), relocation of gasifier and industrial park nearer the source of coal (Alternative D), relocation of gasifier in an existing industrial park nearer the source of coal (Alternative E), and construction of only the industrial park in Georgetown (Alternative F). The major impact criteria of the proposed action were identified and the potential change examined on the basis of implementation of the alternative actions. The major impact criteria which were examined were soils, surface waters, groundwater, air, noise, solid wastes, terrestrial ecosystem, aquatic ecosystem, endangered and threatened species, and socioeconomic structure. Ways in which the impacts could change were elimination of the impact, no change in the impact, an increase in the magnitude of the impact, a decrease in the magnitude of the impact, the magnitude of the impact would not change but would be relocated to an area beyond Georgetown, and insufficient information existed to determine whether or not the impact would exist.

C. Environmental Trade-Off Analysis

1. Construction

Table XI-1 presents a grid composed of each of the reasonably available alternatives and each area of potential impact related to construction activities. For each combination of alternative and potential impact, it has been postulated how the impact would change.

a. No Action (Alternative A)

The no action alternative, i.e., not building the gasifier or the industrial park, would result in an elimination of the potential environmental and socioeconomic impacts in the Georgetown area.

Table XI-1. Changes in Potential Impacts During Construction Considering Selected Alternatives

	Projected Impacts									
Alternatives	Soils	Surface Water	Ground-Water	Air	Noise	Solid Wastes	Terrestrial Ecosystem	Aquatic Ecosystem	Endangered Species	Socioeconomic Structure
A = No Action	E	E	E	E	E	E	E	E	E	E
B = Relocation to Area 1	NC	I	E	NC	NC	NC	NC	I	U	NC
C = Relocation to Area 2	NC	I	E	NC	NC	NC	NC	I	U	NC
D = Relocation Near Source of Coal	R	U	U	R	R	R	U	U	U	NC
E = Relocation in Existing Industrial Park Nearer Source of Coal	D	D	E	D	D	D	D	D	U	U
F = Construction of Only Industrial Park in Georgetown	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC

Key: E = Impact would be eliminated
NC = No change in impact
I = Increase in magnitude of impact
D = Decrease in magnitude of impact
R = Magnitude of impact would remain the same but the impact itself would be relocated beyond the Georgetown area
U = Existence or magnitude of impact cannot be determined from available data

b. Relocation of Gasifier and Industrial Park at Industrial Area #1 (Alternative B) and Relocation of Gasifier and Industrial Park at Industrial Area #2 (Alternative C)

These two alternatives would result in no appreciable change of the proposed impacts to soils including disruption and erosion. The major earthmoving activities, grading and revegetating operations, would be much the same. The slope in Area 2 is steeper than that at the proposed park site south of Lemons Mill Road and, because of this, erosion may be more intense.

The impacts to North Elkhorn Creek would be magnified. It runs through these two alternative areas. Consequently, the distance that runoff would cover is much smaller. The sediment load of North Elkhorn Creek would be greatly increased during construction activities. Impacts to Cane Run from runoff from Area 1 would be decreased because it is located more than a mile to the south, twice as far as the distance between the proposed site and Cane Run. Impacts to Cane Run from Area 2 would be eliminated because North Elkhorn Creek lies between Area 2 and Cane Run. Consequently, it would intercept all runoff from Area 2. Additional degradation of Little Eagle Creek would occur due to the inadequacy of the treatment facility operated by the developer of the Delaplain area. Impacts to Royal Spring would be eliminated because neither Area 1 nor Area 2 is located in the recharge zone.

There would be no change in the amount of construction rubble generated. There may be a slight change in the mass and species of cleared vegetation. The type of wildlife habitat existing at the alternative industrial sites is the same as that present at the proposed site. Consequently, the same kinds and numbers of animal migrants would be expected. They would experience the same detrimental conditions, such as crowding, greater competition for food, interruption of breeding patterns, and interruption of predator-prey relationships. There are probably no additional impacts to endangered and threatened species other than slightly reducing the feeding zone of the turkey vulture. Impacts to the aquatic ecosystem would be increased but would still be minor; this would be attributed to the increases in suspended sediment from runoff.

There would be no change in the increase of noise level generated during construction activities. Those persons inhabiting the trailer park may experience increases over ambient levels. The socioeconomic impacts would not change because the proposed project would be relocated within the town of Georgetown, and the influx of population would remain the same.

c. Relocation of Gasifier and Industrial Park Nearer the Source of Coal (Alternative D)

Impacts to soils would be relocated and would be of the same order of magnitude. Whether or not they would increase or decrease would depend on the slope and kinds of soils present.

Impacts to surface and groundwater cannot be determined. They would depend on the exact location of the alternate site. Surface waters in a coal producing region have probably undergone significant degradation. Consequently, that sediment load produced during construction activities would probably not create noticeable additional degradation. However, if the receiving body is of pristine character, a significant decline in water quality may be experienced. Impacts to air quality, noise levels, and generation of solid wastes would not change in magnitude but would be relocated. The same vehicle emissions and fugitive dust emissions as expected from the proposed action would occur. The increases in existing noise levels would be the same but their impact on ambient noise levels would depend on the exact location. The volume of solid waste generated would be approximately the same. The impact of this volume would depend on the existence of an adequate landfill.

Impacts to the terrestrial and aquatic ecosystems and to endangered and threatened species cannot be determined. To the extent that the existing ecosystem is similar to that present at the proposed site, impacts would be much the same. If the terrain and vegetative cover are different, such as forested instead of old field, impacts would be significantly different. If the alternate location were to be highly urbanized and industrialized, impacts to wildlife would be mostly eliminated.

d. Relocation of Gasifier Nearer the Source of Coal in an Existing Industrial Park (Alternative E)

Implementation of Alternative E would result in a very large decrease in impacts to soil. Only 7.1 acres would be disturbed instead of the 174 acres required for the entire park. The area disrupted would be less than 5 percent of that involved if the entire industrial park were constructed. Likewise, impacts to surface and groundwater would be greatly decreased. In the case of groundwater, impacts would be largely eliminated. These decreases are related to the large reduction in sediment load which would be introduced into aqueous systems. The exact volume of runoff and sediment load would depend on the type of soil present, the topography, and proximity of a receiving water body.

Impacts to air quality would be greatly reduced and of much shorter duration. Fewer construction vehicles would be required. Total emissions would be much less and would be over an 18-month period instead of the 7-10 years required for constructing the entire industrial park. The same reduction in duration of increased noise levels would be applicable.

The volume of solid waste generated would be much smaller because only one structure would be built instead of twelve. Proper disposal of this volume would depend on an acceptable landfill.

Impacts to the terrestrial and aquatic ecosystems would be greatly diminished. If the terrain and groundcover were the same as that present at the proposed site, the number of migrants would decrease by approximately 95 percent. The impact of these migrants on the surrounding biota would be small and they would be easily absorbed into surrounding communities. Impacts to the aquatic ecosystem would be greatly decreased because the amount of sediment contributed from runoff during construction would be quite small.

Impacts to endangered and threatened species cannot be determined because it is not known which species would exist at the alternative site. Impacts to the socioeconomic environment are unknown but probably would be slight because few persons would be involved in construction activities.

e. Construction of Only the Industrial Park in Georgetown (Alternative F)

Construction of only the industrial park at the proposed site south of Lemons Mill Road would result in no change to the potential impacts to the physical, biological, or socioeconomic environments. This is because construction activities and length of construction would be principally the same whether the gasifier is built or not.

2. Operation

Table XI-2 presents a grid composed of each of the reasonably available alternatives and each area of potential impact related to operation of the gasifier and/or industrial park. For each combination of alternative and potential impact, it has been postulated how the impact would be altered.

a. No Action (Alternative A)

The no action alternative would eliminate all potential environmental impacts which might result from operation of the gasifier and industrial park at the proposed site.

b. Relocation of Gasifier and Industrial Park at Area #1 (Alternative B) and Relocation of Gasifier and Industrial Park at Industrial Area #2 (Alternative C).

As in the proposed action, these two alternatives would result in no appreciable impacts to soils themselves. However, implementation of either of these two alternatives would reduce the impact on prime farmland. Fifty-five percent of the 400 acres in the alternative industrial area park has been designated prime farmland. (Eighty-four percent of the 174 acres at the proposed site has been designated as prime farmland.) Also, most of this prime farmland is located in the center of the site. It is possible that the developer could acquire 174 contiguous acres of nonprime farmland at the alternative industrial park site. Thus, the crop-producing capacity of this land would not be lost.

If the gasifier and industrial park were relocated in alternative Area 1 or 2, impacts to surface waters, i.e., North Elkhorn Creek, from spills and accidental releases of untreated wastewater would increase. North Elkhorn Creek is adjacent to this area, and runoff would reach it more rapidly and directly. If the pollutants reached the creek through storm sewers or discharge pipes, the impacts would not change. Impacts to Little Eagle Creek would be greatly increased because of inadequacies of treatment system operated by that developer. Impacts to Royal Spring would be eliminated because neither area lies within the recharge zone.

Impacts to air quality, noise levels, and the terrestrial ecosystem and the generation of solid wastes would not change. Air emissions and increases in noise would be the same. Those residing in

Table XI-2. Changes in Potential Impacts During Operation Considering Selected Alternatives

Alternatives	Projected Impacts									
	Soils	Surface Water	Ground-Water	Air	Noise	Solid Wastes	Terrestrial Ecosystem	Aquatic Ecosystem	Endangered Species	Socioeconomic Structure
A = No Action	E	E	E	E	E	E	E	E	E	E
B = Relocation to Area 1	E	I	E	NC	NC	NC	NC	I	NC	NC
C = Relocation to Area 2	E	I	E	NC	NC	NC	NC	I	NC	NC
D = Relocation Near Source of Coal	U	U	U	R	R	R	U	U	U	U
E = Relocation in Existing Industrial Park Nearer Source of Coal	E	D	D	D	D	D	E	D	E	E
F = Construction of Only Industrial Park in Georgetown	NC	NC	NC	NC	NC	NC	NC	NC	NC	I

Key: E = Impact would be eliminated
NC = No change in impact
I = Increase in magnitude of impact
D = Decrease in magnitude of impact
R = Magnitude of impact would remain the same but the impact itself would be relocated beyond the Georgetown area
U = Existence or magnitude of impact cannot be determined from available data

the trailer park might experience increases in noise levels. The terrain and ground cover of the alternative industrial park sites appear to be similar to that at the proposed site. Consequently, the terrestrial ecosystem sould be similar. The proposed impacts on this ecosystem including those to endangered and threatened species should not change due to its similarity in character. The kind and volume of solid waste generated i.e., sludge, would not change and would be disposed of at the same landfill.

Impacts to the aquatic ecosystem would be directly related to water quality. It is expected that, if spills of polluting substances or untreated wastewater were to reach North Elkhorn Creek via runoff, there would be greater impacts to the aquatic ecosystem.

Since the gasifier and industrial park would still be located in the jurisdiction of Georgetown the projected population increase would not change. Consequently, the expected impacts to the socioeconomic environment would not be altered.

c. Relocation of Gasifier and Industrial Park Nearer the Source of Coal (Alternative D)

It cannot be postulated what the impact on prime farmland would be if the gasifier and industrial park were relocated in an area closer to the source of coal. Since it is now known that such a consideration must be made in all Federal actions, every effort would be made to locate the proposed gasifier and industrial park in an area not designated as prime farmland.

Potential impacts to surface waters and groundwaters are unknown. The proximity of streams is not known. Also, the character of the user-industries may change substantially. The wastewater volumes and constitutents which may be discharged would change.

Expected air emissions, increases in ambient noise levels, and the kinds and volumes of raw waste generated would remain the same so long as the identity of the industries remained the same. To the extent that these change, these three aspects may change. However, industrial users would still be required to obey air pollution and solid waste disposal regulations issued by the State and Federal government. It is not known what the terrestrial or aquatic ecosystems or socioeconomic conditions would be like. Therefore, it cannot be hypothesized what the impacts on these systems would be.

d. Relocation of Gasifier Near the Source of Coal in an Existing Industrial Park (Alternative E)

Implementation of this alternative would eliminate any impacts to prime farmlands. Approximately seven acres would be required to build the gasifier. This is a relatively small area, and ample space should be available in an existing industrial park for the gasifier. The existence of an industrial park would preclude the use of that acreage occupied by the park as farmland. If it were necessary to acquire the seven-acre plot on the boundaries of the existing park, it is unlikely that land area that close to industrial facilities would be under cultivation. Consequently, in either instance impacts to prime farmland would be eliminated.

Relative to expected impacts from operation of the gasifier and the industrial park, expected impacts from operation of only the gasifier would be much smaller in magnitude. This is true in all areas considered in Table XI-2. The actual decrease in impacts which would occur depends upon the exact location of the existing industrial park and conditions present.

e. Construction of Only the Industrial Park in Georgetown (Alternative F)

Operation of only the industrial park would result in no significant changes in impacts to the physical and biological environments so long as the character of the industries remained much the same as projected. However, if the user-industries were to significantly change, the volumes and constituents of wastewaters may change also. Spills or accidental discharges may have a greater or lesser effect depending upon their nature. Impacts resulting from the gasifier would be eliminated. These would include coal pile runoff, coal dust emissions, air emissions from flaring, and solid wastes including coal ash, sulfur cake, and tars and oils.

Impacts to the socioeconomic environment would increase if, as the Irvin Industries' estimates indicate, the type of industries coming into the park would employ three to four times as many people as those coming to the park if the gasifier is constructed. The housing situation and the inadequacies of the fire department would be even more acute. Also, the school system probably would not be able to absorb the additional pupils.

APPENDIX A

ANALYSIS OF MAJOR SOILS MAPPED AT THE INDUSTRIAL PARK SITE

APPENDIX A

Soil Phase: Maury silt loam   **Profile No.: 72Ky105-6 (1-9*)**

Classification:
Sub-Group: Typic Paleudults
Family: Clayey, mixed, mesic

Location: Scott County, Kentucky, east side of US 62; 3/10 mile north of US 227, about 1.2 miles northeast of Georgetown.

Moisture when sampled: Moist

Sub-Sample Number	Hori-zon	Depth Inches	Description
1	Ap	0-8	Dark brown (7.5YR 3/2), crushed dark yellowish brown (10YR 3/4), dry pale brown (10YR 6/3) silt loam; moderate fine and medium granular structure; very friable; many small roots; slightly acid; gradual smooth boundary.
2	A3	8-16	Dark brown (7.5YR 3/2), crushed brown (7.5YR 4/4) silt loam; weak fine and medium granular structure; very friable; common small roots; few small pores; slightly acid; clear, smooth boundary.
3	B1	16-21	Brown (7.5YR 4/4) silt loam; weak fine granular and weak fine subangular blocky structure; very friable; few small roots; few small pores; few small pockets or cavities filled with earth worm casts; slightly acid, clear, smooth boundary
4	B21t	21-29	Reddish brown (5YR 4/4) silty clay loam; moderate medium subangular parting to moderate very fine angular blocky structure; friable; few small roots; few small pores; few small black concretions; many clay films; slightly acid; gradual smooth boundary.
5	B22t	29-36	Yellowish red (5YR 4/6) silty clay; moderate medium angular blocky parting to moderate very fine angular blocky structure; friable; few small roots; few small pores; common small black concretions; many clay films; few very small chert flecks; slightly acid.

Sub-Sample Number	Hori-zon	Depth Inches	Description
6	B23t	36-42	Same as above; divided for sampling; gradual smooth boundary.
7	B24t	42-51	Yellowish red (5YR 4/6) clay; moderate medium angular blocky parting to very fine angular blocky structure; firm; occasional small root; common small black concretions and soft material; many clay films; common small yellow chert flecks and few fragments 1 inch across; slightly acid; clear, smooth boundary.
8	B25t	51-58	Brown (7.5YR 4/4) clay; moderate medium angular blocky parting to very fine angular blocky structure; firm; occasional small root; common soft black concretions; many clay films; common small chert flecks; slightly acid; abrupt wavy boundary.
*9	B3t	58-75	Horizonal layers of brown (7.5YR 4/4) and pale brown (10YR 6/3) clay; weak medium angular blocky structure; very firm; occasional root in upper few inches; common small black concretions and few horizonal layers of soft black material; many clay films; common small yellow chert flecks; medium acid.

Maury silt loam — SOIL NO. S72Ky105-6-(1-9*) LOCATION Scott County, Kentucky

AGRONOMY DEPARTMENT
UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY 40506

General Methods: 1A1, 1A2, 1B1b, 2A1, 2B

Depth in	Horizon	3A1x Size Class and Particle Diameter (mm): Total: Sand (2-0.05)	Silt (0.05-0.002)	Int. IV Clay (< 0.002)	Sand: Very Coarse (2-1)	Coarse (1-0.5)	Medium (0.5-0.25)	Fine (0.25-0.1)	Very Fine (0.1-0.05)	Silt: (0.05-0.02)	Int. III (0.02-0.002)	Int. II (0.2-0.02)	Int. I (2-0.2)	Sand Coarser Than VF (2-0.1)	VFS Plus Silt (0.1-0.002)	Textural Class	2A2 Coarse Fragments: >2 Pct.	2-19 Pct. of < 76 mm	19-76
		← Pct. of < 2mm													→				
0-8	Ap	6.0	69.5	24.5	0.6	2.1	1.4	1.0	0.9					5.1	70.4	sil			
8-16	A3	5.3	68.6	26.1	0.4	1.8	1.3	0.9	0.9					4.4	69.5	sil/sicl			
16-21	B1	5.9	63.9	30.2	0.6	2.1	1.3	0.9	1.0					4.9	64.9	sicl			
21-29	B21t	8.2	53.4	38.4	1.4	2.9	1.5	1.2	1.2					7.0	54.6	sicl/sic			
29-36	B22t	9.5	44.1	46.4	1.4	3.2	1.7	1.6	1.6					7.9	45.7	sic			
36-42	B23t	10.8	38.1	51.1	1.7	2.9	1.8	2.2	2.2					8.6	40.3	c/sic			
42-51	B24t	10.8	34.8	54.4	0.8	1.7	1.7	3.2	3.4					7.4	38.2	c			
51-58	B25t	16.1	29.4	54.5	0.7	1.7	3.0	6.3	4.4					11.7	33.8	c			
58-75	B3t	15.6	27.2	57.2	0.3	1.4	2.2	5.7	6.0					9.6	33.2	c			

Depth in	8C1 pH: 8C1a (1:1) H_2O	8C1c (1:1) KCl		5A1 Exchangeable Bases: 6N2x Ca	6O2x Mg	6Q2a K	6P2y Na	5B1a TEB	5A1a CEC	Base Saturation: 5C1 Pct	5C3 Pct	Al meq/100 gm	6H1a E.A. meq/100gm	5A3a SC meq	Fe_2O_3 Pct		6A1a Organic Matter Pct	6E7 $CaCO_3$ eq %	6S6 P Bray No.1 ppm
				← meq/100 gm					→										
0-8	6.25	5.45		10.8	0.12	0.94	0.07	11.93	15.8	75.5	38.13		19.36	31.29			4.80	0.51	195
8-16	5.25	4.7		6.5	0.08	0.53	0.06	7.17	12.5	57.4	26.74		19.64	26.81			1.61	0.27	220
16-21	5.95	4.65		7.8	0.09	0.57	0.12	8.58	14.9	57.6	30.40		19.64	28.22			0.97	0.24	255
21-29	6.0	4.85		10.0	0.10	0.77	0.11	10.98	17.1	64.2	32.78		22.52	33.50			0.42	0.23	432.5
29-36	6.4	4.9		11.8	0.11	0.60	0.15	12.66	17.8	71.1	33.80		24.80	37.46			0.33	0.28	492.5
36-42	6.1	4.9		13.0	0.09	0.41	0.12	13.62	21.1	64.5	34.45		25.92	39.54			0.33	0.25	500
42-51	5.8	4.4		13.5	0.14	0.36	0.13	14.13	23.6	59.9	33.38		28.20	42.33			0.33	0.34	467.5
51-58	5.35	3.85		10.3	0.02	0.30	0.10	10.72	24.6	43.6	25.31		31.64	42.36			0.32	0.44	450
58-75	5.3	3.9		16.4	0.08	0.38	0.13	16.99	28.8	59.0	36.88		29.08	46.07			0.34	0.49	422.5

Mineralogical Analysis—Estimated Percentage (±10) in Various Size Fractions

Depth	Silt: 50-20μ	20-10μ	10-5μ	5-2μ	Clay: 2-0.2μ	0.2-0.08μ	< 0.08μ		Total Mineralogy Whole Soil Basis

A-3

S72KY-105-6-(1 to 9*)

7A2

Mineralogical Analysis—Estimated Percentage (± 10) in Various Size Fractions

Depth in	Silt 50-20μ	Silt 20-10μ	Silt 10-5μ	Silt 5-2μ	Clay 2-0.2μ	Clay <0.2μ	Total Mineralogy Whole Soil Basis
0-8	Q90 F10	Q90 F10	Q85 F10 I5	Q80 K10 F5 I5	K35 Vc30 I25 Q10	Vc45 K30 I25	
8-16	Q90 F10	Q85 F10 I5	Q90 F5 I5	Q80 I15 K5	Vc35 K30 I20 Q15	Vc60 K35 I5	
16-21	Q95 F5	Q90 I5 K5	Q90 K5 I5	Q90 K5 I5	Vc35 K35 I20 Q10	Vc70 K30	
21-29	Q95 F5	Q95 F5	Q80 I10 K5 F5	Q80 I10 K5 F5	Vc45 K30 I15 Q10	Mc75 K25	
29-36	Q85 F15	Q90 I5 F5	Q80 I10 K5 F5	Q90 I5 F5	Vc45 K25 I20 Q10	Mc80 K20	
36-42	Q95 F5	Q95 I5	Q90 I10	Q85 I10 K5	Vc45 K25 I20 Q10	Mc85 K15	
42-51	Q100	Q90 I10	Q85 I15	Q80 I20	I65 Vc15 K15 Q5	Mc80 K20	
51-58	Q100	Q90 I10	Q85 I15	Q80 I15 K5	I45 Vc35 K20	Mc50 K25 I25	
58-75	Q100	Q100	Q80 I20	Q85 I15	Vc60 I30 K10	M40 I40 Mc20	

A-4

Depth in	Moisture Retention—Pct by Weight 0 bar	1/10 bar	1/3 bar	15 bar						Bulk Density (gm/cc)	Aeration Porosity (Pct)	3x2 Sand	Particle Size Fractionation — Pct of Soil < 2mm: Silt—Elutriation 3x2 50-20μ	20-10μ	10-5μ	5-2μ	Clay—Centrifug 2-0.2μ	0.2μ
0-8												6.84	15.73	26.01	23.47	11.51	15.52	0.97
8-16												6.41	16.09	23.08	16.80	14.30	19.10	4.02
16-21												7.26	14.57	23.63	16.74	12.10	20.77	4.93
21-29												9.56	14.28	17.51	16.07	5.36	25.89	11.33
29-36												12.85	11.30	13.60	10.42	9.03	31.12	11.61
36-42												15.07	10.79	11.66	13.52	25.75	30.86	6.23
42-51												12.41	9.84	8.07	7.36	7.19	36.68	18.46
51-58												21.20	7.44	6.36	6.37	5.90	35.66	17.08
58-75												18.01	7.19	5.50	6.65	8.04	39.63	14.99

Soil Phase: Lowell silt loam

Profile No.: 72Ky105-3 (1-8*)

Classification:
Sub-Group: Typic Hapludalfs
Family: Fine, mixed, mesic

Location: Scott County, Kentucky, 200 feet northwest of large barn, 6/10 mile north of US 227, 1.2 miles northeast of Newtown, about 6 miles east of Georgetown.

Moisture when sampled: Moist

Sub-Sample Number	Horizon	Depth Inches	Description
1	Ap	0-7	Brown (10YR 4/3) silt loam, moderate fine and medium subangular blocky and granular structure; very friable; many small roots; few small black concretions; medium acid; clear, smooth boundary.
2	A3	7-13	Brown (10YR 4/3) silt loam; weak medium subangular blocky parting to weak fine granular structure; very friable; common small roots; few small pores; few small black concretions; medium acid; clear, smooth boundary.
3	B21t	13-23	Yellowish brown (10YR 5/6) silty clay loam; moderate medium subangular blocky parting to fine angular blocky structure; firm; common small roots; few small pores; common smooth black concretions; many clay films; slightly acid; gradual smooth boundary.
4	B22t	23-30	Strong brown (7.5YR 5/6) silty clay; common fine faint light yellowish brown (10YR 6/4) mottles; moderate medium angular blocky parting to moderate fine angular blocky structure; firm; few small roots; few small pores; common small black concretions; many clay films; few black coatings; slightly acid; gradual, wavy boundary.
5	B23t	30-37	Yellowish brown (10YR 5/6) silty clay; few medium faint pale brown (10YR 6/3); other characteristics like horizon above; clear, smooth boundary.

Sub-Sample Number	Hori-zon	Depth Inches	Description
6	B24t	37-45	Yellowish brown (10YR 5/8) silty clay; few fine faint yellowish brown (10YR 5/4) mottles; moderate medium angular blocky parting to very fine angular blocky structure; firm; occasional small root; few small black concretions; many clay films; very strongly acid.
7	B31t	45-57	Yellowish brown (10YR 5/6) clay; common medium distinct light gray (10YR 7/1) mottles; weak fine and medium angular blocky structure; very firm; occasional root; few small black concretions; few clay films; diffuse smooth boundary.
*8	B32t	57-68	Yellowish brown (10YR 5/6) clay; many medium distinct light gray (10YR 7/2) mottles; massive and some weak fine angular blocky structure; extremely firm; many soft concretions and black stains in an irregular pattern; few slickensides; medium acid.

Note: 86 inches, bedrock-limestone; depth determined with tile probe.

Lowell silty clay loam SOIL NO. S72Ky105-3-(1 to 8*) LOCATION Scott County, Kentucky

AGRONOMY DEPARTMENT
UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY 40506

General Methods: 1A1, 1A2, 1B1b, 2A1, 2B

Depth in	Horizon	3A1x Size Class and Particle Diameter (mm) Total Sand (2-0.05)	Total Silt (0.05-0.002)	Total Int. IV Clay (< 0.002)	Sand Very Coarse (2-1)	Sand Coarse (1-0.5)	Sand Medium (0.5-0.25)	Sand Fine (0.25-0.1)	Sand Very Fine (0.1-0.05)	Silt (0.05-0.02)	Silt Int. III (0.02-0.002)	Int. II (0.2-0.02)	Int. I (2-0.2)	Sand Coarser Than VF (2.-0.1)	VFS Plus Silt (0.1-0.002)	Textural Class	2A2 Coarse Fragments > 2 Pct.	2-19 Pct. of < 76 mm	19-76 Pct. of < 76 mm
		← Pct. of < 2mm →																	
0-7	Ap	9.7	62.3	28.0	0.8	3.1	2.5	2.1	1.2					8.5	63.5	sicl/sil			
7-13	A3	6.7	60.0	33.3	0.6	2.2	1.7	1.4	0.8					5.9	60.8	sicl			
3-23	B21t	7.9	58.6	33.5	0.7	2.3	1.8	1.6	1.5					6.4	60.1	sicl			
3-30	B22t	10.3	52.4	37.3	1.0	3.5	2.3	2.1	1.4					8.9	53.8	sicl			
0-37	B23t	10.0	45.2	44.8	1.3	2.9	2.0	2.2	1.6					8.4	46.8	sic			
7-45	B24t	7.4	32.8	59.8	0.6	1.5	1.3	2.2	1.8					5.6	34.6	c			
5-57	B31t	6.1	29.8	64.1	0.3	0.9	1.1	2.1	1.7					4.4	31.5	c			
7-68+	B32t	2.3	33.1	64.6	0.1	0.3	0.3	0.7	0.9					1.4	34.0	c			

Depth in	8C1 pH 8C1a (1:1) H_2O	8C1c (1:1) KCl		5A1 Exchangeable Bases 6N2x Ca	6O2x Mg	6Q2a K	6P2y Na	5B1a TEB	5A1a CEC	Base Saturation 5C1 Pct	5C3 Pct	Al meq/100 gm	6H1a E.A. meq/100gm	5A3a SC meq	Fe_2O_3 Pct		6A1a Organic Matter Pct	6N7 $CaCO_3$ eq %	6S6 P Bray No.1 ppm
				← meq/100 gm →															
0-7	5.5	4.2		6.25	0.12	0.28	0.12	6.77	14.99	45.2	24.56		20.80	27.57			1.60	0.26	7.5
7-13	5.65	4.3		6.75	0.10	0.15	0.13	7.13	14.64	48.7	28.46		17.92	25.05			1.22	0.15	4
13-23	5.9	4.5		10.00	0.15	0.13	0.11	10.39	17.85	58.2	37.07		17.64	28.03			0.68	0.15	3
23-30	5.95	4.6		10.88	0.19	0.15	0.13	11.35	18.28	62.1	38.00		18.52	29.87			0.48	0.18	5
30-37	5.6	3.9		10.25	0.22	0.13	0.12	10.72	22.10	48.5	31.98		22.80	33.52			0.41	0.18	4
37-45	5.05	3.4		9.75	0.23	0.20	0.13	10.31	35.13	29.3	23.16		34.20	44.51			0.30	0.12	2
45-57	4.8	3.2		10.50	0.27	0.28	0.15	11.20	35.91	31.2	23.91		35.64	46.84			0.24	0.23	1
57-68+	4.9	3.25		22.25	0.35	0.31	0.15	23.06	34.70	66.5	48.79		24.20	47.26			0.19	0.13	2.5

Mineralogical Analysis—Estimated Percentage (± 10) in Various Size Fractions

Depth	Silt 50-20μ	Silt 20-10μ	Silt 10-5μ	Silt 5-2μ	Clay 2-0.2μ	Clay 0.2-0.08μ	Clay < 0.08μ	Total Mineralogy Whole Soil Basis

7A2

Depth in	Mineralogical Analysis—Estimated Percentage (±10) in Various Size Fractions: Silt 50-20 µm	Silt 20-10 µm	Silt 10-5 µm	Silt 5-2 µm	Clay 2-0.2 µm	Clay < 0.2 µm	Total Mineralogy Whole Soil Basis
0-7	Q90 Mi5 F5	Q90 Mi5 F5	Q85 Mi10 F5	Q90 Mi5 F5	V30 Mi25 Vc15 K15 Q15	Mc50 Mi50	
7-13	Q85 F10 Mi5	Q90 Mi5 F5	Q90 Mi5 F5	Q85 Mi10 K5	V30 Mi25 K20 Q15 Vc10	Vc40 Mi40 K20	
13-23	Q90 F5 Mi5	Q75 F15 Mi10	Q85 Mi10 F5	Q85 Mi10 F5	V35 Vc25 Mi15 K15 Q10	Mt45 Mi40 K15	
23-30	Q90 F10	Q75 Mi10 F10 K5	Q90 Mi5 F5	Q85 Mi15	Vc40 V30 Mi15 K10 Q5	Mt70 Mi20 K10	
30-37	Q100	Q85 Mi10 K5	Q95 Mi5	Q90 Mi10	Vc35 V35 Mi15 K10 Q5	Mt55 Mi35 K10	
37-45	Q85 Mi10 F5	Q90 Mi10	Q85 Mi15	Q75 Mi25	V50 Vc20 Mi20 K5 Q5	Mt90 K10	
45-57	Q90 Mi10	Q85 Mi15	Q80 Mi20	Q70 Mi25 F5	V55 Mi25 K10 Vc5 Q5	Mt100	
57-68+	Q80 Mi15 F5	Q75 Mi25	Q65 Mi35	Q60 Mi40	V70 Mi20 K5	Mt100	

Depth in	Moisture Retention—Pct by Weight: 0 bar	1/10 bar	1/3 bar	15 bar						Bulk Density (gm/cc)	Aeration Porosity (Pct)	3x2 Sand	Particle Size Fractionation — Pct of Soil < 2mm: Silt—Elutriation 3x2: 50-20µ	20-10µ	10-5µ	5-2µ	Clay—Centrifuge 3x4: 2-0.2µ	< 0.2u
0-7												11.61	17.99	17.55	15.57	10.50	21.87	4.92
7-13												8.38	16.84	21.79	15.10	11.71	22.55	3.63
13-23												9.63	12.75	19.48	14.47	10.78	26.12	6.78
23-30												15.33	9.48	16.75	14.03	11.20	25.46	7.74
30-37												16.57	8.39	13.29	11.89	10.24	30.79	8.82
37-45												10.60	6.16	7.78	9.10	10.02	40.38	15.96
45-57												8.38	5.51	6.56	8.25	9.45	44.21	17.64
57-68+												4.97	5.84	6.34	10.47	11.93	47.35	13.10

Bulk Density, COLE, and Moisture – Saran coated [illegible]

Clod No.	Profile No.	Name	Horizon & Depth	$D_{b(m)}$	$D_{b(d)}$	$D_{b(d)}/D_{b(m)}$	COLE	% Moisture (wt)	% Moisture Volume
1	72Ky-120-1-4	Maury	B22t(23-32")	1.55	1.60	1.032	0.009	20.7	33.1
2	"	"	"	1.54	1.58	1.026	0.008	22.0	34.8
3	"	"	"	1.50	1.54	1.027	0.008	22.4	34.5
4	72Ky-120-2-4	Maury	B22t(27-38")	1.57	1.59	1.013	0.004	20.6	32.8
5	"	"	"	1.57	1.60	1.019	0.006	21.3	34.1
6	"	"	"	1.55	1.59	1.026	0.008	21.4	34.0
7	72Ky-120-3-4	Lowell	B22t(24-32")	1.43	1.61	1.126	0.040	27.7	44.6
8	"	"	"	1.41	1.59	1.128	0.040	28.8	45.8
9	"	"	"	1.40	1.59	1.136	0.042	28.2	44.8
10	72Ky-57-1-3	Lowell	B21t(16-23")	1.39	1.61	1.158	0.051	28.6	46.0
11	"	"	"	1.38	1.59	1.152	0.049	27.9	44.4
12	"	"	"	1.38	1.61	1.167	0.054	28.0	45.1
13	72Ky-105-1-4	Eden	B23t(13-24")	1.48	1.69	1.142	0.045	25.4	42.9
14	"	"	"	1.57	1.72	1.096	0.031	19.2	33.0
15	"	"	"	1.61	1.76	1.093	0.030	18.9	33.3
16	72Ky-105-2-2	Eden	B21t(5-19")	1.58	1.72	1.089	0.028	19.5	33.5
17	"	"	"	1.57	1.72	1.096	0.031	19.3	33.2
18	"	"	"	1.57	1.71	1.089	0.028	21.1	36.1
19	72Ky-105-3-4	Lowell	B22t(23-30")	1.61	1.68	1.043	0.013	19.2	32.2
20	"	"	"	1.59	1.65	1.038	0.010	20.4	33.7
21	72Ky-105-3-7	"	B31t(45-57")	1.43	1.66	1.161	0.052	27.7	46.0
22	72Ky-105-4-5	Lowell	B24t(35-44")	1.49	1.66	1.114	0.036	25.1	41.7
23	"	"	"	1.47	1.61	1.095	0.031	26.0	41.9
24	"	"	"	1.45	1.66	1.145	0.046	27.6	45.8
25	72Ky-105-5-4	Maury	B22t(25-35")	1.58	1.64	1.038	0.011	21.0	34.4
26	"	"	"	1.58	1.63	1.032	0.009	20.9	34.1
27	"	"	"	1.56	1.58	1.013	0.004	21.9	34.6
28	72Ky-105-6-5	Maury	B22t(29-36")	1.50	1.52	1.013	0.010	23.8	36.2
29	"	"	"	1.55	1.55	1.000	0	20.7	32.1
30	"	"	"	1.54	1.58	1.026	0.008	23.5	37.1
31	72Ky-105-7-2	Nicholson	B2t(8-18")	1.64	1.67	1.018	0.006	16.5	27.6
32	72Ky-105-7-3	"	Bx1(18-26")	1.67	1.68	1.006	0.001	16.1	27.0
33	"	"	Bx1(18-26")	1.65	1.65	1.000	0	17.0	28.0
34	72Ky-105-8-4	Nicholson	B22t(21-28")	1.56	1.56	1.000	0	17.5	27.3
35	"	"	"	1.61	1.57	0.975	-	18.0	28.3
36	72Ky-105-8-7	"	B3t(70-80")	1.55	1.64	1.058	0.018	21.9	35.9
37	"	"	"	1.54	1.65	1.071	0.022	23.0	38.0

No correction for coarse data. Gilpin & Jefferson have coarse fragments that would appreciably influence.
Moist Bulk Density - (D_{b_m}) - at time of sampling - slightly less than Field Capacity.
Volume percent moisture - at moisture content of Field. (These values should approach the low field capacity and might be more representative

APPENDIX B

BIRDS LIKELY TO OCCUR IN THE INDUSTRIAL PARK SITE REGION

APPENDIX B

BIRDS LIKELY TO OCCUR IN THE ENERGY PARK SITE REGION[1]

Common Name	Scientific Name	Status[3]
Common loon	*Gavia immer*	N.A.
Red-throated loon	*Gavia stellata*	N.A.
Red-necked grebe	*Podiceps grisegena*	R
Horned grebe	*Podiceps auritus*	N.A.
Pied-billed grebe	*Podilymbus podiceps*	N.A.
Double-crested cormorant	*Phalacrocorax auritus*	V
Great blue heron	*Ardea herodias*	C
Green heron	*Butorides virescens*	*
Little blue heron	*Florida caerulea*	C
Cattle egret	*Bubulcus ibis*	V
Great egret	*Casmerodius albus*	U
Black-crowned night heron	*Nycticorax nycticorax*	U
Yellow-crowned night heron	*Nyctanassa violacea*	R
Least bittern	*Ixobrychus exilis*	R
American bittern	*Botaurus lentiginosus*	U

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[1]Environmental Resources Inventory of the Lexington, Kentucky Urban Area by U.S. Army Corps of Engineers Topographic Laboratories, 1974 (includes all of Scott County).

[2]Species observed during the field survey.

[3]Status: C = Common to abundant, at least locally
U = Uncommon, but found regularly in small numbers
R = Rare, found infrequently but may be expected, especially at certain times of the year
V = Very rare or irregular
A = Accidental visitor
N.A.= Not Available
* - Indicates species breeds within the state

APPENDIX (Continued)

Common Name	Scientific Name	Status3
Canada goose	Branta canadensis	U
Snow goose	Chen caerulescens	R
Mallard	Anas platyrhynchos	N.A.
Black duck	Anas rubripes	N.A.
Gadwall	Anas strepera	U
Green-winged teal	Anas crecca	U
Blue-winged teal	Anas discors	*
American wigeon	Anas americana	N.A.
Northern shoveler	Anas clypeata	N.A.
Wood duck	Aix sponsa	*
Redhead	Aythya americana	U
Ring-necked duck	Aythya collaris	N.A.
Canvasback	Aythya valisineria	N.A.
Greater scaup	Aythya marila	R
Lesser scaup	Aythya affinis	N.A.
Common goldeneye	Bucephala clangula	N.A.
Bufflehead	Bucephala albeola	U
Ruddy duck	Oxyura jamaicensis	U
Hooded merganser	Lophodytes cucullatus	N.A.
Common merganser	Mergus merganser	N.A.
Red-breasted merganser	Mergus serrator	N.A.
Turkey vulture[2]	Cathartes aura	*
Black vulture	Coragyps atratus	U, *
Sharp-shinned hawk	Accipiter striatus	R, *
Cooper's hawk	Accipiter cooperii	U, *
Red-tailed hawk	Buteo jamaicensis	*
Red-shouldered hawk	Buteo lineatus	U, *
Broad-winged hawk	Buteo platypterus	U, *
Rough-legged hawk	Buteo lagopus	R
Golden eagle	Aquila chrysaetos	V
Bald eagle	Haliaeetus leucocephalus	N.A.
Marsh hawk	Circus cyaneus	N.A.
Osprey	Pandion haliaetus	U,
American kestrel	Falco sparverius	N.A.
Ruffed grouse	Bonasa umbellus	R, *
Bobwhite[2]	Colinus virginianus	U, *
Sandhill crane	Grus canadensis	V
King rail	Rallus elegans	V
Virginia rail	Rallus limicola	R
Sora	Porzana carolina	U
Common gallinule	Gallinula chloropus	R
American coot	Fulica americana	C

APPENDIX (Continued)

Common Name	Scientific Name	Status[3]
Semipalmated plover	Charadrius semipalmatus	U
Piping plover	Charadrius melodus	V
Killdeer[2]	Charadrius vociferus	C, *
American golden plover	Pluvialis dominica	R
Black-bellied plover	Pluvialis squatarola	R
Ruddy turnstone	Arenaria interpres	V
Common snipe	Capella gallinago	C
Upland sandpiper	Bartramia longicauda	V
Spotted sandpiper	Actitis macularia	N.A.
Solitary sandpiper	Tringa solitaria	C
Greater yellowlegs	Tringa melanoleuca	U
Lesser yellowlegs	Tringa flavipes	U
Red knot	Calidris canutus	V
Pectoral sandpiper	Calidris melanotos	U
White-rumped sandpiper	Calidris fuscicollis	V
Baird's sandpiper	Calidris bairdii	V
Least sandpiper	Calidris minutilla	U
Dunlin	Calidris alpina	R
Western sandpiper	Calidris mauri	R
Sanderling	Calidris alba	R
Short-billed dowitcher	Limnodromus griseus	R
Stilt sandpiper	Micropalama himantopus	R
Buff-breasted sandpiper	Tryngites subruficollis	V
Red phalarope	Phalaropus fulicarius	V
Wilson's phalarope	Steganopus tricolor	R
Northern phalarope	Lobipes lobatus	V
Glaucous gull	Larus hyperboreus	A
Herring gull	Larus argentatus	R
Ring-billed gull	Larus delawarensis	U
Bonaparte's gull	Larus philadelphia	R
Forster's tern	Sterna forsteri	R
Common tern	Sterna hirundo	U
Least tern	Sterna albifrons	R
Caspian tern	Hydroprogne caspia	R
Black tern	Chlidonias niger	V
Rock dove[2]	Columba livia	C, *
Mourning dove[2]	Zenaida macroura	C, *
Yellow-billed cuckoo[2]	Coccyzus americanus	C, *
Black-billed cuckoo	Coccyzus erythropthalmus	U, *

APPENDIX (Continued)

Common Name	Scientific Name	Status[3]
Barn owl	Tyto alba	U, *
Screech owl	Otus asio	C, *
Great horned owl	Bubo virginianus	R, *
Snowy owl	Nyctea scandiaca	V
Barred owl	Strix varia	R, *
Long-eared owl	Asio otus	V
Short-eared owl	Asio flammeus	U
Saw-whet owl	Aegolius acadicus	V
Chuck-will's-widow	Caprimulgus carolinensis	R, *
Whip-poor-will	Caprimulgus vociferus	R, *
Common nighthawk[2]	Chordeiles minor	C, *
Chimney swift[2]	Chaetura pelagica	C, *
Ruby-throated hummingbird	Archilochus colubris	U, *
Belted kingfisher	Megaceryle alcyon	U, *
Common flicker[2]	Colaptes auratus	C, *
Pileated woodpecker	Dryocopus pileatus	U, *
Red-bellied woodpecker	Centurus carolinus	C, *
Red-headed woodpecker	Melanerpes erythrocephalus	R, *
Yellow-bellied sapsucker	Sphyrapicus varius	C
Hairy woodpecker	Dendrocopos villosus	U, *
Downy woodpecker[2]	Dendrocopos pubescens	C, *
Eastern kingbird	Tyrannus tyrannus	C, *
Western kingbird	Tyrannus verticalis	V
Scissor-tailed flycatcher	Muscivora forficata	A
Great crested flycatcher	Myiarchus crinitus	C, *
Eastern phoebe	Sayornis phoebe	C, *
Yellow-bellied flycatcher	Empidonax flaviventris	N.A.
Acadian flycatcher	Empidonax virescens	U, *
Willow flycatcher	Empidonax traillii	*
Alder flycatcher	Empidonax alnorum	R
Least flycatcher	Empidonax minimus	C
Eastern wood pewee	Contopus virens	C, *
Olive-sided flycatcher	Nuttallornis borealis	V
Horned lark	Eremophila alpestris	C, *
Tree swallow	Iridoprocne bicolor	C
Bank swallow	Riparia riparia	*
Rough-winged swallow	Stelgidopteryx ruficollis	C, *
Barn swallow	Hirundo rustica	C, *
Cliff swallow	Petrochelidon pyrrhonota	U
Purple martin	Progne subis	U, *

Common Name	Scientific Name	Status[3]
Blue jay[2]	Cyanocitta cristata	C, *
Common crow[2]	Corvus brachyrhynchos	C, *
Carolina chickadee[2]	Parus carolinensis	C, *
Tufted titmouse	Parus bicolor	C, *
White-breasted nuthatch	Sitta carolinensis	U, *
Red-breasted nuthatch	Sitta canadensis	R
Brown creeper	Certhia familiaris	U
House wren	Troglodytes aedon	C, *
Winter wren	Troglodytes troglodytes	U
Bewick's wren	Thryomanes bewickii	R, *
Carolina wren	Thryothorus ludovicianus	C, *
Long-billed marsh wren	Telmatodytes palustris	V
Short-billed marsh wren	Cistothorus platensis	V
Mockingbird[2]	Mimus polyglottos	C, *
Cray catbird	Dumetella carolinensis	C, *
Brown thrasher[2]	Toxostoma rufum	C, *
American robin[2]	Turdus migratorius	C, *
Wood thrush	Hylocichia mustelina	C, *
Hermit thrush	Catharus guttatus	N.A.
Swainson's thrush	Catharus ustulatus	C
Gray-cheeked thrush	Catharus minimus	U
Veery	Catharus fuscescens	U
Eastern bluebird	Sialia sialis	C, *
Blue-gray gnatchatcher	Polioptila caerulea	C, *
Golden-crowned kinglet	Regulus satrapa	C
Ruby-crowned kinglet	Regulus calendula	N.A.
Water pipit	Anthus spinoletta	V
Cedar waxwing	Bombycilla cedrorum	N.A.
Loggerhead shrike	Lanius ludovicianus	R, *
Starling[2]	Sturnus vulgaris	C, *
White-eyed vireo	Vireo griseus	C, *
Bell's vireo	Vireo bellii	V

APPENDIX (Continued)

Common Name	Scientific Name	Status[3]
Yellow-throated vireo	Vireo flavifrons	U, *
Solitary vireo	Vireo solitarius	U
Red-eyed vireo	Vireo olivaceus	C, *
Philadelphia vireo	Vireo philadelphicus	U
Warbling vireo	Vireo gilvus	U, *
Black-and-white warbler	Mniotilta varia	*
Prothonotary warbler	Protonotaria citrea	R, *
Swainson's warbler	Limnothlypis swainsonii	V
Worm-eating warbler	Helmitheros vermivorus	R, *
Golden-winged warbler	Vermivora chrysoptera	R
Blue-winged warbler	Vermivora pinus	R, *
Tennessee warbler	Vermivora peregrina	C
Orange-crowned warbler	Vermivora celata	R
Nashville warbler	Vermivora ruficapilla	C
Northern parula	Parula americana	*
Yellow warbler	Dendroica petechia	C, *
Magnolia warbler	Dendroica magnolia	C
Cape may warbler	Dendroica tigrina	C
Black-throated blue warbler	Dendroica caerulescens	R
Yellow-rumped warbler	Dendroica coronata	N.A.
Black-throated green warbler	Dendroica virens	C
Cerulean warbler	Dendroica cerulea	U, *
Blackburnian warbler	Dendroica fusca	U
Yellow-throated warbler	Dendroica dominica	U, *
Chestnut-sided warbler	Dendroica pensylvanica	C
Bay-breasted warbler	Dendroica castanea	C
Blackpoll warbler	Dendroica striata	N.A.
Pine warbler	Dendroica pinus	R
Prairie warbler[2]	Dendroica discolor	C, *
Palm warbler	Dendroica palmarum	U
Ovenbird	Seiurus aurocapillus	R, *
Northern waterthrush	Seiurus noveboracensis	C
Louisiana waterthrush	Seiurus motacilla	C, *
Kentucky warbler	Oporornis formosus	U, *
Connecticut warbler	Oporornis agilis	V
Mourning warbler	Oporornis philadelphia	R
Common yellowthroat[2]	Geothlypis trichas	C, *
Yellow-breasted chat	Icteria virens	C, *
Hooded warbler	Wilsonia citrina	U, *
Wilson's warbler	Wilsonia pusilla	U
Canada warbler	Wilsonia canadensis	C
American redstart	Setophaga ruticilla	U, *
House sparrow[2]	Passer domesticus	C, *

APPENDIX (Continued)

Common Name	Scientific Name	Status[3]
Bobolink	Dolichonyx oryzivorus	N.A.
Eastern meadowlark[2]	Sturnella magna	C, *
Yellow-headed blackbird	Xanthocephalus xanthocephalus	V
Red-winged blackbird[2]	Agelaius phoeniceus	C, *
Orchard oriole	Icterus spurius	C, *
Northern oriole	Icterus galbula	*
Rusty blackbird	Euphagus carolinus	U
Brewer's blackbird	Quiscalus quiscula	V
Common grackle[2]	Quiscalus quiscula	C, *
Brown-headed cowbird[2]	Molothrus alter	C, *
Scarlet tanager	Piranga olivacea	U, *
Summer tanager	Piranga rubra	U, *
Cardinal[2]	Cardinalis cardinalis	C, *
Rose-breasted grosbeak	Pheucticus ludovicianus	C
Blue grosbeak	Guiraca caerulea	R, *
Indigo bunting[2]	Passerina cyanea	C, *
Dickcissel	Spiza americana	C, *
Evening grosbeak	Hesperiphona vespertina	R
Purple finch	Carpodacus purpureus	N.A.
Common redpoll	Acanthis flammea	V
Pine siskin	Spinus pinus	U
American goldfinch	Spinus tristis	C, *
Rufous-sided towhee	Pipilo erythrophthalmus	C, *
Savannah sparrow	Passerculus sandwichensis	*
Grasshopper sparrow	Ammodramus savannarum	C, *
Henslow's sparrow	Ammodramus henslowii	R, *
Le Conte's sparrow	Ammospiza leconteii	V
Vesper sparrow	Pooecetes gramineus	*
Lark sparrow	Chondestes grammacus	*
Dark-eyed junco	Junco hyemalis	C
Tree sparrow	Spizella arborea	U
Chipping sparrow	Spizella passerina	C, *
Field sparrow[2]	Spizella pusilla	C, *
Harris's sparrow	Zonotrichia querula	V
White-crowned sparrow	Zonotrichia leucophrys	U
White-throated sparrow	Zonotrichia albicollis	C
Fox sparrow	Passerella iliaca	N.A.
Lincoln's sparrow	Melospiza lincolnii	U
Swamp sparrow	Melospiza georgiana	U
Song sparrow[2]	Melospiza melodia	C, *
Lapland longspur	Calcarius lapponicus	R
Snow bunting	Plectrophenax nivalis	V

APPENDIX C

REPORT OF ARCHEOLOGICAL SURVEY

AN ARCHAEOLOGICAL SURVEY OF THE PROPOSED GEORGETOWN INDUSTRIAL PARK SCOTT COUNTY, KENTUCKY

Prepared by

Michael B. Collins

August 1977

Archaeological Services, Inc. of Kentucky

Report No. 10

Report prepared for: Dames and Moore Consultants in
Environmental and Earth Sciences,
Lexington

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ABSTRACT

The proposed locality of the Georgetown Industrial Park, near Georgetown, Scott County, Kentucky, is situated in the central part of the Bluegrass region. It encompasses some 170 acres of rolling farmland with limited improvements. When surveyed for archaeological sites, the cultivated portions of the property were found to contain 14 prehistoric sites. None of these is deemed significant.

AN ARCHAEOLOGICAL SURVEY OF THE PROPOSED GEORGETOWN INDUSTRIAL PARK SCOTT COUNTY, KENTUCKY

by

Michael B. Collins

INTRODUCTION

On 20 July and 10 August, 1977, an archaeological survey and limited soil testing were conducted at the proposed Georgetown Industrial Park location in Scott County, Kentucky. In the course of the survey, 14 prehistoric archaeological sites were located, and three of these were probed to determine if there was any likelihood of intact archaeological deposits being present. None of these sites is deemed significant, and further archaeological work is not warranted.

MANAGEMENT SUMMARY

The archaeological survey of the Georgetown Industrial Park was conducted in compliance with provisions contained in the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915; 16 USC. 470), the National Environmental Policy Act of 1969 (P.L. 91-190; 83 Stat. 852; 42 USC 4321-4327), and Executive Order 11593 of May 13, 1971 (36 FR 8921, 16 USC 470). Also, the provisions of the Kentucky Antiquities Act (K.R.S. Ann. 164.705-735; 1970) were adhered to. Fourteen sites were located within the project area; however, it is the belief of the archaeologist that these are not significant sites and that further mitigation is not required. However, in the event that during the course of construction deposits containing additional archaeological materials are encountered, the Office of State Archaeology should be notified at once.

ENVIRONMENTAL SETTING

The proposed location of the Georgetown Industrial Park is about one mile southeast of Georgetown in the south central part of Scott County (Figs 1 and 2). This is gently rolling land, all of fairly high elevation, situated about one mile south of North Elkhorn Creek and one and one half mile north of Cane Run. The property encompasses approximately 200 acres of which some 170 are undeveloped at this time. About the southern half of the property is in row crops as is a tract in the northeastern corner. The remainder, approximately 30%, is in pasture and cover crops or is wooded. The locality is on a well drained part of a ridge with intermittent streams carrying runoff north into North Elkhorn Creek and south into Cane Run. In the general area, Karstic features, such as springs and sinkholes, are in evidence.

This setting is typical of the Inner Bluegrass region of central Kentucky (Karan 1973). The underlying bedrock is limestone of Ordovician age (McFarlan 1943) and the soils are light brown silt loams (Bailey and Winsor 1964).

Vegetation in this area originally was part of the western mesophytic forest (Braun 1950), composed primarily of sugar maple, walnut, bur oak, white oak, several species of bristle-tip oaks, hickories, wild cherry, black and honey locusts, and mulberry. Along the streams, larger trees occur and tree spacing is often somewhat closer than in the uplands. There were open areas of grassland in the Bluegrass region, giving the forest a parkland appearance. With clearing in recent decades, many areas are now open pasture land or have grown up in underbrush and weeds.

Faunal communities over this area include a variety of mammals, birds, fish, reptiles, shell fish, and amphibians. Opossum, raccoon, mink, longtail weasel, striped skunk, river otter, beaver, whitetail deer, red fox, gray fox, woodchuck, eastern gray squirrel, fox squirrel, flying squirrel, and cottontail rabbit are among the mammals present today. Bison are reported to have also been present at earlier times (Young 1910). Other animals include numerous species of ducks, owls, vultures, quail, dove, and other birds; turtles, snakes, frogs, cray fish, mussels, and bass, crappie, drum, catfish, and other varieties of fish.

Under aboriginal conditions, this section of Kentucky undoubtedly offered an attractive habitat for man both as a hunter-gatherer and as a farmer. Earlier, when the region was affected by nearby glaciation, it probably also had many attractions for man.

Figure 1. Location of Study Area
in Kentucky.

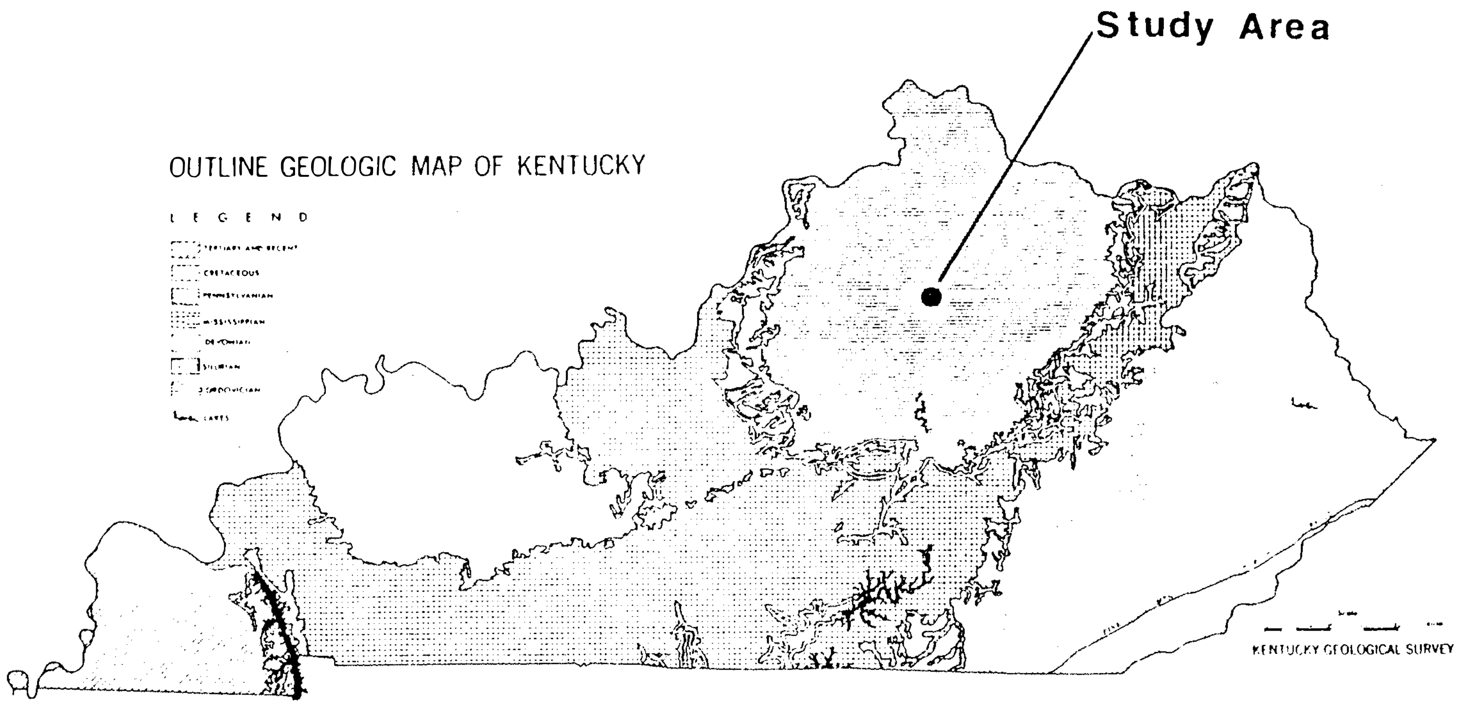
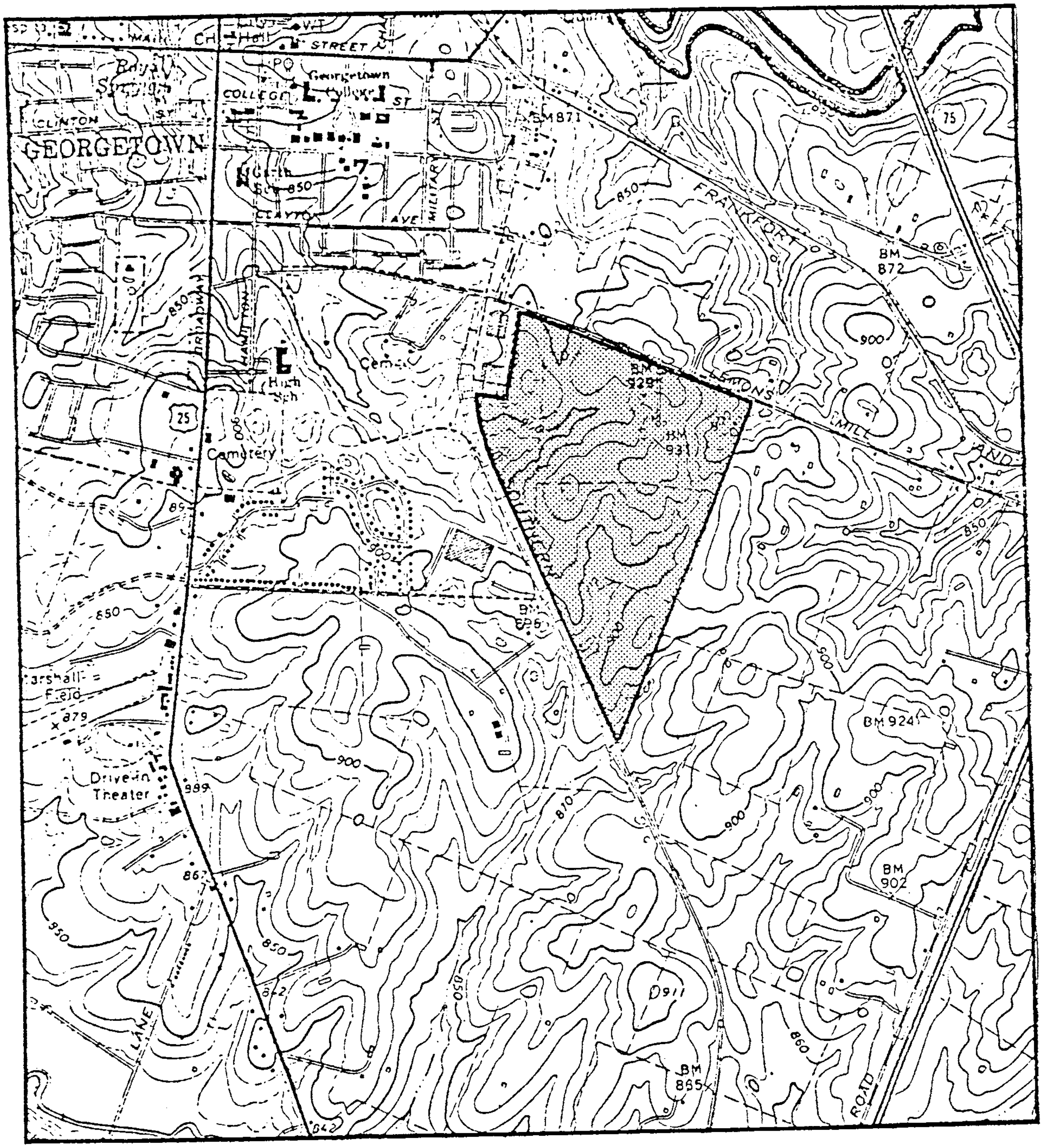

Study Area
OUTLINE GEOLOGIC MAP OF KENTUCKY
LEGEND
TERTIARY AND RECENT
CRETACEOUS
PENNSYLVANIAN
MISSISSIPPIAN
DEVONIAN
SILURIAN
ORDOVICIAN
LAKES
KENTUCKY GEOLOGICAL SURVEY

Figure 2. Location of Georgetown Industrial Park. Shaded area denotes undeveloped parts of property. Scale 1:24,000 (Base map, USGS 7.5 minute Georgetown, Kentucky, Quadrangle topographic sheet)


GEORGETOWN
Georgetown College
COLLEGE ST
CLINTON ST
STREET
CLAYTON AVE
MILITARY
BROADWAY
HAMILTON
High Sch
Cemetery
Cem
FRANKFORT
SIMONS MILL
BM 871
BM 872
BM 929
BM 931
BM 924
BM 902
BM 865
850
900
Marshall Field
879
Drive-in Theater
LANE
ROAD
75
25
911
860

ARCHAEOLOGICAL BACKGROUND

The prehistoric cultural remains of the Bluegrass region of Kentucky are generally viewed according to a Cultural-Historical framework that recognizes a developing sequence of cultures that became more complex with time. This sequence began in the late Pleistocene ("Ice Age") and continued until the arrival of Europeans. The earliest cultural manifestation, usually called the PaleoIndian period, was characterized by migratory hunting-gathering by small bands of people living on a landscape affected by its proximity to the advancing and retreating edge of the Laurentian Ice Sheet. As the Pleistocene ended and environmental conditions became more as they are today, the PaleoIndian way of life gradually gave way to a somewhat different mode of hunting-gathering known as the Archaic. Archaic hunter-gatherers maintained an apparently very successful adaptation to their environment until several technological advancements, in the first millennium before Christ, gave rise to a more complex lifeway known as the Woodland. During the Woodland period, the manufacture of pottery and the gardening of a few domesticated plants were technological concommitents of greater social and political complexity producing the distinctive cultural forms, Adena, Middle Woodland, and Late Woodland. Near the end of the first millennium after Christ, Village Farming became the dominant cultural manifestation in the Bluegrass. By the time Europeans arrived, the bluegrass region was not intensively used by American Indians; however, campsites of Shawnee and use of the region by Miami, Iroquois, and other groups are recorded (Goodell 1971a, b, c; Willey 1966; Clark 1974).

Archaeological research strives not only to describe but to understand the past cultures of any region. Unlike the chemist or botanist who can often repeat under controlled conditions experiments designed to discover the nature of any particular phenomenon, the archaeologist must rely upon archaeological data which are, for any period in the past, finite and irreplaceable. The remains at any given site are virtually unique. Every care, therefore, must be taken to insure that sites are not wantonly destroyed. Archaeology substitutes comparative studies for controlled experimentation such that rather than experimentally holding a variable constant while changing another, one compares data from sites chosen such that, as nearly as possible, some variables are about the same (analogous to the "constant" of experimentation) and others are in contrast (the changing variable of experimentation).

At present, we have only a vague, descriptive picture of the prehistoric cultures in the Bluegrass region (the "whens" and "wheres"), which leaves as the greatest current need a beginning toward the understanding in greater detail of the "hows" and "whys" of this segment of human history. We need also to learn what these local remains can tell us about some of the broader questions of human history. With these thoughts in mind, we may briefly review the culture history of the Bluegrass region of Kentucky and identify some of the specific problems which reside in these materials.

PALEO-INDIAN TRADITION

Man may have first entered Kentucky as early as 14,000 or 15,000 years ago, as inferred from radiocarbon determinations on charcoal found in association with cultural materials at the Meadowcroft Rockshelter in Washington County, Pennsylvania (Adovasio et al. 1975). Thus far nothing very distinctive has been found at Meadowcroft, and even if very early cultural materials of this sort were found elsewhere it is doubtful that their significance would be immediately recognized. Other more distinctive artifacts, particularly projectile points, are characteristic of the later phases of this tradition. The Paleo-Indian stage lasted until perhaps 9,000 years ago.

Paleo-Indian sites in Kentucky are generally recognized by the presence of a series of usually lanceolate shaped projectile points. These specimens often exhibit shallow channels or flutes extending up both faces and are usually assumed to date from about 11,000 to 9,000 years ago. Scraping and cutting tools of chipped stone are also found on sites of this period, whereas stone tools made by grinding and pecking are notable for their absence (Witthoft 1952; Willey 1966).

Paleo-Indian peoples were probably organized into small nomadic or semi-nomadic bands and depended upon a subsistence economy of hunting and gathering. The hunting of Pleistocene megafauna, such as mammoth and several extinct forms of bison, provided the focus of the subsistence activities at least in the western parts of North America (Willey 1966), but absolutely no proof of this kind of focus also occurring in the greater Ohio Valley region has yet come to light. Wild plant foods and small game were undoubtedly important to all Paleo-Indian peoples, but may have been of prime importance in the eastern part of North America.

A survey of known artifact collections in Kentucky was conducted by M. Rolingson in an attempt to define areas within the state which had been occupied by Paleo-Indian peoples. This survey indicated that the Bluegrass contained a relatively high density of the distinctive fluted projectile points. This may be evidence of a relatively high population in the area during this early period (Rolingson, 1964).

Despite a number of studies, the Paleo-Indian tradition is one of the least well known aspects of Kentucky prehistory. Among the most critical research needs is a systematic survey directed towards locating Paleo-Indian sites. Our knowledge of the distribution of such localities is woefully inadequate despite several preliminary efforts (Prufer and Baby 1963; Dorwin 1966; Rolingson 1964). Following this, research aimed at more specifically defining the chronological placement of the Paleo-Indian tradition as a whole and possible phases within the tradition should be undertaken. Such phases as yet are undefined, but there is little doubt that they do exist given a 5,000 year duration for the tradition.

Concomitant with chronological studies, excavations should be carried out whose goal is defining possible functional variation between Paleo-Indian sites, and research into the subsistence economy should be conducted. We still do not have a very good idea of the economic organization of the Eastern Paleo-Indian groups. Considering the environmental variation between the two regions, it is not realistic to assume that Pleistocene megafauna were as important in this area as they were in the west.

ARCHAIC TRADITION

The Archaic tradition began roughly 10,000 years ago and lasted until approximately 1,500 or 1,000 B.C. Over this period, a number of important cultural changes took place. In general, the term, Archaic, refers to a set of cultural adaptations to an essentially modern environment in which the hunting and gathering of a wide variety of animal and plant species provided the basis of the subsistence economy. White-tailed deer and various nut-bearing tree species were especially important, and such commodities as shell fish were locally important. The exploitation of the environment often entailed a seasonal nomadism in which particular localities were visited seasonally over a number of years. The scheduling of the nomadic rounds was tied to the seasonal availability of certain plant or animal foods.

In general, Archaic sites are identified by the presence of a series of distinctive stemmed and notched projectile points and a wide variety of cutting, scraping and piercing implements made of bone and chipped chert. Ground stone technology was developed during this period and was employed in the manufacture of axe heads, stone pipes, numerous food grinding and pounding implements, spear-thrower weights, and ornaments (Willey 1966).

In other areas of the eastern United States, the Archaic tradition has been divided into three phases, Early, Middle, and Late. Due to a lack of research in the present study area, it is not known if this scheme has local utility.

A few early Archaic style projectile points are found in the Central Bluegrass (c.f. Collins ms), and are currently being found in deeply buried deposits in Jefferson County (site 15JF243) but little is known about the activities represented by their presence.

Middle Archaic materials, also are typologically indicated for the Central Bluegrass (Goodell 1971; Collins ms), but again their significance is obscure.

Late Archaic materials are much more numerous according to local collectors and as demonstrated in adjacent areas - the Cincinnati area (Vickery 1975), Eagle Creek (Allen 1973), and in Jefferson County (J. Granger, personal communication).

One of the most prominant features of Late Archaic society was the development of extensive procurement systems (probably trade). These are most strongly evidenced in the obtaining of stone for utilization in tool manufacture. A recent study of the chert recovered at the Maple Creek site in Clermont County, Ohio, showed that much of it was obtained from sources located more than 100 miles from the site (Vickery 1974). Other sites in the Ohio Valley, especially the large shell middens along the Green River in Western Kentucky, provide evidence for trade networks extending across the entire eastern part of North America. Artifacts made of marine shell from the Gulf of Mexico and copper from the Lake Superior region are common in these sites (Webb 1940).

There are a number of problems regarding the occupation of the area by Archaic groups. We need to know more about the nature and extent of the Early and Middle phase utilization of the area, especially in how they relate to the development of the apparent substantial Late Archaic occupation. In other words, it is important to know the reasons for the Late Archaic population explosion. There is also a paucity of information on subsistence economy for all phases of the Archaic. Learning more about this is critical in answering questions about the development of agriculture which apparently occurred just after the end of the period and undoubtedly had its origins in intensive late Archaic wild plant food gathering.

There is increasing evidence that in certain parts of the greater Ohio and Mississippi valleys, late Archaic and early Woodland peoples may have unsuccessfully experimented with the domestication of certain native food plants. If this can be verified, a major contribution will be made toward the comparative data base needed to understand the origins of food production as a major subsistence activity of man. In southeast Asia, the Near East, Mexico, and South America archaeologists have documented a number of successful experiments which led to plant domestication, and ultimately to food production. No one has yet adequately documented an unsuccessful experiment in plant domestication which, by its contrasting qualities would bring into sharper focus our understanding of this, one of the principal achievements of mankind.

WOODLAND TRADITION

The Woodland tradition is usually marked by the appearance of three significant cultural patterns: (1) the manufacture of pottery, (2) the development of elaborate burial ceremonialism, and (3) the introduction or development of agriculture. This tradition began around 1500 or 1000 B.C. and lasted until around A.D. 900.

Agriculture did not immediately alter in any significant way the subsistence or social structure of the Woodland groups. Rather, domesticated plants supplemented the diet which was still largely composed of wild plant and animal foods.

Cultivated plants can be divided into two complexes, (1) introduced species (which included corn, beans, and squashes) first domesticated in Meso-America or South America and diffused to eastern North America, and (2) species (including marsh elder, sunflower, canary grass, and possibly others) which grew wild in the area and were apparently brought under domestication by local groups; of these, only the sunflower remained significant for very long.

Woodland pottery is found in a relatively small range of forms and methods of manufacture. For the most part, the vessels are tempered with sand, grog, or crushed stone. Surfaces usually exhibit evidence of having been treated with a cord or fabric wrapped paddle or stick. Designs tend to be fairly simple except in the case of some of the elaborate mortuary wares associated with Middle Woodland burial mounds.

The tradition of constructing earthen mounds over the graves of the honored dead probably began in tne Late Archaic period where small mounds are occasionally found. It is most characteristic of the Early and Middle Woodland periods.

The Early Woodland Adena culture (ca. 500 B.C. to A.D. 600) is best known from a series of burial mounds found in northeastern Kentucky, West Virginia, Ohio, and southeastern Indiana. This culture partially overlaps in time with the Hopewell culture which is centered in Ohio. Both Adena and Hopewell sites are known in the general vicinity of this study area.

The Adena burial complex includes burial in elaborate log tombs, cremation and other interrment modes. Exotic goods, such as copper ornaments, marine shell and cut mica are found as offerings in the graves. The mounds built over the burials tend to become larger over time and the later graves are more elaborate and contain larger amounts, and more flamboyant examples, of grave goods (Dragoo 1963).

The Hopewell culture with its large mounds and earthen enclosures marks the climax of the Woodland mound building tradition in the eastern United States. Mounds of this complex enclose graves which are notable for the variety and amount of grave goods which they contain. Hopewellian sites are known from southeastern Indiana and over much of Ohio. There have been reports of Hopewell sites in the Covington area of Kentucky, but these are not yet published. It is not expected that Hopewellian sites themselves would occur in the Central Bluegrass, but the distinctive ceramics, if found as intrusives, could be important clues to age.

Among the most important Woodland research needs is a study of Adena and Hopewell habitation sites. Excavations aimed at understanding the subsistence economy, social organization and settlement systems of the groups responsible for the construction of the burial mounds would add much to our knowledge of this important period.

VILLAGE FARMING TRADITIONS (MISSISSIPPIAN AND FORT ANCIENT)

The final prehistoric occupation in Kentucky is represented by two related traditions which arose sometime around A.D. 900 and continued until the historic period.

The Mississippian tradition is centered to the west and southwest of the study area in the Lower Ohio and Mississippi River valleys. Peoples of this tradition developed a dependable agriculture based economic system which allowed the development of permanent village life and relatively complex social organization. Extensive political and economic systems are probably also to be inferred from the archaeological evidence on Mississippian. Sites of this tradition are often quite large, fortified with log palisades and marked by substantially built houses and large, rectangular, flat topped earthen mounds which served as bases for public building. The subsistence economy focused on corn, beans and squash agriculture but hunting and gathering continued to play an important role.

Mississippian pottery is largely plain surfaced and usually tempered with crushed mussel shell. There is a marked elaboration of form and decoration.

The Fort Ancient tradition is centered to the north, east and southeast of the study area, but is strongly represented in this area as well. It is usually viewed as a continuation of the local Woodland tradition which had come under strong cultural influence from the vigorous Mississippian tradition. Corn, beans and squash became the mainstay of the diet, and as in Mississippian, this dependable subsistence economy allowed the development of a more permanent settlement pattern and the concomitant rise in importance of large stable villages. These sites do not, however, reach the size of the Mississippian settlements, nor do they exhibit temple mounds or other evidences for the level of social complexity reached by Mississippian groups.

Fort Ancient pottery exhibits numerous continuities with the earlier Woodland wares of the Middle Ohio Valley. These are especially evident in vessel form and surface treatment. The influence of the Mississippian tradition is seen in the presence of shell tempering and in some vessel forms and decorative styles.

Mississippian sites have been located as far east as Louisville and there are reports of similar sites in southeastern most Indiana Ohler, personal communication). Fort Ancient sites are known from most of the Bluegrass area. Numerous sites of this tradition are also known in Ohio, West Virginia, and southeastern Indiana (Griffin 1943).

One of the most critical problems of the archaeology of these Village Farming traditions that might be partially solved by research in the study area is the relationships between the Fort Ancient and the Mississippian. Local sites of either tradition might be important in providing information on specific mechanisms of interaction between the two. Sites in the area could also be important in studying differences in cultural ecology.

PREVIOUS RESEARCH IN THE AREA

Beginning in the early 19th century, archaeological sites in Scott County have attracted the attention of observant individuals. Rafinesque in 1824 reported that 5 "sites" and 12 "monuments" were known in Scott County; Squier (1849) reports only 3 earthworks. Cyrus Thomas (1891) reiterates Rafinesque's list.

In this century, Webb and Funkhauser (1932) report 6 sites (all mounds) near Elkhorn Creek in the western part of the county. Between 1932 and 1973, 5 more sites (one a mound and 4 poorly described) were recorded in the files of the Museum of Anthropology at the University of Kentucky.

Donald Crusoe (1976) reports a site of uncertain cultural affiliation (SC 13) found during a survey of the proposed airport locality north of Georgetown.

Charles Hockensmith has, over the past year, been surveying for sites in Scott County and to date has located 50 sites (8 Fort Ancient, 1 Adena, 12 Archaic, 13 multicomponent, and 16 of uncertain affiliation).

Collectors have long noted that Scott County was prolific in sites, and the accumulating evidence, including the present survey, corroborates this view.

Enough site distributional data are now available that the beginnings of a comprehensive settlement pattern study could be made.

RESEARCH METHODS

Three methods were employed in assessing the likelihood of impact to archaeological sites by development of the Georgetown Industrial Park. A search of archival records was made, an on-the-ground survey was conducted, and soil columns were examined at the three sites considered most likely to contain undisturbed deposits. In addition, amateur and professional archaeologists familiar with the area were queried about the presence of sites.

The archaeological records of the University of Kentucky and the National Register of Historic Places were systematically searched and queries made of the other archaeological archives in the state to determine the presence of known sites and the general status of research in Scott County. No prehistoric sites are listed in the National Register in Scott County (Federal Register Vol. 42, No. 21, page 6245, July 1977) and only the records at the University of Kentucky contained materials useful to preparation of the accompanying background statement.

In the field phase of this investigation, the author, accompanied by Mr. Chris Turnbow, walked over the undeveloped parts of the property on 20 July 1977. Areas in pasture or cover crops provided very poor survey conditions, whereas those in crops (corn and tobacco, principally) afforded good to very good ground visibility (see Fig. 3). When surface indications of prehistoric occupation were noted, all observed materials were collected and placed in bags labeled as to location; locations were marked on a topographic map as well as on a tracing of an aerial photograph. In most cases, it was difficult to determine the boundaries of sites because of the low densities of materials observed and the fact that isolated flakes or other objects were often noted in the intervening areas between sites.

After analysis of the materials collected during the first survey, it was felt that additional information was required to fully assess three of the sites, so on 10 August, the author returned to sites SC-69, SC-74, and SC-76 to obtain soil columns. Ten soil profiles were measured at each of these sites (see Figures 4, 5) for the purpose of determining whether undisturbed cultural deposits were present.

RESULTS

Fourteen localities produced evidence of prehistoric utilization and were designated as sites (Fig. 4). Each of these is described below, and where possible the cultural affiliation is inferred. Site locations are given below in distances (feet) measured at right angles south from Lemons Mill Road and west from the east boundary of the property, augmented by descriptive data under current conditions. In Table 1, UTM locations for each site are given.

SC-67 is near the center of the property and straddles the fence and tree line separating two corn fields about 300 feet west of the main road. The diameter of the site is estimated to be about 150 feet (14 meters), and it is centered about 2000 feet south of Lemons Mill Road and 1100 feet west of the east property boundary. A triangular arrow point, a miscellaneous biface, a core and one flake and one chert chunk were collected, indicating a possible village farming period affiliation for the site.

Figure 3. Georgetown Industrial Park, Survey conditions. Shaded areas depict heavy ground cover at time of survey.

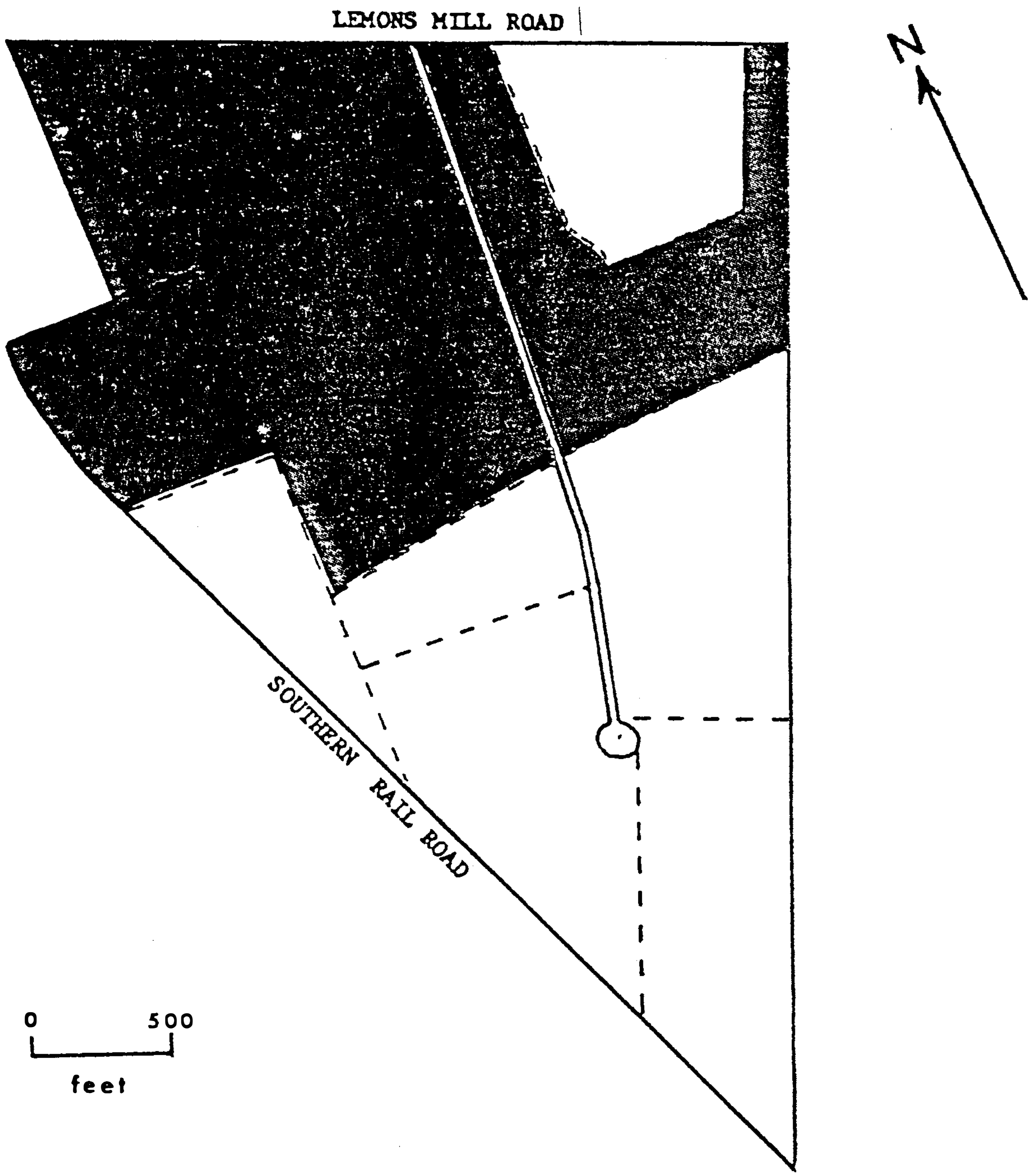

LEMONS MILL ROAD
N
SOUTHERN RAIL ROAD
0
500
feet

Figure 4. Survey route. Dotted lines indicate path followed by surveyors; shaded areas indicate approximate site areas.

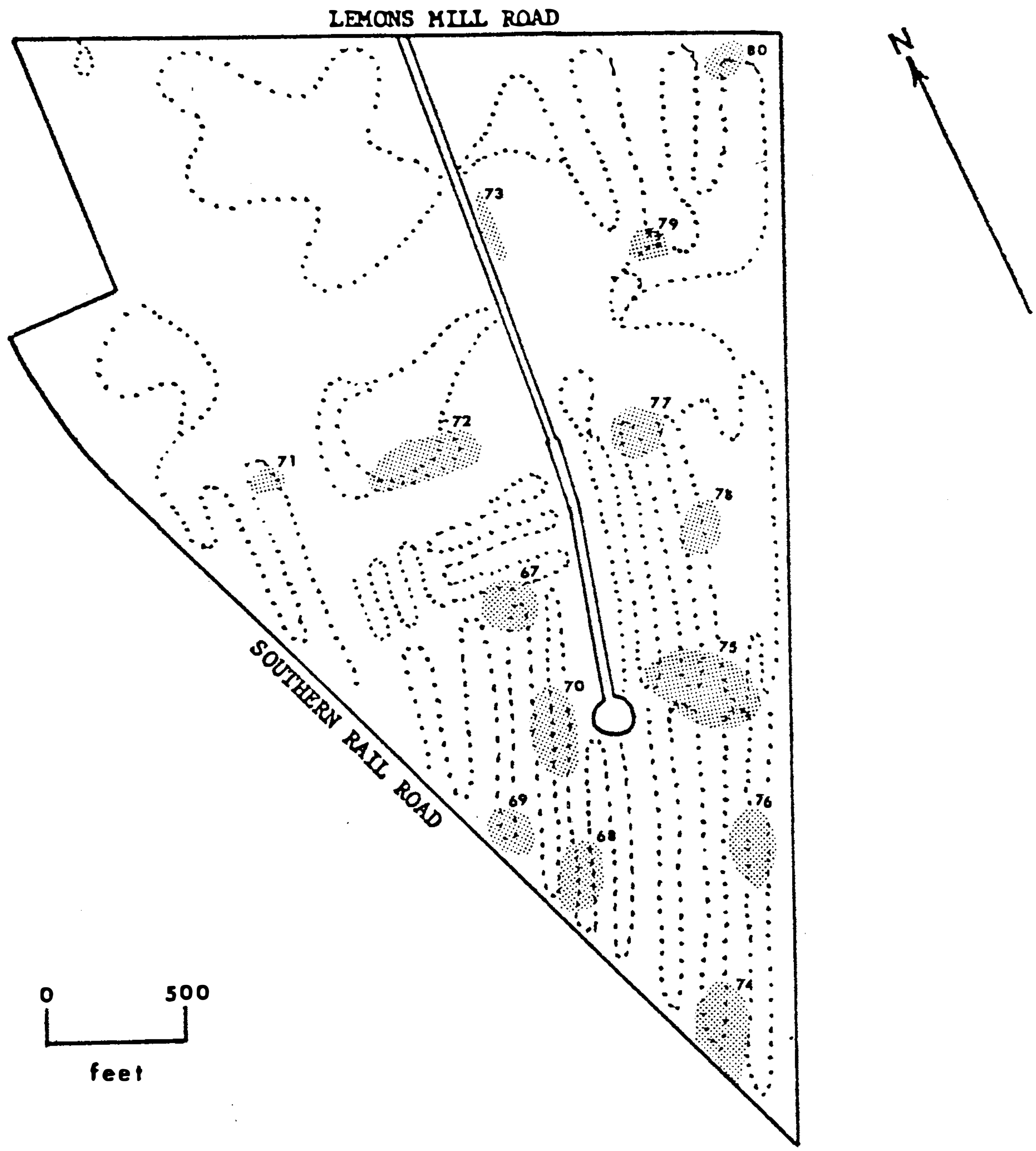

LEMONS MILL ROAD
N
80
73
79
77
72
71
78
67
75
70
76
69
68
74
SOUTHERN RAIL ROAD
0
500
feet

Figure 5. Sketch map of sites SC-69, SC-74, and SC-76 showing spacing of measured soil profiles.

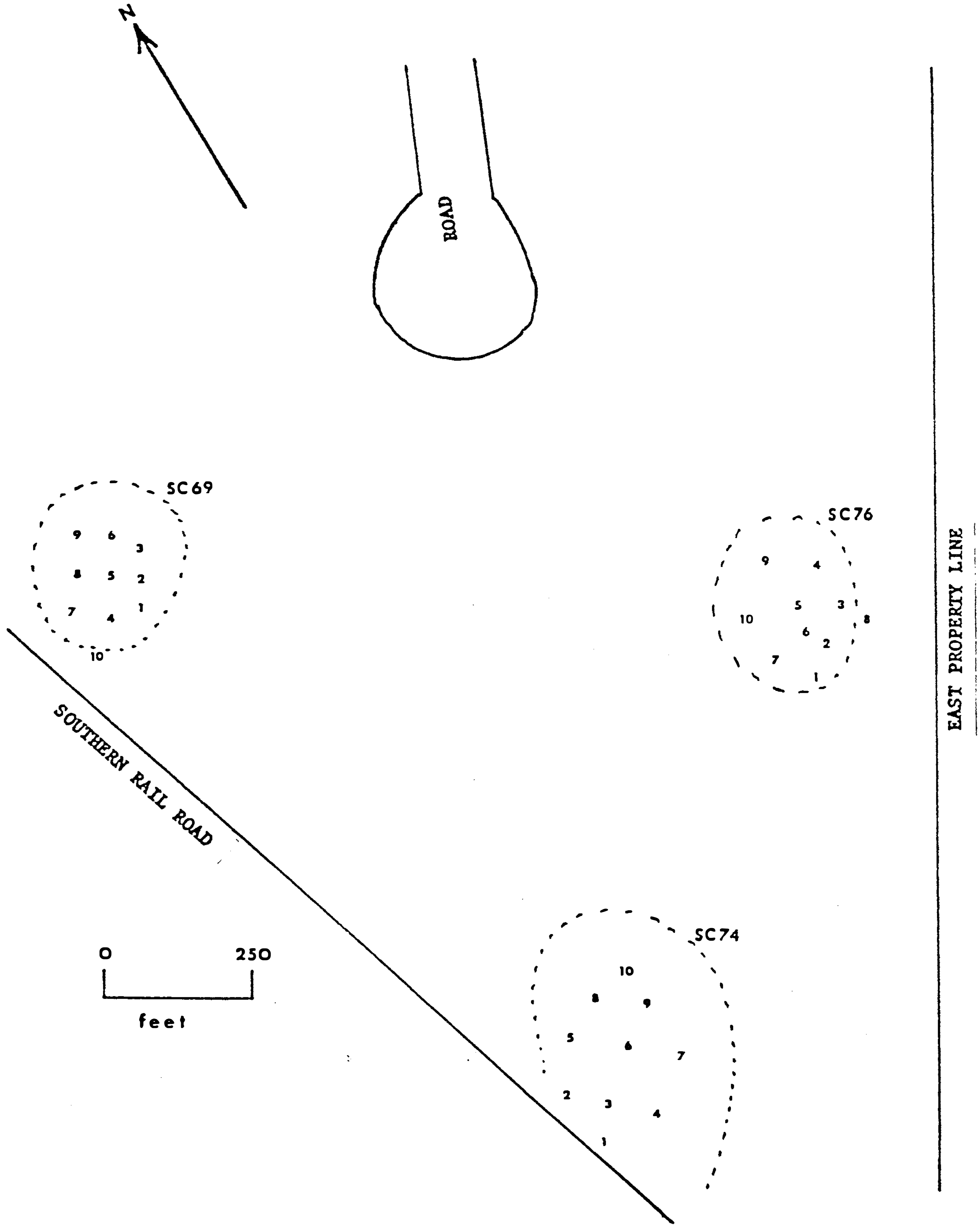

N
ROAD
SC69
SC76
SC74
SOUTHERN RAIL ROAD
EAST PROPERTY LINE
0
250
feet

Table 1. Site Locations by U.T.M. Co-ordinates.

Site No.	N	E
SC-67	$^{42}29850$	$^{7}14900$
SC-68	$^{42}29500$	$^{7}14900$
SC-69	$^{42}29545$	$^{7}14850$
SC-70	$^{42}29620$	$^{7}15050$
SC-71	$^{42}30050$	$^{7}14750$
SC-72	$^{42}30110$	$^{7}14920$
SC-73	$^{42}30350$	$^{7}15100$
SC-74	$^{42}29300$	$^{7}15050$
SC-75	$^{42}29670$	$^{7}15100$
SC-76	$^{42}29425$	$^{7}15080$
SC-77	$^{42}30015$	$^{7}15130$
SC-78	$^{42}29850$	$^{7}15175$
SC-79	$^{42}30330$	$^{7}15260$
SC-80	$^{42}30375$	$^{7}15440$

SC-68 is in the southern edge of a large cornfield about 650 feet south of the end of the road, 3200 feet south of Lemons Mill Road, and 1065 feet west of the east property boundary. The 19 chipped objects were in an area some 150 feet in diameter and included nothing diagnostic; there were observed, in addition to the collected materials, a few possibly introduced limestone rocks which may indicate cultural activity.

SC-69 is a small area near the southern edge of the same field which hosts SC-68. SC-69 yielded a triangular arrow point, a biface, a core, and 29 flakes (one of which was modified), possibly indicating village farming period affiliation. These materials, as well as numerous limestone rocks, were found over an area about 125 feet (40 m) in diameter located approximately 2860 feet south of Lemons Mill Road and 1330 feet west of the east property boundary. Ten soil profiles measured at this site (Fig. 5) indicated a disturbed zone of brown loamy soil about 20 to 25 cm in thickness underlain by a compact yellow-orange, clayey zone at least 15 cm in thickness. Other than charcoal which was found in the disturbed portion of profiles near the southeastern edge of the site, nothing of possible cultural origin was noted in these tests. It appears from field observations that the thin scatter of materials at this site reside entirely in disturbed deposits.

SC-70 is in the eastern edge of the same cornfield as the two previously described sites. It is about 150 feet west of the turn around at the end of the property road, about 2500 feet south of Lemons Mill Road and 1000 feet west of the eastern property line. This is an area about 150 feet north-south by 50 feet east-west from which 15 non-diagnostic flakes were recovered.

SC-71 is a spot in the northeastern corner of a tobacco field at the western edge of the property where a single flake was found. Survey conditions at the time of this find were very poor, and it is likely that if the ground were visible, more would be found -- hence the site designation. This find was made 1700 feet south of Lemons Mill Road and 2100 feet west of the eastern property boundary.

SC-72 lies in a previously disturbed area just south of a n unfinished metal building near the center of the property, 1500 feet south of Lemons Mill Road and 1460 feet west of the east boundary of the property. It covers an area roughly 275 feet east-west by 100 feet north-south and consists of a few cultural items resting on exposed rocky subsoil. Ten non-diagnostic flakes, chips, and chunks of chert were collected.

SC-73 denotes the location where a single retouched flake was collected at the edge of the roadway disturbance 600 feet south of Lemons Mill Road and 1150 feet west of the east boundary of the property. It is likely that more material resides under the heavy vegetation cover that lies just east of the area where the object was exposed.

SC-74 appears to be the remnant of a larger site which once extended southward into the present Southern Railroad right of way. The present area is in the southern edge of a cornfield 3660 feet south of Lemons Mill Road and 350 feet west of the eastern property boundary; it covers an area some 200 feet east-west and 300 feet north-south. There were observed a number of imported rocks in addition to the 24 objects collected. A potsherd and a side-notched dart point were the only diagnostic items recovered, possibly indicating both Archaic and Woodland affiliations. Auger testing at ten places in this site revealed a loose, brown loamy plowzone (20-25 cm thick) resting directly on a light yellow-orange subsoil. No undisturbed cultural deposits were indicated at this site.

SC-75 is a site consisting of a thin scatter of materials in two adjacent cornfields some 2500 feet south of Lemons Mill Road and 400 feet west of the eastern property line. Ground visibility over huch of this area was poor because of a heavy weed cover, but a pestle 13 flakes were recovered. These cultural materials were spread over an area about 300 feet east-west by 200 feet north-south.

SC-76 lies along the eastward dipping slope of a low hill in the eastern part of a large cornfield near the southern end of the property. This locality is 3100 feet south of Lemons Mill Road and about 100 feet west of the eastern property line. The area covered is about 250 feet north-south and 100 feet east-west. The soil is somewhat rocky and is currently erroding fairly rapidly. Thirty-six artifacts, including a corner-notched dart point and two potsherds, were collected here. It would seem that the pottery is of Woodland affiliation and that the dart point is Archaic. Ten soil profiles were examined at this site; each revealed a thin plowzone resting on rocky, clayey subsoil without evidence of intact cultural deposits.

SC-77 is a small site in the edge of a large cornfield 1450 feet south of Lemons Mill Road and 660 feet west of the eastern property boundary. An arrow point and two flakes were found in fairly close proximity, but nothing else of cultural origin was noted.

SC-78 is another small site in the same cornfield, 1960 feet south of Lemons Mill Road and 400 feet west of the east property boundary. A core and 4 flakes were found in fairly close proximity, but as in SC-77, nothing else cultural was noted. In the case of site SC-78, poor ground visibility was undoubtedly a factor.

SC-79 is located near the crest of a hill 730 feet south of Lemons Mill Road and 600 feet west of the eastern property line. It is a small area, only about 25 feet in diameter, from which 5 flakes were collected. A heavy sod covered much of this area, and poor visibility may have contributed to the restricted material noted.

SC-80 is a small area in the edge of a tobacco field in the northeastern corner of the property, 100 feet from Lemons Mill Road and 160 feet from the east boundary of the property. Four non-diagnostic flakes and chips were the only materials recovered.

ARTIFACT DESCRIPTIONS

A total of 174 specimens was collected from the 14 sites located during this survey; of this total, 170 are of chipped stone, one is of ground, stone, and three are of pottery. The artifact categories in each of these three classes are discussed individually below, and site proveniences are reported in Table 2.

CHIPPED STONE

Dart Points

Corner-notched. One corner-notched dart point was recovered (Fig. 6a); it has a slightly convex base, deep corner notches, and strong barbs; blade edges are very slightly convex, and cross section is lenticular; basal edge is ground; in general, it resembles the corner-notched forms of the early Archaic.
Length: 44mm; width: 27mm; thickness: 7.5 mm.

Side-notched. A single side-notched dart point was recovered (Fig. 6b); it has a straight base, shallow side notches, and convex lateral edges; it is lenticular in cross section; basal edge is ground. It resembles middle Archaic types of dart points.
Length: 39mm; width: 20mm; thickness: 7mm.

Arrow Points

Triangular. Three small, triangular arrowpoints were found; all are thin and bifacially chipped; one is lanceolate with slightly concave base (Fig. 6c); one is fragmentary but evidently has recurved edges and a concave base (Fig. 6d); and one has recurved edges and a convex base (Fig. 6e). These points are generally associated with the late, village farming cultures of the region. Lengths range from 26 to 39 mm; widths, from 13 to 19 mm; and thicknesses from 3 to 5 mm.

Miscellaneous Bifaces

Four small bifacially flaked objects were recovered; these are irregular in outline and vary from moderately thin and lenticular in cross section to thick and asymmetrical; function is not readily apparent for any of these specimens; however, at least one of them (Fig. 6f) may be an unfinished object and the convex edge of another (Fig. 6g) may have served as a scraper.

Figure 6 . Representative artifacts. a, corner-notched dart point; b, side-notched dart point; c-e, triangular arrow points; f-g, miscellaneous bifaces; h-i, cores; j, modified flake; k, limestone tempered, cordmarked sherd.

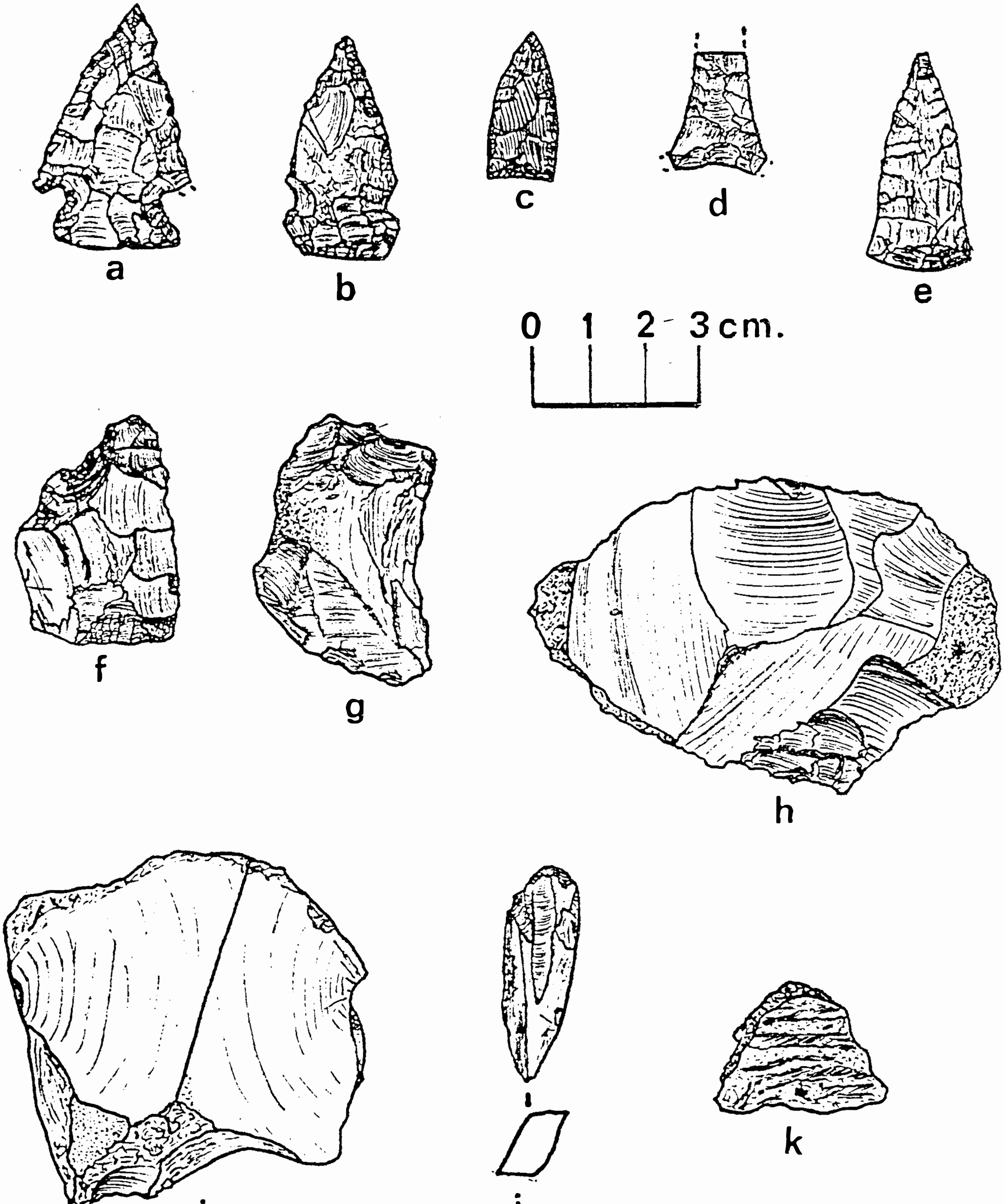

a
b
c
d
e
0 1 2 3 cm.
f
g
h
i
j
k

TABLE 2. Provenience of all collected materials by sites, Georgetown Industrial Park survey.

	SC-67	SC-68	SC-69	SC-70	SC-71	SC-72	SC-73	SC-74	SC-75	SC-76	SC-77	SC-78	SC-79	SC-80	Totals
CHIPPED STONE															
Dart Points															
corner-notched										1					1
side-notched								1							1
Arrow Points															
triangular	1		1								1				3
Miscellaneous Bifaces	1		1							2					4
Unifaces								2							2
Modified Flakes		2	1				1		1		1	1			7
Cores and Core Fragments	1	1	1					2		2		1			8
Waste Flakes	1	13	28	15	1	6		15	12	23	1	3	5	2	125
Chips and Chunks	1	3				4		3		6				2	19
GROUND STONE															
Pestle									1						1
CERAMICS															
Pottery Sherd								1		2					3
Totals	5	19	32	15	1	10	1	24	14	36	3	5	5	4	174

Unifaces

Two small flakes with distinct unifacial flaking were recovered; both were thick; one is almost round with steep flaking around about one half of the perimeter; the other is fragmentary, but also exhibits a convex retouched edge.

Modified flakes

Seven flakes exhibit limited edge modification; this consists of small chips removed from one or more edges; as the chipping may be discontinuous or limited to a small area, it is possible that it was not intentionally produced, and may not even relate to aboriginal utilization; one specimen has an almost burin-like series of flakes removed from one edge (Fig. 6 j).

Cores and Core Fragments

Eight small pieces of chert (maximum dimensions, 70 mm x 65 mm x 35 mm) exhibiting the removal of two or more flakes were classified as cores; these are all irregular and show no evidence of purposeful shaping or signs of wear (Fig 6 h and i).

Waste Flakes

A total of 125 flakes was recovered; these include examples of all stages of reduction from primary cortex flakes to bifacial thinning flakes; most are small (less than 25 mm in maximum dimension).

Chips and Chunks

Nineteen irregular, small chert fragments were collected. These lack criteria for identification as flakes or other objects, and may include manufacturing shatter as well as flake or other fragments.

GROUND STONE

Pestle

A single, small, asymmetrically conical pestle of dense sandstone was recovered; it is 67 mm high and 95 mm in maximum diameter at the base; basal surface is polished and exhibits a shallow, centrally located pit; all other exterior surfaces show evidence of pecking. This specimen lacks the evidence of heavy battery that often appears on pestles.

CERAMICS

Cordmarked Pottery Sherds

Three small sherds of pottery were recovered; all exhibit cordmarking on the exterior (Fig. 6 k). The two sherds from SC-76 are light tan in color with both limestone and grit termpering whereas the one sherd from SC-74 is darker in color and has less grit and more limestone in the temper.

CONCLUSIONS

This study has resulted in the identification of 14 small sites. Their distribution over the Industrial Park property reflects, in part, survey conditions at the time of the survey in that the areas where ground cover is heaviest fewer sites were found. In spite of these limitations, however, the pattern emerges of numerous small, probably intermittently used localities on high ground roughly a mile south of North Elkhorn Creek. The culturally disgnostic specimens indicate utilization of this area in the Early and Middle Archaic, Woodland, and Fort Ancient periods.

In their present condition, none of the sites is considered significant and no further archaeological work is deemed necessary unless additional remains are encountered during construction.

REFERENCES CITED

Adavasio, M., J.D.Gunn, J. Donahue, and R. Stuckenrath
1975 Excavations at Meadowcroft Rockshelter, 1973-1975: a progress report. Pennsylvania Archaeologist 45:3:1-31

Allen, R.C.
1973 Salvage Excavations in the Eagle Creek Reservoir-1972. Report to the National Park Service. Manuscript on file, Museum of Anthropology, University of Kentucky

Bailey, H. and J. Winsor
1964 Kentucky Soils. University of Kentucky Extension Service, Agricultural Experiment Station, Misc. 308. Lexington.

Braun, E.L.
1950 Deciduous Forests of Eastern North America. Philadelphia.

Clark, J.E.
1974 Shawnee Indian Migration: A System Analysis. PhD dissertation on file, the University of Kentucky.

Collins, M.B. (compiler)
ms Archaeological Survey in Fayette County, Kentucky, Spring 1975. Manuscript on file, University of Kentucky.

Crusoe, D.L.
1976 An Archeological Reconnaissance of the Proposed Georgetown-Scott County, Kentucky, Airport Project. Report on file, Department of Anthropology, University of Kentucky.

Dorwin, J.T.
1966 Fluted Points and Late Pleistocene Chronology in Indiana. Indiana Historical Society, Prehistory Research Series 4:3. Indianapolis.

Dragoo, D.W.
1963 Mounds for the Dead. Annals of Carnegie Museum: 37. Pittsburg.

Goodell, K.
1971a Archaic Manifestations in the Bluegrass Region of Kentucky. Ms. on file, The University of Kentucky.

1971b The Woodland in the Bluegrass of Kentucky: with an emphasis on the Adena. Ms. on file, the University of Kentucky.

1971c Fort Ancient. Ms. on file, the University of Kentucky.

Griffin, J.B.
1943 The Fort Ancient Aspect. University of Michigan, Museum of Anthropology, Anthropological Papers 28. Ann Arbor.

Karan, P.P. (editor)
1973 Kentucky, A Regional Geography. Dubuque.

McFarlan, A.C.
1943 Geology of Kentucky. Lexington.

Prufer, O.H. and R.S. Baby
1963 The Paleo-Indian of Ohio. The Ohio Historical Society, Columbus.

Rafinesque, C.S.
1824 Ancient Annals of Kentucky or Introduction to the History and Antiquities of the State of Kentucky. Printed for the Author, Frankfort.

Rolingson, M.A.
1964 Paleo-Indian Culture in Kentucky. Studies in Anthropology 2. Lexington.

Squier, E.G.
1849 A Monograph of the Ancient Monuments of the State of Kentucky. American Journal of Science and Arts, Vol. 8, pp. 1-14.

Thomas, C.
1891 Catalogue of Prehistoric Works east of the Rocky Mountains. Smithsonian Institution, U.S. Bureau of American Ethnology Bulletin 12.

Vickery, K.
1974 Chert utilization by a Late Archaic group in southwestern Ohio. Paper presented to the Ohio Valley Archaeological Conference, Tullahoma, Tennessee.

1975 Report on 1975 Archaeological Work by the University of Cincinnati. Cincinaati.

Webb, W.S.
1940 Indian Knoll, Site Oh-2, Ohio County, Kentucky. University of Kentucky Reports in Archaeology and Anthropology 4:3 part 1. Lexington.

Webb, W.S. and W.D. Funkhouser
1932 Archaeological Survey of Kentucky. University of Kentucky Reports in Archaeology and Anthropology 2. Lexington.

Willey, G.R.
1966 An Introduction to American Archaeology: I, North and Middle America. Englewood Cliffs.

Witthoft, J.
1952 A Paleo-Indian Site in Eastern Pennsylvania, An Early Hunting Culture. Proceedings of the American Philosophical Society 96:4:464-495.

Young, B.H.
1910 The Prehistoric Men of Kentucky. Filson Club, Louisville.

APPENDIX D

EXPLANATION OF UNIVERSAL SOIL LOSS EQUATION

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EXPLANATION OF UNIVERSAL SOIL LOSS EQUATION

Soil Loss Prediction Method

The universal soil loss equation can be applied all over the U.S. to predict tons of soil lost per acre. Originally the equation was used for agricultural erosion predictions, but now can also be used to predict silt loads in rivers and soil losses from construction sites. While the information which follows is "universal" and does provide a useful guide to most U.S. soils, more precise site data would give a more accurate soil loss estimate.

The equation is:

$$A = RKLSCP$$

where A is the estimated average annual soil loss in tons per acre and the other terms are defined as follows:

R is the rainfall and runoff erosivity index. Its local value can generally be obtained by interpolating between the iso-value lines of Figures A-1 and A-2. (Exceptions are the Coastal Plains of the Southeast. R values presently used in the Coastal Plains do not exceed 350. In the Northwest, the map values must be increased to account for effect of runoff from thaw and snowmelt. Estimated adjustments for specific locations can be obtained from the Soil Conservation Service.)

K is the soil-erodibility factor. It is the average soil loss per unit of R under arbitrarily selected "basic" conditions, and depends on soil properties. The value of K for most of the U.S. mainland soils can be obtained from local offices of the Soil Conservation Service (example: Table 1). Gross approximations based primarily on soil texture can be obtained from Table 2.

TABLE 1

TYPICAL SOILS DATA AND K VALUES FOR SITE-SPECIFIC ANALYSIS

SOIL SERIES[a]	HORIZON[b]	USDA TEXTURE RANGE[c]	K-VALUE[d]
Abbottstown	A	l, sil	0.43
	B	l, sil, sicl	0.43
	C	l	0.43
Adelphia	A	sl, fsl	0.32
	B	l, scl, fsl	0.43
	C	sl, ls	0.43
Albrights	A	sil, gsil, gl	0.43
	B	sicl, cl, scl	0.43
	C	l	0.43
Aldino	A	sil	0.43
	B	sicl, sil	0.43
	C	l, sil	0.43
Allegheny	A	l, fsl, sil	0.32
	B	cl, sil, sicl	0.28
	C	cl, l, scl	0.28
Alluvial Land	A	variable	0.28
	B	variable	0.28
	C	variable	0.28
Altavista	A	fsl, sl, l	0.32
	B	sil, cl	0.43
	C	gsl	0.43
Andover	A	l, gl, sl	0.43
	B	cl, l, gcl	0.43
	C	gl, gscl	0.43
Armaugh	A	sil, sicl	0.43
	B	sicl, sic, c	0.28
	C	sic, sicl, cl	0.17
Ashby	A	shl, sil	0.28
	B	sil	0.24
	C	shale	--
Ashton	A	l, sil, fsl	0.28
	B	sil, sicl	0.28
	C	fsl, l, sil	0.28
Athol	A	l, sil,	0.37
	B	sil, cl, scl	0.28
	C	gl, (variable)	0.28

[a]Over 6000 in U.S.
[b]A--surface material; B--intermediate; C--parent material
[c]Silt, loam, clay, etc.
[d]Erodibility: 0.43--highly erodible; 0.28--moderate; 0.17--low.

TABLE 2

INDICATIONS OF THE GENERAL MAGNITUDE
OF THE SOIL-ERODIBILITY FACTOR, K[1]

TEXTURE CLASS	ORGANIC MATTER CONTENT		
	<0.5%	2%	4%
	K	K	K
Sand	0.05	0.03	0.02
Fine Sand	0.16	0.14	0.10
Very Fine Sand	0.42	0.36	0.28
Loamy Sand	0.12	0.10	0.08
Loamy Fine Sand	0.24	0.20	0.16
Loamy Very Fine Sand[1]	0.44	0.38	0.30
Sandy Loam	0.27	0.24	0.19
Fine Sandy Loam	0.35	0.30	0.24
Very Fine Sandy Loam	0.47	0.41	0.33
Loam	0.38	0.34	0.29
Silt Loam	0.48	0.42	0.33
Silt	0.60	0.52	0.42
Sandy Clay Loam	0.27	0.25	0.21
Clay Loam	0.28	0.25	0.21
Silty Clay Loam	0.37	0.32	0.26
Sandy Clay	0.14	0.13	0.12
Silty Clay	0.25	0.23	0.19
Clay	--	0.13-0.29	--

[1]The values shown are estimated averages of broad ranges of specific-soil values. When a texture is near the borderline of two texture classes, use the average of the two K values. For specific soils, use Soil Conservation Service K-value tables.

LS is the slope-effect on erosion. The factor LS is the expected ratio of soil loss per unit area on a field slope to corresponding loss from the basic nine-percent slope, 72.6 feet long. This ratio, for specific combinations of slope length and gradient, may usually be taken directly from the slope-effect chart (Figure 2). For example, a ten-percent slope, 260 feet long, would have an LS ratio fo 2.6.

When the equation is used as a guide for selection of practices on an area where several slopes are combined into a single field, the slope characteristics of the most erosive significant segment of the field should be used for Figure 2. Use of field averages on such slope complexes would underestimate soil movement on significant parts of the field.

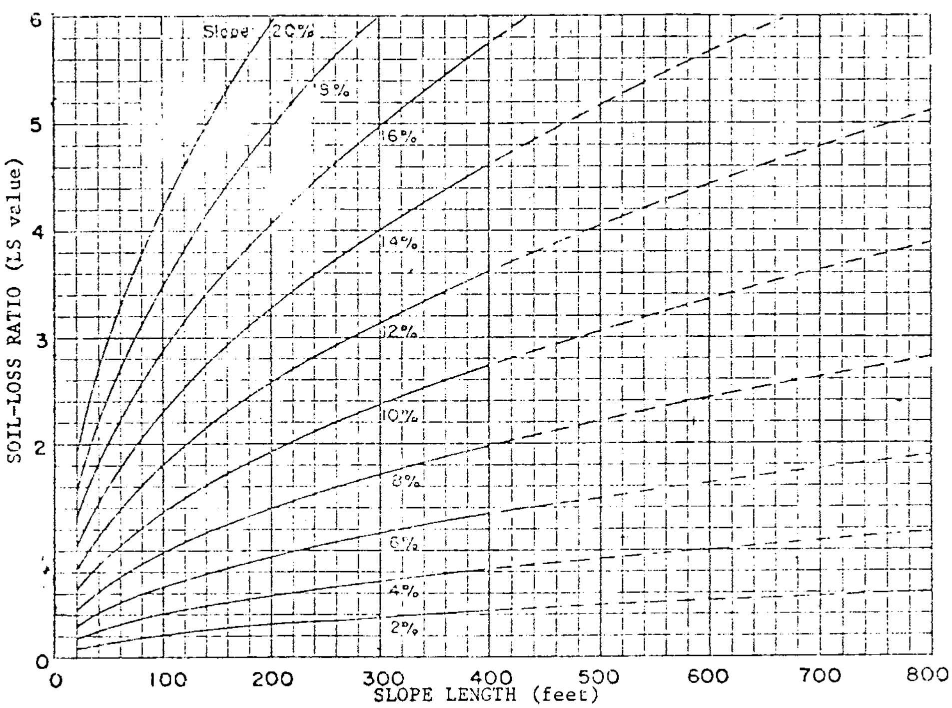

FIGURE 2
SLOPE-EFFECT CHART (topographic factor, LS)

C is the cover and management factor. C values range from 0.001 for well-managed woodland to 1.0 for tilled, continuous fallow. C for a given cropping and management system varies with rainfall distribution and planting dates. Generalized values for illustrative purposes are given in Table 4. Local values can be computed by a procedure published in Agriculture Handbook No. 282, or computed values may be obtained from the Soil Conservation Service. Values following construction can be estimated from Table 5.

TABLE 4

MAXIMUM PERMISSIBLE C VALUES (T/RKLS) FOR INDICATED GRADIENT AND SLOPE LENGTH WITH STRAIGHT AND WITH CONTOURED ROWS

GRADIENT (percent)	VALUES FOR SLOPE LENGTH (in feet) OF							
	60	80	100	150	200	250	300	400
	STRAIGHT ROW							
2	0.45	0.35	0.33	0.26	0.22	0.20	0.17	0.15
4	0.22	0.19	0.17	0.13	0.11	0.10	0.092	0.081
6	0.13	0.11	0.10	0.083	0.072	0.065	0.058	0.050
8	0.089	0.077	0.068	0.055	0.048	0.043	0.039	0.034
10	0.064	0.056	0.050	0.040	0.035	0.030	0.028	0.024
12	0.048	0.042	0.037	0.030	0.026	0.023	0.021	0.018
14	0.038	0.033	0.029	0.024	0.020	0.018	0.017	0.014
16	0.030	0.026	0.024	0.019	0.016	0.015	0.013	0.012
18	0.025	0.022	0.019	0.016	0.014	0.012	--	--
20	0.021	0.018	0.016	0.013	0.011	--	--	--
	CONTOURED							
2	0.75	0.58	0.57	0.43	0.37	0.33	0.28	0.25
4	0.44	0.38	0.34	0.26	0.22	0.20	0.18	0.16
6	0.26	0.22	0.20	0.17	0.14	0.13	0.12	0.10
8	0.15	0.13	0.11	0.092	0.080	0.072	0.065	0.057
10	0.11	0.093	0.083	0.067	0.058	0.050	0.047	0.040
12	0.08	0.070	0.062	0.050	0.043	0.038	0.035	0.030
14	0.048	0.041	0.036	0.030	0.025	0.022	0.021	0.018
16	0.038	0.032	0.030	0.024	0.020	0.019	0.016	0.015
18	0.031	0.027	0.024	0.020	0.018	0.015	--	--
20	0.023	0.020	0.018	0.014	0.012	--	--	--

Source: U.S. Department of Agriculture Handbook 282.

TABLE 5

AVERAGE FACTOR C VALUES FOR VARIOUS SURFACE STABILIZING TREATMENTS

TREATMENT	FACTOR C VALUES TIME ELAPSED BETWEEN SEEDING AND BUILDING	
	NONE	6 MONTHS
Seed, fertilizer and straw mulch Straw disked or treated with asphalt or chemical straw tack.	0.35	0.23
Seed and fertilizer	0.64	0.54
Chemical treatment	0.89	--
Seed and fertilizer with chemicals	0.52	0.38

P is the factor for supporting practices. Its value can be obtained from Table 6. With no support practices, P=1.0. Support practices are erosion control factors during construction.

TABLE 6

FACTOR P VALUES FOR COMPONENTS OF EROSION AND SEDIMENT CONTROL SYSTEMS

COMPONENT	FACTOR P VALUE
Small sediment basin:	
0.04 basin/acre	0.50
0.06 basin/acre	0.30
Downstream sediment basin:	
With chemical flocculants	0.10
Without chemical flocculants	0.20
Erosion reducing structures:	
Normal rate usage	0.50
High rate usage	0.40
Strip building	0.75

EXAMPLE SOIL LOSS PROBLEM

Using the soil loss equation, a theoretical strip mine of 10,000 acres in steep Kentucky mountain soils is computed. The R factor for rainfall is 200 from Figure a-1. The K factor for a clay loam with very low organic content is .28 (Table 2). Since the steepest land has 20% slopes, from Figure 2 at 200 feet, the LS value is 6. The C value for at least 6 months will be 1.0 when the land is bare. After the strip-mining is complete, slopes will be seeded and fertilized. The C factor is then reduced to .54 (Table 5). A downstream sediment basin is used during mining with chemical flocculants to settle silt. After the area is mined, the watershed is seeded and the sediment basin structure removed. During the mining period, the P factor is 0.2 (Table 6). With no supporting practices the P factor becomes 1, six months later.

Thus two equations for the year are appropriate:

$A_1 = 200 \times .28 \times 6 \times 1 \times .2 = 67.2$

$A_2 = 200 \times .28 \times 6 \times .54 \times 1 = 181.4$

67.2 A_1 = tons/acre/$\frac{\text{year}}{2}$ during mining for six months

181.4 A_2 = tons/acre/$\frac{\text{year}}{2}$ during six months following mining operation.

$A_1 + A_2$ = amount of soil lost per acre x 10,000 acres for the year* = 2.5 million tons.

*The soil loss equation and supporting data tables were designed to predict longtime average losses for specific conditions. Specific-year losses may be substantially greater or smaller than the annual averages because of differences in the number, size and timing of erosive rainstorms and in other weather parameters.

EXAMPLE SOIL LOSS PROBLEM

Using the soil loss equation, a theoretical strip mine of 10,000 acres in steep Kentucky mountain soils is computed. The R factor for rainfall is 200 from Figure a-1. The K factor for a clay loam with very low organic content is .28 (Table 2). Since the steepest land has 20% slopes, from Figure 2 at 200 feet, the LS value is 6. The C value for at least 6 months will be 1.0 when the land is bare. After the strip-mining is complete, slopes will be seeded and fertilized. The C factor is then reduced to .54 (Table 5). A downstream sediment basin is used during mining with chemical flocculants to settle silt. After the area is mined, the watershed is seeded and the sediment basin structure removed. During the mining period, the P factor is 0.2 (Table 6). With no supporting practices the P factor becomes 1, six months later.

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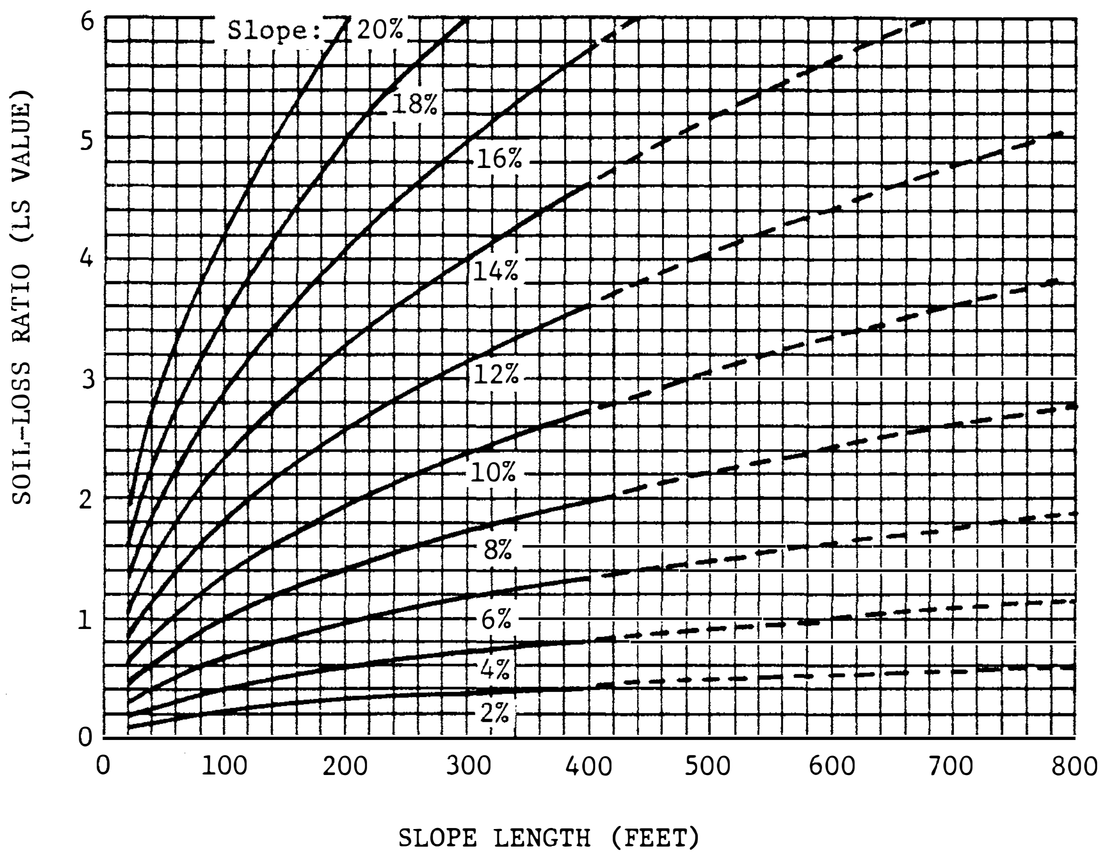

FIGURE

Slope-Effect Chart (Topographic Factor, LS)

FIGURE A-1
RAINFALL-EROSION LOSSES FROM EASTERN U.S.

SOURCE: U. S. Department of Agriculture,
Agricultural Research Service,
1965. Agriculture Handbook No. 282

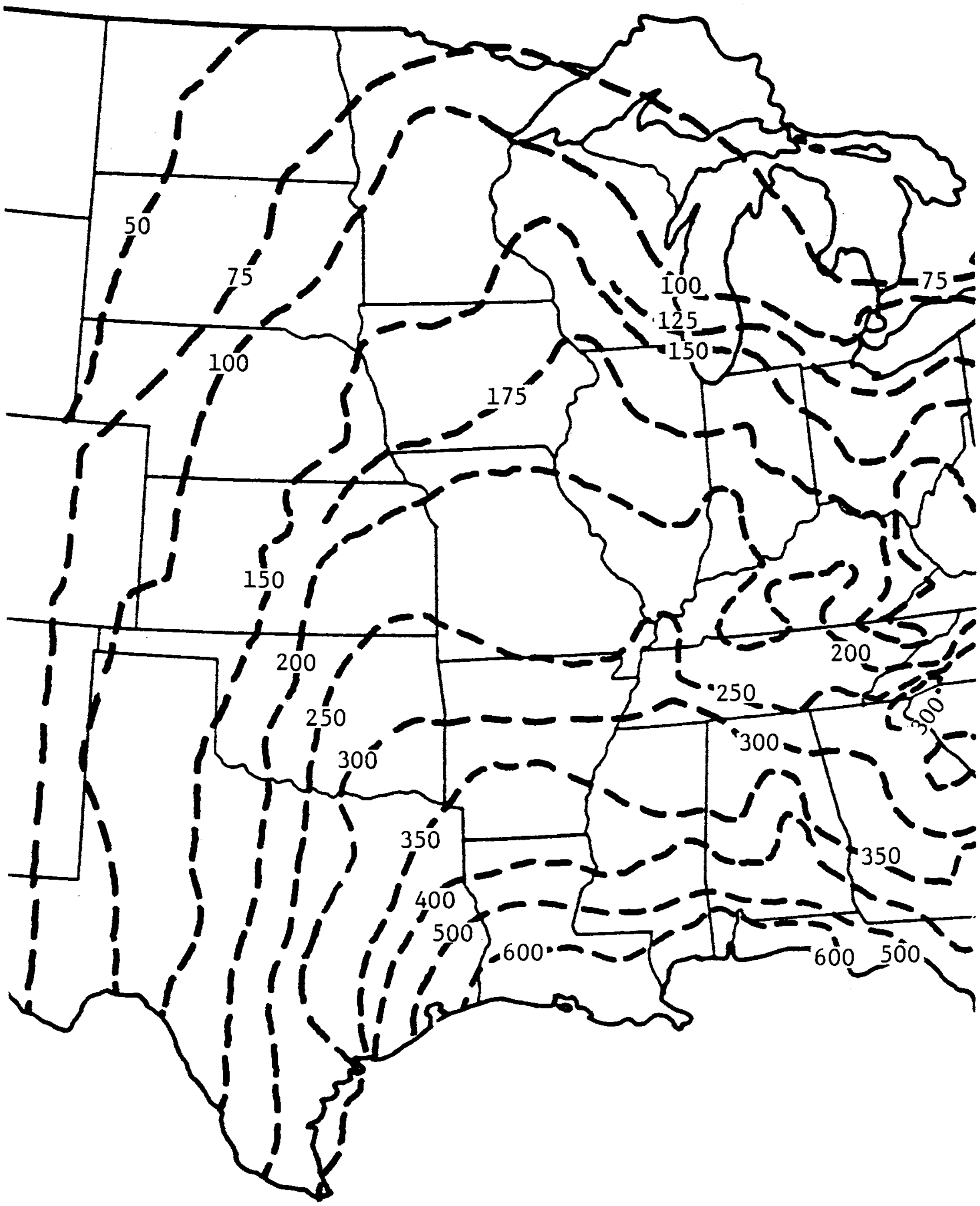

FIGURE A-2
RAINFALL-EROSION LOSSES FROM THE MIDWEST

Table D-1. Potential Soil Losses from Proposed Site During Construction

LOT (TOTAL ACREAGE)	SOIL TYPE/ % OF LOT	ACRE-AGE	RAINFALL/ RUNOFF EROSIVITY INDEX (R)	SOIL-ERODIBILITY FACTOR (K)	SLOPE EFFECT ON EROSION (LS)	COVER AND MGMT. FACTOR[1] (C_1)	COVER AND MGMT. FACTOR[1] (C_2)	EROSION AND SEDIMENT CONTROL[2] (P)	SOIL LOSS PER ACRE DURING 1st 6 MONTHS $A_1 = RKLSC_1P/2$	SOIL LOSS FROM TOTAL ACREAGE OF EACH SOIL TYPE DURING FIRST 6 MONTHS (acreage x A_1)	SOIL LOSS PER ACRE DURING NEXT 12 MONTHS $A_2 = RKLSC_2P$	SOIL LOSS FROM 60% OF TOTAL ACREAGE OF EACH SOIL TYPE DURING FOLLOWING 12 MONTH PERIOD (Soil Loss /60% of acreage)	TOTAL SOIL LOSS PER LOT DURING 18 MONTH CONSTRUCTION PERIOD (6 month loss + 12 month loss)
Gasifier Lot (7.1 acres)	Maury silt loam (90%)	6.39	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	23.07 tons	3.9 tons	14.9 tons/ (3.8 acres)	52.56 tons
	McAfee silt loam (10%)	0.71	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	8.89 tons 31.96 tons (Lot Total)	13.5 tons	5.7 tons/ (0.43 acres) 20.6 tons	
Miniature Light Bulb Site (15.6 acres)	Huntington silt loam[3] (40%)	6.2	188	--	--	--	--	--	--	--	--	--	
	McAfee silt loam (50%)	7.8	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	97.66 tons	13.5 tons	63.2 tons/ (4.68 acres)	170.3 tons
	Maury silt loam (10%)	1.6	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	5.78 tons 103.44 tons (Lot Total)	3.9 tons	3.7 tons/ (.96 acres) 66.9 tons	
Porcelainized Products (18.9 acres)	Maury silt loam (90%)	17.01	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	61.41 tons	3.9 tons	39.8 tons/ (10.2 acres)	140.2 tons
	McAfee silt loam (10%)	1.89	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	23.66 tons 85.07 tons (Lot Total)	13.5 tons	15.3 tons/ (1.1 acres) 55.1 tons	
Wood Laminator (12.4 acres)	Maury silt loam (80%)	9.42	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	34.01 tons	3.9 tons	22.0 tons/ (5.7 acres)	107.2 tons
	Lowell silt loam (20%)	2.48	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	31.05 tons 65.06 tons (Lot Total)	13.5 tons	20.1 tons/ (1.48 acres) 42.1 tons	
Ceramic Tile Manufacturer (14.1 acres)	Maury silt loam (40%)	5.64	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	20.36 tons	3.9 tons	13.2 tons/ (3.4 acres)	
	Nicholson silt loam (25%)	3.525	186	0.37	0.6	1.0	0.54	0.2	4.18 tons	14.73 tons	4.5 tons	9.5 tons/ (2.1 acres)	82.0 tons
	Lowell silt loam (25%)	3.525	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	14.73 tons	4.5 tons	9.5 tons/ (2.1 acres)	
	Huntington silt loam (10%)	1.41	188	--	--	1.0	0.54	0.2	--	-- 49.82 tons (Lot Total)	--	-- 32.2 tons	
Commercial Heat Treatment (12.9 acres)	Maury silt loam (40%)	5.16	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	18.6 tons	3.9 tons	12.1 tons/ (3.1 acres)	
	Nicholson silt loam (30%)	3.87	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	16.2 tons	4.5 tons	10.45 tons (2.3 acres)	75.1 tons
	Lowell silt loam (20%)	2.58	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	10.8 tons	4.5 tons	6.97 tons (1.55 acres)	
	Huntington silt loam (10%)	1.29	188	--	--	--	--	--	--	-- 45.6 tons (Lot Total)	--	-- 29.52 tons	

Table D-1. Potential Soil Losses from Proposed Site During Construction (Continued)

LOT (TOTAL ACREAGE)	SOIL TYPE/ % OF LOT	ACRE-AGE	RAINFALL/ RUNOFF EROSIVITY INDEX (R)	SOIL-ERODIBILITY FACTOR (K)	SLOPE EFFECT ON EROSION (LS)	COVER AND MGMT. FACTOR[1] (C_1)	COVER AND MGMT. FACTOR[1] (C_2)	EROSION AND SEDIMENT CONTROL[2] (P)	SOIL LOSS PER ACRE DURING 1st 6 MONTHS $A_1 = RKLSC_1P/2$	SOIL LOSS FROM TOTAL ACREAGE OF EACH SOIL TYPE DURING FIRST 6 MONTHS (acreage x A_1)	SOIL LOSS PER ACRE DURING NEXT 12 MONTHS $A_2 = RKLSC_2P$	SOIL LOSS FROM 60% OF TOTAL ACREAGE OF EACH SOIL TYPE DURING FOLLOWING 12 MONTH PERIOD (Soil Loss /60% of acreage)	TOTAL SOIL LOSS PER LOT DURING 18 MONTH CONSTRUCTION PERIOD (6 month loss + 12 month loss)
Stamping and Metal Fabrication (13.2 acres)	Nicholson silt loam (40%)	5.28	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	22.1 tons	4.5 tons	14.3 tons/ (3.17 acres)	
	Lowell silt loam (40%)	5.28	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	22.1 tons	4.5 tons	14.3 tons/ (3.17 acres)	88.5 tons
	Maury silt loam (20%)	2.64	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	9.5 tons 53.7 tons (Lot Total)	3.9 tons	6.2 tons/ (1.58 acres) 34.8 tons	
Glass Products Manufacture (14.1 acres)	Maury silt loam (30%)	4.23	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	15.2 tons	3.9 tons	9.8 tons/ (2.5 acres)	
	Lowell silt loam (30%)	4.23	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	52.9 tons	13.5 tons	34.2 tons/ (2.5 acres)	
	Lowell silt loam (30%)	4.23	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	17.7 tons	4.5 tons	11.3 tons (2.5 acres)	204.8 tons
	McAfee silt loam (10%)	1.41	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	17.6 tons 138.7 tons (Lot Total)	13.5 tons	10.8 tons/ (0.8 acres) 66.2 tons	
Warehouse (Lot 8) (6.7 acres)	McAfee silt loam (60%)	4.02	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	14.5 tons	3.9 tons	9.4 tons/ (2.4 acres)	
	Lowell silt loam (30%)	2.01	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	8.4 tons	4.5 tons	5.4 tons/ (1.2 acres)	51.5 tons
	McAfee silt loam (10%)	0.67	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	8.4 tons 31.3 tons (Lot Total)	13.5 tons	5.4 tons/ (0.4 acres) 20.2 tons	
Warehouse (Lot 7) (6.0 acres)	Maury silt loam (75%)	4.5	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	16.2 tons	3.9 tons	10.5 tons/ (2.7 acres)	
	Lowell silt loam (15%)	0.9	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	11.3 tons	13.5 tons	7.3 tons/ (0.54 acres)	49.3 tons
	Lowell silt loam (10%)	0.6	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	2.5 tons 29.9 tons (Lot Total)	4.5 tons	1.6 tons/ (0.36 acres) 19.4 tons	
Commercial (1) (12.3 acres)	Maury silt loam (70%)	8.61	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	31.1 tons	3.9 tons	20.1 tons/ (5.16 acres)	
	McAfee silt loam (20%)	2.46	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	30.8 tons	13.5 tons	19.9 tons/ (1.47 acres)	110.3 tons
	Lowell silt loam (10%)	1.23	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	5.1 tons 67.0 tons (Lot Total)	4.5 tons	3.3 tons/ (0.74 acres) 43.3 tons	

Table D-1. Potential Soil Losses from Proposed Site During Construction (Concluded)

LOT (TOTAL ACREAGE)	SOIL TYPE/ % OF LOT	ACRE-AGE	RAINFALL/ RUNOFF EROSIVITY INDEX (R)	SOIL-ERODIBILITY FACTOR (K)	SLOPE EFFECT ON EROSION (LS)	COVER AND MGMT. FACTOR[1] (C_1)	COVER AND MGMT. FACTOR[1] (C_2)	EROSION AND SEDIMENT CONTROL[2] (P)	SOIL LOSS PER ACRE DURING 1st 6 MONTHS $A_1 = RKLSC_1P/2$	SOIL LOSS FROM TOTAL ACREAGE OF EACH SOIL TYPE DURING FIRST 6 MONTHS (acreage x A_1)	SOIL LOSS PER ACRE DURING NEXT 12 MONTHS $A_2 = RKLSC_2P$	SOIL LOSS FROM 60% OF TOTAL ACREAGE OF EACH SOIL TYPE DURING FOLLOWING 12 MONTH PERIOD (Soil Loss /60% of acreage)	TOTAL SOIL LOSS PER LOT DURING 18 MONTH CONSTRUCTION PERIOD (6 month loss + 12 month loss)
Warehouse (2) (7.2 acres)	Maury silt loam (70%)	5.04	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	18.2 tons	3.9 tons	11.8 tons (3.0 acres)	44.8 tons
	Lowell silt loam (30%)	2.16	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	9.0 tons 27.2 tons (Lot Total)	4.5 tons	5.8 tons (1.29 acres) 17.6 tons	
Warehouse (3) (8.1 acres)	Maury silt loam (100%)	8.1	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	29.2 tons	3.9 tons	18.9 tons (4.86 acres)	48.1 tons
Commercial (4) (15.3 acres)	Lowell silt loam (80%)	12.24	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	51.2 tons	4.5 tons	33.0 tons (7.3 acres)	
	Lowell silt loam (10%)	1.53	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	19.2 tons	13.5 tons	12.4 tons (0.92 acres)	124.8 tons
	Maury silt loam (10%)	1.53	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	5.5 tons 75.9 tons (Lot Total)	3.9 tons	3.6 tons (0.92 acres) 48.9 tons	
Commercial (5) (8.0 acres)	Maury silt loam (60%)	4.8	188	0.32	0.6	1.0	0.54	0.2	3.61 tons	17.3 tons	3.9 tons	11.2 tons (2.88 acres)	
	McAfee silt loam (30%)	2.4	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	30.0 tons	13.5 tons	19.4 tons (1.44 acres)	89.0 tons
	Lowell silt loam (5%)	0.4	188	0.37	0.6	1.0	0.54	0.2	4.18 tons	1.8 tons	4.5 tons	1.1 tons (0.24 acres)	
	Lowell silt loam (5%)	0.4	188	0.37	1.8	1.0	0.54	0.2	12.52 tons	5.0 tons 54.1 tons (Lot Total)	13.5 tons	3.2 tons (0.24 acres) 34.9 tons	

APPENDIX E

METHODOLOGY FOR DETERMINING AIR EMISSIONS

APPENDIX E

METHODOLOGY FOR DETERMINING AIR EMISSIONS

Emissions from Combustion of Low-Btu Gas

Estimates of ground level nitrogen oxide concentrations from the combustion of low-Btu gas were made using an area source dispersion modeling technique given by Turner (1969). The relationship used to assess the concentrations for sampling times of short duration (approximately 10 minutes) is given by:

$$\chi = \frac{Q}{\pi \sigma_y \sigma_{z_i} u} \quad \exp \quad \{ -.5(H_e/\sigma_{z_i})^2 \}$$

where Q is the emission rate (gm/sec); u is the wind speed (m/sec); H_e is the average effective height for the source (m); σ_{z_i} is the standard deviation of the initial vertical distribution of plume (m); σ_y is the horizontal standard deviation of the plume (m); and χ is the concentration ($\mu g/m^3$).

The effective plume height is given by:

$$H_e = H_s + \Delta H$$

where H_s (m) is the stack height and ΔH is the plume rise. The Briggs formulation for plume rise used in this study is given by (stable conditions only):

$$\Delta H = 2.4 \ (F/us)^{1/3} \quad \text{for} \quad x > 2.4 \ u \ s^{-1/2}$$

$$\Delta H = 1.6 \ F^{1/3} \ u^{-1} x^{2/3} \quad \text{for} \quad x \leq 2.4 \ u \ s^{-1/2}$$

where F is the buoyancy flux (m^4/sec^3); and u is the ambient wind speed (m/s); s is a stability parameter (sec^{-2}); and x is the downwind distance (m). The bouyancy flux is related to the heat emission rate (Q_h, cal/sec) by:

$$F = (3.7 \times 10^{-5}) \ (Q_h)$$

The heat emission rate was calculated from:

$$Q_h = \rho v \pi r^2 c_p \Delta T$$

where ρ is density of the stack gas (assigned to hot air) (gm/m^3); v is the stack exit velocity (m/s); r is the stack radius (m); c_p is the specific heat at constant pressure for air (cal/gm ^oK); and ΔT is the difference between the stack gas temperature and the ambient temperature (^oK). The stability parameter s is defined by:

$$s = \frac{g}{T_a} \left(\frac{d\theta}{dz} \right)$$

where g is the acceleration of gravity (m/sec^2); T_a is the ambient temperature (^oK); and $\frac{d\theta}{dz}$ is the gradient of potential temperature.

The methodology involved calculating concentrations for stable conditions with low wind speeds (i.e., F stability with a wind speed of 2 meters per second). Concentrations were estimated for several downwind distances to establish the maximum concentrations for the conditions studied.

Emissions from Vehicular Traffic

Carbon monoxide (CO) emissions from increased vehicular traffic following completion of the industrial park were calculated to establish any resultant impacts. A method for estimating peak carbon monoxide concentrations associated with event-oriented indirect sources is provided by EPA (1974). The following assumptions were made during this first approximation to determine whether the given operating parameters would be capable of exceeding the 1-hour carbon monoxide National Ambient Air Quality Standards (NAAQS) in the vicinity of the proposed industrial park: 1) To maximize carbon monoxide concentrations, assume that one large parking lot with one gate consisting of two lanes each with capacities of 1000 vehicles per hour will be constructed; 2) Assume, for the worst case, that the total operating work force is 1044 persons and assume that the average vehicle occupancy is one; 3) Assume that the nearest reasonable receptor site is 10 meters from the gate and assume each lane is 5 meters wide; 4) Assume that the wind speed is 1 meter per second and acts at right angles to the flow of traffic through the gate; and 5) Assume a background CO concentration of 0 ppm (no data available; however, in this area, it is anticipated that concentrations would be very low).

For event-oriented traffic situations the EPA (1974) suggests that a convenient indicator of traffic congestion is the ratio (the volume demand-capacity ratio) of traffic volume demand flow rate at the gate to traffic capacity at the gate. Observations in the vicinity of similar types of auto parks have indicated periods of extreme congestion for a fraction of an hour after the event with practically no traffic toward the end of the hour. Accordingly, it is realistic to assume that the volume demand-capacity ratio of one (1) prevails during the total time period required to accommodate all vehicles wishing to use the gate and is zero for the remaining portion of the hour.

The time required to accommodate all vehicles wishing to use each gate is derived from the following expression:

$$T = v/c$$

where v = traffic volume wishing to use the gate, vehicles and c = maximum capacity of the gate [(# of lanes) (average lane capacity)], vehicles per hour. Substituting the appropriate values into the above expression yields a T of 0.5 hour. From EPA figures for 1000 vehicles per hour free-flow curves, the following CO concentrations would be expected at 10 meters (x_1) and 15 meters (x_2) from the traffic lanes:

$$x_1 = 25 \text{ ppm}$$

$$x_2 = 23 \text{ ppm}$$

Therefore, the average 1-hour concentrations at the receptor would be:

$$= (x_1 + x_2)\ T + x_{Bgd}$$

$$x_1\text{-hour} = (28 + 23)\ (0.5) + 0$$

$$= 25.5 \text{ ppm}$$ (per 1974 automobile pollution control abatement program)

This compares with the NAAQS 1-hour averaging CO values of 35 ppm.

Since the source is scheduled to begin operation in some year after 1974, peak CO concentrations obtained using the above described procedures should be adjusted by the appropriate factor given in the EPA document providing correction factors for pollution control abatement at various years. Therefore, if it is assumed that the development begins operation in the year 1979 (more conservative than a more realistic date of 1987), the maximum 1-hour CO concentration at the receptor cited may be:

$$x_1\text{-hour} = (x_1\text{-hour 1974})\ (\text{adjustment factor})$$

$$= (25.8 \text{ ppm})\ (0.5)$$

$$= 12.8 \text{ ppm}$$

It can be seen that these values are well below the NAAQS standards of 35 ppm, and, therefore, carbon monoxide levels from increased vehicular traffic in the industrial park are not anticipated to represent a problem.

APPENDIX F

COMMENTS

APPENDIX F
COMMENTS

This appendix contains reproductions of letters received from various Federal, state, and private organizations in response to the Federal Register Notice of August 30, 1977 (40FR116) announcing the intent to prepare this Draft Environmental Impact Statement. The following index to the letters is provided for the convenience of the reader.

Exhibit	Organization
1	Kentucky Preservation Review Board, Kentucky Heritage Commission
2	Marion F. Hall and signatures of Central Kentuckians
3	Illinois Coal Gasification Group
4	National Park Service, United States Department of the Interior
5	Institute of Gas Technology
6	Geological Survey, United States Department of the Interior
7	Bureau of Outdoor Recreation, United States Department of the I Interior
8	Ruth W. Bowling
9	Nancy N. Phares
10	Land and Nature Trust of the Bluegrass, Inc.
11	Stoll, Keenon & Park
12	G. Gibson Downing
13	Stoll, Keenon & Park
14	Sierra Club, Cumberland Chapter, Bluegrass Group
15	Jane Allen Offutt
16	Sierra Club, Cumberland Chapter, Bluegrass Group
17	Kentucky Heritage Commission

Ann Bolton Bevins
Route 4, Lexington Pike
Georgetown, Kentucky 40324

Mr. W.H. Pennington , Director
U.S. Energy Research and Development Administration
Washington, D.C. 20545

Dear Sir:

As a historian specializing in the field of documentation of and preservation of natural and manmade landmarks, I would like to register my conclusions with ERDA regarding the proposed Low BTU Coal Gasification Facility on a tract adjacent to Georgetown,Ky.

If it is necessary, and I presume it is, to erect such a plant in this area, then it would make sense to erect it away from a populated area, and at a point which wouldn't command further encroachment on the limited prime agricultural land in Scott County and Central Kentucky. This point is made in addition to the obvious danger of gaseous and other wastes dangerous to health. The point selected by Irvin Industrial Development Company is the high point in the area immediately east of Georgetown, and a point directly over one of the sources of the Big Spring, Georgetown's source of water supply. The land chosen is the finest Blue Grass loam soil. The industrial park attendant to the proposed plant site would further remove this area from agricultural use, and would cause by extensive blacktopping a new watershed situation. With water shortages becoming a great threat to our future, it makes sense that we try not only to conserve those sources we have, but to ensure their continuation of all natural supply.

Scott County has among its 181,020 acres of land, only 58,038 acres of prime agricultural land. Not only would the industrial park remove about 200 acres of good farmland permanently from agricultural use, but the accompanying housing and service facilities would divert thousands of acres of nearby land from the use for which it should be intended.

There are in addition to the 58,038 acres of prime agricultural land some 32,580 acres land farmland that are nevertheless somewhat important to farming, and 81,690 acres of Eden Shale land. (Some 8,712 acres of good agricultural land are already "built up" with housing, communities and other developments.) Would it not make sense for the experimental gasification plant as well as the industrial park and the housing necessitated thereby to be located on the land that is only secondarily important to agriculture, or which really has not yet found its adaptive uses?

66150
49326

EXHIBIT 1

A great influx of industrial and management workers is anticipated with the location of the plant here, and it is hoped that there will be federal assistance for a hurried-up enlargement of the public school system, for improvement of roads and services, and for protection of landmarks.

Therefore I would like to urge that ERDA direct the location of the Scott County coal gasification plant in the largely undeveloped area north of Georgetown, either near the Clark Equipment Company factory at Delaplain, or north of that site. Furthermore, I would ask that the accompanying report insist on future residential developments being situated also in that area, thus preserving the agricultural land that America is destined to need in years to come.

Sincerely yours,

Ann Bolton Bevins, Member
Kentucky Preservation Review Board
Kentucky Heritage Commission

EXHIBIT 1 (Concluded)

August 15, 1977

Mr. W. H. Pennington, Director
Office of NEPA Coordination
U. S. Energy Research and Development Administration
Washington, D. C. 20545

Re: Proposed Low-BTU Coal Gasification Facility at the Irvin Industrial Development Company Site in Georgetown, Scott County, Kentucky

Dear Mr. Pennington:

By this letter an official objection to the proposed coal gasification plant and industrial park is submitted for the record. It is the strong belief of many Central Kentuckians that this development would constitute a detriment to Georgetown.

The contemplated industrial growth to accompany the coal gasification plant would result in a devastating threat to the city's water supply, air quality, school capacity, housing base, employment ratio, traffic and road system and overall socio-economic balance. Georgetown, Scott County is a community of low unemployment, low crime rate, excellent ecological balance and high quality of life. Many of us are anxious to preserve this unique aspect of our existance.

We acknowledge our country's energy plight and share in the responsibility for solving the problem. Coal gasification is an old, proven technique. Why burden our community with a potentially crippling complex to do what has already been done? If this concept is crucial to ERDA's national program, we urge that development be located in an economically depressed area closer to the coal fields where it would be welcome.

We urge ERDA to abandon its consideration of Georgetown, Kentuck[illegible]s the site of a proposed low-BTU coal gasification facility.

Yours very truly,

Marion L. Hall
524 Estill Ct.
Georgetown, Ky 40324

P. S. Please send a copy of the draft environmental impact statement to me when it is available. Thank you.

EXHIBIT 2

Form letters received re Georgetown Kentucky Low BTU coal gasifier

MRS. MITCHELL ADAMS
205 NORTH HAMILTON STREET
GEORGETOWN KY 40324

MR. WILLYE AMERSON
R #4
GEORGETOWN KY 40324

MR. J. C. BRADLEY JR.
W. MAIN STREET
GEORGETOWN KY 40324

MRS. CRAIG BRADLEY
WEST MAIN STREET
GEORGETOWN KY 40324

MS. KATE BRASHEAR
132 MILITARY STREET
GEORGETOWN KY 40324

MR. CLAY BROCK
321 E. MAIN STREET
GEORGETOWN KY 40324

MS. PATRICIA C. BUTCHER
FLAIR
306 E. MAIN STREET
GEORGETOWN KY 40324

MR. GENE BUTCHER JR.
701 E. COLLEGE
GEORGETOWN KY 40324

MR. JAMES C. CANTRILL
CANTRILL/BROWN AND HOLLINGSWORTH
ST. LUKE PLACE
GEORGETOWN KY 40324

MR. CLARK CLEVELAND
CLEVELAND FARM INC.
404 HIAWATHA TR.
GEORGETOWN KY 40324

MS. JANE W. DUNCAN
ROUTE #3
GEORGETOWN KY 40324

MR. FRED M. DUNCAN
ROUTE #3
GEORGETOWN KY 40324

MS. CAROL G. ELAM
P. O. BOX 434
GEORGETOWN KY 40324

MS. SANDRA FIELDS
144-A DOWSON WAY
GEORGETOWN KY 40324

MRS. JAE H. GAINES
528 E. MAIN STREET
GEORGETOWN KY 40324

MR. HORACE G. GAINES
519 E. COLLEGE STREET
GEORGETOWN KY 40324

DR. CHARLES H. HAGGARD
MEMBER
SCOTT COUNTY BOARD OF EDUCATION
GEORGETOWN KY 40324

MS. MARY P. HAGGARD
RR 3
LLOYD ROAD
GEORGETOWN KY 40324

MS. MARION HALL
524 ESTILL COURT
GEORGETOWN KY 40324

MR. NATHAN L. HALL
209 SIOUX TRAIL
GEORGETOWN KY 40324

EXHIBIT 2 (Continued)

MS. D[illegible]THY MCFARLAND
510 FOUNTAIN AVENUE
GEORGETOWN KY 40324

MR. DANIEL W. MCFARL[illegible]
510 FOUNTAIN AVENUE
GEORGETOWN KY 40324

MS. ADA MCFARLAND
510 FOUNTAIN AVENUE
GEORGETOWN KY 40324

MR. DAVID N. MCFARLAND
406 DELAWARE DRIVE
GEORGETOWN KY 40324

MRS. MARY MCFARLAND
416 CHESTNUT STREET
GEORGETOWN KY 40324

MS. CHARLOTTE H. MCFARLAND
DELAWARE DRIVE
GEORGETOWN KY 40324

MR. NOAH MULHOLLAND
305 W. COLLEGE STREET
GEORGETOWN KY 40324

MS. CORA LEE MULHOLLAND
305 W. COLLEGE STREET
GEORGETOWN KY 40324

MRS. JANE ALLEN OFFUTT
336 EAST MAIN STREET
GEORGETOWN KY 40324

MR. WILLIE H. OFFUTT
402 E. JACKSON
GEORGETOWN KY 40324

DR. WILLIAM W. OFFUTT IV
WEST MAIN STREET
GEORGETOWN KY 40324

MS. EVELYN PENN OSBORNE
STAGE COACH STOP ROUTE 2
GEORGETOWN KY 40324

MR. JOHN B. PENN
651 BROADWAY
GEORGETOWN KY 40324

MRS. FRANK PENN
1004 ARAPAHO TRAIL
GEORGETOWN KY 40324

MS. PEGGY B. PETER
629 W. SHORT STREET
LEXINGTON KY 40508

MRS. LINDA RAINS
R.R. #2
GEORGETOWN KY 40324

DR. THOMAS N. SEAY
ASSOCIATE PROFESSOR/BIOLOGICAL SCIENCES
DIRECTOR OF ENVIRONMENTAL STUDIES
GEORGETOWN COLLEGE
GEORGETOWN KY 40324

MR. ROBERT SHIPLEY
106 W. MAIN STREET
GEORGETOWN KY 40324

MRS. L. H. SUBLETT
657 S. BROADWAY
GEORGETOWN KY 40324

DR. HARLEY H. SUTTON
CHAIRMAN
CONCERNED CITIZENS OF SCOTT COUNTY
LEXINGTON ROAD
GEORGETOWN KY 40324

MR. GEORGE SUTTON
ROUTE #2
STAMPING GROUND PIKE
GEORGETOWN KY 40324

MRS. PATSY HALL
209 SIOUX TRAIL
GEORGETOWN KY 40324

MS. BETTY ANNE HALL
524 ESTILL COURT
GEORGETOWN KY 40324

MR. BUFORD HALL IV
115 HIGHLAND COURT
GEORGETOWN KY 40324

MS. L. MAUREEN HALL
524 ESTILL COURT
GEORGETOWN KY 40324

MRS. LORA F. HALL
115 HIGHLAND COURT
GEORGETOWN KY 40324

MRS. WILLIAM HAYS
PRESIDENT
FRIENDS OF THE SCOTT COUNTY LIBRARY
416 E. MAIN STREET
GEORGETOWN KY 40324

MR. WILLIAM F. HAYS
416 E. MAIN
GEORGETOWN KY 40324

MR. VAL HOLLINGSWORTH
ECLIPSE PLACE
GEORGETOWN KY 40324

MR. KENT HOLLINGSWORTH
ECLIPSE PLACE
GEORGETOWN KY 40324

MS. TISH HOLLINGSWORTH
ECLIPSE PLACE
GEORGETOWN KY 40324

MR. EDWIN W. HUMPHREYS
RETIRED PRESIDENT
SOUTHWESTERN TOBACCO COMPANY
ROUTE 3
STAMPING GROUND PIKE
GEORGETOWN KY 40324

MS. SUSAN G. HUMPHREYS
ROUTE 3
GEORGETOWN KY 40324

MS. CLAUDIA JETT
INDIAN HILLS
GEORGETOWN KY 40324

MR. WINFIELD S. JONES
ASSISTANT PROFESSOR
BIOLOGY
GEORGETOWN COLLEGE
GEORGETOWN KY 40324

* MRS. MICHAEL A. KAUPPI
220 INDEPENDENCE COURT
GEORGETOWN KY 40324

MR. DWIGHT M. LINDSAY
CHAIRMAN
BIOLOGY DEPARTMENT
GEORGETOWN COLLEGE
GEORGETOWN KY 40324

MS. RUBY LUSH
53 ESTILL COURT
GEORGETOWN KY 40324

MR. SHANE LUSH
531 ESTILL COURT
GEORGETOWN KY 40324

MR. GARY W. LUSH
531 ESTILL COURT
GEORGETOWN KY 40324

MR. JOSEPH LUSH
531 ESTILL COURT
GEORGETOWN KY 40324

MR. WARRING H. MCFARLAND
510 FOUNTAIN AVENUE
GEORGETOWN KY 40324

EXHIBIT 2 (Continued)

EXHIBIT 2 (Continued)

MRS. KATHLEEN THOMPSON
522 ESTILL COURT
GEORGETOWN KY 40324

MS. MARGARET R. TRIE
R. #1
GEORGETOWN KY 40324

MS. HOLLY WIEDEMANN
NEWTOWN PIKE
GEORGETOWN KY 40324

MR. DORCAS WIEDEMANN
RR 1
GEORGETOWN KY 40324

MR. J. A. WIEDEMANN
RR 1
GEORGETOWN KY 40324

MR. HOWARD O. WILES
ROUTE 3
LLOYD ROAD
GEORGETOWN KY 40324

MS. MARTHA N. WILES
306 E. MAIN STREET
GEORGETOWN KY 40324

MR. CHARLES G. WISE
401 PAWNEE TR #4
GEORGETOWN KY 40324

+ 27 illegible signatures
name, and/or address
as of 11:00 9/19/77

EXHIBIT 2 (Concluded)

ILLINOIS
COAL GASIFICATION
GROUP

122 S. MICHIGAN AVENUE
SUITE 2014
CHICAGO, ILLINOIS 60603
(312) 431-4925

August 23, 1977

IC -E-093

Mr. W. H. Pennington, Director
Office of NEPA Coordination
United States Energy Research and
Development Administration
Washington, D.C. 20545

Dear Sir:

In response to your letter of August 9, 1977, regarding the preparation of the draft EIS for the proposed low-BTU coal gasification facility at the Irvin Industrial Development Company site, we have the following comment.

ERDA has an existing outline for EIS preparation that is quite thorough and will ensure a complete environmental analysis is made of the proposed project; so we recommend that 10 CFR, Chapter III, part 711 be followed with no deletions or additions.

We would also like a copy of the draft statement when it is available. It would be appreciated if you would send it to the undersigned at this letterhead address.

Sincerely,

R. J. Eby
General Manager

RJE:sk

MEMBER COMPANIES SERVING THE PEOPLE OF ILLINOIS
Northern Illinois Gas Company • The Peoples Gas Light and Coke Company
Central Illinois Public Service • Central Illinois Light Company
North Shore Gas Company

EXHIBIT 3

United States Department of the Interior

NATIONAL PARK SERVICE
SOUTHEAST REGIONAL OFFICE
1895 Phoenix Boulevard
Atlanta, Georgia 30349

IN REPLY REFER TO:

L7619-SER-PP
ER 77/757

AUG 25 1977

Mr. W. H. Pennington
Director, Office of NEPA Coordination
Energy Research and Development Administration
Washington, D. C. 20545

Dear Mr. Pennington:

In response to your request for technical assistance for a proposed Low-BTU Coal Gasification Facility, Irvin Industrial Development Company, Scott County, Kentucky, we are pleased to provide the following comments.

The proposed action will not adversely affect any existing, proposed or known potential units of the National Park Service or any known natural areas eligible or considered potentially eligible for the National Landmarks Program. Consultation with the State Historic Preservation Officer should provide information on cultural resources which may be eligible for or in process of nomination to the National Register of Historic Places. That office should also be able to provide an opinion on the probability of archeological resources in the area to be impacted. Archeological resources must be identified and evaluated for significance during the planning stage.

The above comments are being provided on a technical assistance basis only. The U. S. Department of the Interior will be pleased to provide specific comments on the environmental impact statement when it has been prepared.

Sincerely yours,

David D. Thompson, Jr.
Regional Director
Southeast Region

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

EXHIBIT 4

IGT

INSTITUTE OF GAS TECHNOLOGY • 3424 SOUTH STATE STREET • IIT CENTER • CHICAGO, ILLINOIS 60616

3739

August 26, 1977

W. H. Pennington, Director
Office of NEPA Coordination
U.S. Energy Research and
Development Administration
Washington, D.C. 20545

Dear Sir:

This discussion is in regard to your letter of August 9, 1977 with its request for comments to be considered in the preparation of an Environmental Impact Statement for a proposed low-Btu coal gasification facility in Georgetown, Kentucky. I have one major comment -- the section of an EIS on alternatives to the proposed action is often weak. You have an opportunity here to make a significant impact by considering the environmental consequences of alternative methods for supplying this energy.

As I understand the objectives of the proposed project, low-Btu gas will be generated from coal to supply process and space heating requirements for a proposed industrial park.

If the gasifiers were not built, the industrial park would probably rely upon natural gas for its energy requirements (if that natural gas were available). The use of the low-Btu gasifiers would release that gas for use residentially where, otherwise, electricity would be used. The environmental implications of your gasification system can therefore be compared directly to the environmental implications of generating an equivalent amount of heat from coal in the form of electricity. To determine the equivalent amount of electricity, utilization and transmission efficiencies must be considered, as well as the load factor of the generation station.

The industrial park might also get its energy from district heating, using coal-fired boilers and stack gas scrubbers. Here the environmental comparison is more readily apparent.

A third alternative is the use of fuel oil for heating in the industrial park. Although this alternative will not show as great an environmental differential, any such action is contrary to our national objectives of reducing our dependence on foreign oil.

A fourth consideration is no action at all. Without a source of energy, the proposed industrial park will probably not be developed -- due primarily to tight gas supplies. The social and demographic effects of reduced employment opportunities in the area should be carefully considered.

EXHIBIT 5

.nnington

Still further consideration could be given to the overall implications of the development of low-Btu coal gasification -- projecting the environmental consequences of not developing this environmentally-superior source of energy but, rather, using coal directly. Such projections should include the anticipated growth of low-Btu gasification and the savings of criteria pollutants in our national inventory.

I believe your document affords an excellent opportunity to compare the environmental implications of low-Btu gasification with alternative forms of supplying energy and that an EIS should look at the positive, as well as the negative environmental impacts. If properly presented, such a discussion could be an excellent reference for the environmental implications of alternative forms of energy supply.

I would appreciate a copy of the draft statement when it becomes available. If I can be of any further help in this presentation, please do not hesitate to contact me.

Very truly yours,

Donald K. Fleming
Associate Director
Process Evaluation

DKF:pc

EXHIBIT 5 (Concluded)

United States Department of the Interior
GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092

OFFICE OF THE DIRECTOR

In Reply Refer To:
EGS-ER-77/757
Mail Stop 750

AUG 3 1 1977

Mr. W. H. Pennington
Director, Office of NEPA Coordination
Energy Research and Development
Administration
Washington, D. C. 20545

Dear Mr. Pennington:

In response to your letter of August 9 to Mr. Blanchard, we submit the following technical assistance in regard to a proposed low-BTU coal gasification facility in Georgetown, Kentucky.

An environmental statement should consider measures to control stormwater runoff draining coal-storage areas and burned-coal waste disposal sites. Water draining such areas may contain significant concentrations of hazardous substances such as heavy metals. Information on history of flooding, baseline data on water quality, flow characteristics of streams draining the project site, and the source and availability of process water should be included. Also, mitigating measures to minimize any adverse effects on streamflow characteristics and the chemical, physical, and biological water quality of surface-water resources should be considered. Such effects may result from plant effluent, "acid rain" caused by smoke stack emissions, and cooling tower blowdown.

The draft statement should address at least the following aspects of ground-water resources and related impacts:

(1) Quantity of water needed, its uses and flow within the facility, and its eventual release.

(2) Source(s) of the water.

(3) Effects of planned ground-water withdrawals on water levels, quality of water, ground-water availability, and land-surface subsidence.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

EXHIBIT 6

(4) Existing ground-water situation, including pertinent details of ground-water occurrence, aquifer characteristics, and quality.

(5) Disposal of gasifier and boiler ash, related impacts, and proposed mitigation.

(6) Liquid waste products and potential water pollutants produced in gasification and their disposal or fate. (Included among these would be phenol, thiocyanate, cyanide, ammonia, chloride, carbonate, bicarbonate, sulfur, phosphate, trace elements, tars and oils.)

(7) Impacts on ground-water quality and quantity of mining the coal to be used in the plant.

Thank you for the opportunity to offer these suggestions.

Sincerely yours,

Acting Director (Sgd) M. R. Klopper

EXHIBIT 6 (Concluded)

United States Department of the Interior

BUREAU OF OUTDOOR RECREATION
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

SEP 02 1977

Mr. W. H. Pennington
Director, Office of NEPA Coordination
Energy Research and Development
Administration
Washington, D.C. 20545

Dear Mr. Pennington:

The Department's Office of Environmental Project Review has forwarded a copy of your August 9, 1977, letter requesting comments and suggestions for consideration in the preparation of the draft environmental statement for a proposed low-BTU coal gasification facility at the Irvin Industrial Development Company site in Georgetown, Scott County, Kentucky. We offer the following comments and suggestions concerning the possible environmental effects of this project on recreation.

We recommend the draft environmental statement identify existing and proposed park and recreation resources in relation to the project site and provide an analysis of the environmental effects of the project on these resources.

We have a Land and Water Conservation Fund assisted park in Georgetown, Suffoletta Park, which is located approximately half a mile from the proposed facility. We are concerned with the possible effects development of the proposed facility may have on this park, especially adverse air, noise, and esthetic effects.

The draft statement should also evaluate the effects on recreation from the influx of personnel needed for the plant's construction and operation.

We suggest that you coordinate with the following State and local park and recreation officials in order to further identify the effects of the project on recreational areas:

Mr. Bruce Montgomery
Commissioner, Department of Parks
Capital Plaza Tower
Frankfort, Kentucky 40601
(502) 564-4260

EXHIBIT 7

Mr. Gene Lucus
Chairman, Parks and Recreation Board
142 East Main Street
Georgetown, Kentucky 40234
(502) 863-3505

Our comments are provided on a technical assistance basis. Please do not hesitate to call on us should you need additional assistance.

Sincerely,

Chris Therral Delaporte
Director

EXHIBIT 7 (Concluded)

#7

Mrs. Ruth W. Bowling
534 Hamilton
Georgetown, Kentucky 40324

Letter to the Editor:

"What we achieve too cheaply, we esteem too lightly." The largesse experienced by the people of Georgetown came to them free: clean air, pure water, rich country side, tree lined streets and, that prerequisite for healthy emotional and intel-luctual development, space for privacy and intimate domain. These are possessions that should be cherished by the many whose lives are enriched by them now, and gratefully preserved for those who will follow. Instead, we see them disappearing in continuum across our land. At the same time, we see federal tax dollars allocated annually to purchase and preserve these very same qualities that are native to Georgetown and enhance it's life style.

Georgetown is being urged to trade it's birthright for a mess that is less palatable than pottage, and will be much harder to dispose of when the rancidness develops.

It would appear to be more equitable if those whose value systems espouse urbanization and industrialization would look for a community that has already taken that road, rather than being so intent on destroying that which could never be returned to us once it is gone. Let us esteem highly now what we have, not later what we can only remember.

As the step-daughter of a recently retired newspaper publisher, I have the utmost respect for your position, but do deplore your stand on the proposed coal gasification plant and am not impressed by the ploy of using "Tom's Tales" to make Thomas Lohr appear to be a folksy member of the community.

Yours truly,

(Mrs.) Ruth W. Bowling

Published in the Georgetown News in June 1977. I feel just as strongly now as I did then. I am one of many who do not want any part of this plant - or an industrial park!

Ruth W Bowling
9-4-77

EXHIBIT 8

642 South Broadway
Georgetown, Kentucky 40324
September 10, 1977

Mr. W. H. Pennington, Director
Office of NEPA Coordination
U. S. Energy Research and Development Administration
Washington, D. C. 20545

Re: Proposed Low-BTU Coal Gasification Facility at the Irvin Industrial Development Company Site in Georgetown, Scott County, Kentucky

Dear Mr. Pennington:

This letter is written in response to a request for comments on subject project which I received from your agency. I understand that these comments will be weighed in the preparation of the draft environmental impact statement.

As one in strong opposition to this project, I urge and in fact beg you to schedule a public hearing in Georgetown, Kentucky to obtain comments from those of us who object. Mr. Pennington, we are not a bunch of flag-waving radicals who strongly stand in the path of development but rather we are qualified, clear-thinking individuals who boast a great pride in our community and want what's best for it. Our people are like most in that it is difficult for some to convey their feelings long distance to some federal agency located in Washington. I believe that a visit to Georgetown and a public hearing there would provide valuable information for your assessment of this project.

A group of us have studied and followed this project for many months now. We have listened to all the reasons why it would benefit our nation and our community and we are not convinced. The advantages seem to go to the owners and developers of the site who purchased the property some years ago. Their efforts to sell industrial plots have failed and installation of a coal gasification plant will supply the energy necessary to accommodate prospective purchasers of the land. The project is purely profit-motivated with benefits to accrue to a select few who neither reside in nor care about Scott County. If the federal government chooses to be a party to such an undertaking, our nation is in a sad state.

So that you don't think our contingent is anti-energy-development, we offer the only logical alternative. Place the coal gasification plant nearer to the coal supply in an area where growth and economic stimulation is needed - eastern Kentucky. Transportation of the coal to Central Kentucky would certainly be a total waste of much cherished energy. A calculation of the cost per mile should be included in your assessment.

EXHIBIT 9

Another consideration is that of whether or not the adjacent industries will in fact locate in Georgetown to utilize the gas from the plant. Any industrialist will certainly weigh factors other than the availability of energy. He will consider labor force and housing which are non-existant in Scott County. He will consider acceptability of his facility and find a vocal faction strongly opposed to his factory. It is entirely conceivable that the coal gasification plant would be constructed and no industry enter to utilize the gas.

Other objections to this development stem from research into such areas as our water supply. A noted geologist has presented for consideration a study revealing that this plant will be located on top of a major source of Georgetown's water supply. Any contamination would certainly have a devastating effect on Georgetown's future water supply. A visit to the site will demonstrate its proximity to the city and the undeniable fact that air pollution could be a factor. These two considerations are presented along with factors such as 2% unemployment, practically non-existant housing, and limited transportation facilities.

In conclusion, Mr. Pennington, there is opposition with factual basis in Georgetown. Our faction would like to present its case face to face with your staff. As we cannot travel en masse to Washington and implore you to send representatives to our city. Your consideration of these comments and suggestions is appreciated.

Yours very truly,

Nancy N. Phares

(Mrs) Nancy N. Phares

NNP:s

EXHIBIT 9 (Concluded)

THE LAND AND NATURE TRUST OF THE BLUEGRASS IS A NONPROFIT ORGANIZATION OF CITIZENS DEDICATED TO THE PRESERVATION OF THE LANDSCAPE OF CENTRAL KENTUCKY.

September 12, 1977

Mr. W. H. Pennington, Director
Office of NEPA Coordination
Energy Rersearch and Development Administration
Washington, D. C. 20545

Dear Sir:

The Land and Nature Trust of the Bluegrass appreciates the opportunity to comment on the feasibility of a coal gasification plant at the Irvin Industrial Development site in Georgetown, Kentucky. We believe such a facility at this location is environmentally unsound.

A coal gasification plant would more logically be located nearer the source of coal; also it could serve better in an area with higher unemployment. Certainly it would be less harmful in a section which is not karst and which is not prime farm land.

The Inner Bluegrass region throughout its history has been outstanding for the richness of its land, but prime agricultural land is not prevalent in the rest of the Commonwealth of Kentucky, and in Scott County it is restricted to the southernmost part of the county around Georgetown. The prime land that would be sacrificed as a result of the proposed industrial complex would exceed the acreage now designated as an "industrial park"; for instance, a 4-lane highway would be constructed to connect it with I-75 and U.S. 25, and more land would be taken for residential developments that would follow in its wake. As citizens of Kentucky and the United States, we disapprove of state and federal funds being used to promote and indirectly force the appropriation of scarce prime agricultural land for other irrevocable uses, to the detriment of future generations.

Any urban development in a karst area has potential, unforeseen hazards. The Lexington and Fayette County government has learned this the "hard way" - costly way - and is now applying lessons learned in hindsight to a consideration of depressions and sinks in land use planning. This is even more serious in the proposed gasification plant and its associated industrial complex since it is located on one of the principal recharge areas for Georgetown's main water supply, specifically on a trunk line of the aquifer. The location of the plant here would affect both water quantity and water quality.

Pennington Dept

LAND AND NATURE TRUST OF THE BLUEGRASS, INC. ● 712 WEST SHORT STREET ● LEXINGTON, KENTUCKY 40508 ● (606) 254-2411

EXHIBIT 10

THE LAND AND NATURE TRUST OF THE BLUEGRASS IS A NONPROFIT ORGANIZATION OF CITIZENS DEDICATED TO THE PRESERVATION OF THE LANDSCAPE OF CENTRAL KENTUCKY.

The percentage in reduction of recharge would be much greater than is indicated by the "Environmental Assessment" prepared for the Irvin Industrial Development Company. Taking their figure of 25% of the 172.5 acres to be paved over, with this runoff going to storm sewers rather than the aquifer, we calculate the average daily reduction of the potential water supply as 48,221 gallons instead of 40,000. Saying this is "less than 1% of the total amount of water consumed by the Georgetown community" is false, since the average daily water consumption reported in 1976 was 1,300,000 gallons. Also erroneous is the statement, "The capacity of the Royal Springs aquifer has been estimated to be up to 4,000,000 gallons per day." Four million gallons is the capacity of the recently enlarged treatment plant; at present there is not that much water to be treated. Only on very rare occasions of the most severe flooding would that much ever be discharged from the spring.

In time of drought the present water supply would be inadequate to accommodate the gasifier using 70,000 gallons per day, plus the water demands of probably 26 associated industries, and the demands of the increased population accompanying the development. The discharge from Royal Spring has been as low as one half million gallons per day; although this is rare, the critical lows must be considered. Existing facilities can pump up to 1,000,000 gallons per day from North Elkhorn Creek. To accommodate the gasification plant and the industrial complex the city would be compelled to expend funds to enlarge its dams on Elkhorn Creek; this seems hardly fair to the citizens of the community.

The threat to water quality is serious. There can be no guarantee that no hazardous spill or leak will ever reach the aquifer. Runoff from the coal pile is to be discharged to grade (and thence to drinking water); although most solids would be removed by impoundment, that will not remove 100% of substances weathered from the coal, some of which are potentially harmful. Effluents discharged into the sewer system may not always have 100% of harmful chemicals removed, and hence could endanger the health of persons using water downstream.

It is glibly stated in the "Environmental Assessment" that ash, sulphur, and organic residues are to be disposed of in landfills. This is not so simple, and it presents grave problems in a karst area. Fayette County, with its landfill nearing capacity, spent years in an effort to locate a new one; the chief problem was underground drainage and possible contamination of wells and springs used by livestock as well as by man.

LAND AND NATURE TRUST OF THE BLUEGRASS, INC. ● 712 WEST SHORT STREET ● LEXINGTON, KENTUCKY 40508 ● (606) 254-2411

EXHIBIT 10 (Continued)

Land & nature trust of the BLUEGRASS

THE LAND AND NATURE TRUST OF THE BLUEGRASS IS A NONPROFIT ORGANIZATION OF CITIZENS DEDICATED TO THE PRESERVATION OF THE LANDSCAPE OF CENTRAL KENTUCKY.

The Executive Committee of the Land and Nature Trust of the Bluegrass is in sympathy with energy research and development. However, it is unanimous in the view that the Georgetown, Kentucky, site is environmentally unsuitable for coal gasification, and has directed that these comments be sent to you.

Yours sincerely,

Mary E. Wharton

Dr. Mary E. Wharton,
Vice President

LAND AND NATURE TRUST OF THE BLUEGRASS, INC. ● 712 WEST SHORT STREET ● LEXINGTON, KENTUCKY 40508 ● (606) 254-2411

EXHIBIT 10 (Concluded)

STOLL, KEENON & PARK
1000 FIRST SECURITY PLAZA
LEXINGTON, KENTUCKY 40507
(606) 259-0444

September 12, 1977

Mr. W. H. Pennington
Director, Office of NEPA
Coordination
United States Energy and
Research Administration
Washington, D. C. 20045

Re: ERDA Low Btu Coal Gasification Demonstration Plant, Georgetown, Scott County, Kentucky; ERDA Technical Proposal No. PON-FE4

Dear Mr. Pennington:

By your letter dated August 12, 1977, you extended the comment period with respect to preparation of the draft Environmental Impact Statement to September 15, 1977. As we have previously advised ERDA, our firm represents a group of citizens of Georgetown and Scott County who oppose the construction of the Irvin Industrial Development Company's low Btu coal gasification facility at the proposed location on or near Lemons Mill Road, Georgetown, Scott County, Kentucky. The citizens which we represent have adopted the name of Concerned Citizens of Scott County and no doubt other comments have been made by the organization.

The purpose of this letter is to assemble in general form comments of the group which we trust will be considered in the preparation of the Environmental Impact Statement. The areas of concern are multiple and have been covered previously in the following documents, to which reference should be made by the persons preparing the Impact Statement:

1. Transcript of Proceedings of public hearing re proposed Kentucky Federal Energy Park in Scott County, Kentucky, said hearing held at the Garth Elementary School in Georgetown,

CERTIFIED
No. 089927
MAIL

EXHIBIT 11

Kentucky, on January 27, 1977. By letter dated February 22, 1977, addressed to Mr. Russell Bardos of the Energy Research and Development Administration (ERDA), I furnished a copy of the transcript of this purported public hearing to ERDA.

2. Water Availability Studies made by professional engineers for the City of Georgetown, including the following:

   a. Water Study for the City of Georgetown, Georgetown, Kentucky, completed by Clyde P. Mason, Consulting Engineer, in October 1968.

   b. Water Resource Plan for City of Georgetown, Kentucky, and West Scott County prepared by Proctor-Davis-Ray, Consulting Engineers, dated January 19, 1973.

   c. Report of the Bluegrass Area Development District with respect to present and future water systems in Georgetown, Kentucky prepared by the Bluegrass Area Development District, dated June 1973.

   d. An Analysis of Community Water Systems in the Bluegrass Region prepared by the Bluegrass Regional Planning Council, Inc., Lexington, Kentucky, in 1971 (pages III-19 and III-20).

By letter dated January 25, 1977, addressed to E. L. Clark, then Acting Chief, Gaseous Fuels Project, Management Branch, ERDA, I furnished copies of portions of these reports to ERDA. I am enclosing herewith a copy of my said letter of January 25, 1977, with attachments, with the request that the letter of January 25, 1977, be considered as a part of and supplemental to the comments contained herein.

3. U. S. Geological Survey Report entitled "The Hydrology of the Lexington and Fayette County, Kentucky, Area" prepared in 1968, specifically that portion of the report relating to the basic water supply of Georgetown and Scott County, pages 14 through 18 thereof. Extracts from this report were furnished to ERDA as part of the transcript of proceedings of the public hearing mentioned in paragraph 1 above.

4. Report to the Mayor and City Council of Georgetown, with respect to the proposed coal gasification plant made by Dr. Mary E. Wharton, Professor Emeritus of Biology and Geology of Georgetown College. Copies of this report, along with copies of a report of Dr. Genevieve Clark were also submitted with the aforesaid transcript.

5. Publication entitled "Environment and Conservation in Energy Research and Development" published September 1976, by the Council on Environmental Quality, pages 51 through 83, in which potentially dangerous and hazardous substances from coal conversion technologies are described. Copies of pages 56 through 64 of this document are enclosed herewith.

6. Publication of the Bluegrass Area Development District regarding the economic impact of the proposed coal gasification plant, said publication being dated November 4, 1976 and addressed to the Mayor and City Council of the City of Georgetown.

7. The Physical Development Plan for Georgetown-Scott County published June 1974.

The foregoing publications all contain information pertaining to matters which should be considered and commented upon in the Environmental Impact Statement to be prepared with respect to this proposed coal gasification plant. The following are categories, by subject matter, which should be addressed in the Environmental Impact Statement:

Mr. W. H. Pennington
September 12, 1977
Page Four

Water Resources

We have repeatedly raised with ERDA in correspondence requirements contained in 42 USC, Section 5912, with respect to the making of a site specific assessment of availability of adequate water resources. We have taken the position consistently that under the provisions of Section 5912, that a site specific water resource availability study is a pre-condition to federal assistance with respect to this project, where a demonstration project involves a significant impact on water resources. I refer you specifically to my letter to Mr. Bardos dated February 22, 1977, a copy of which is enclosed herewith. On this issue, I further refer you specifically to my letter to Mr. Clark dated January 25, 1977, and the attachments thereto, a copy of which letter, with attachments, is also enclosed herewith. We would again point out on this issue that available studies of water supply at Georgetown, in Scott County, Kentucky, indicate shortages of water availability at Georgetown, for existing uses beginning in the year 1970 with projected increases of this shortage becoming steadily worse through the year 2000. The proposed low Btu coal gasification plant, and the industries which it proposes to bring into the community, will have a substantial adverse impact on available water supplies at Georgetown, which, according to all available engineering studies are already deficient.

Water Quality

The source of water for the City of Georgetown and surrounding areas in Scott County is what is known as Royal Springs, located in the heart of downtown Georgetown. As is described in the report of the U. S. Geological Survey mentioned above, Royal Springs is fed by aquifers, the greatest part of which has as a direct source the property proposed to be developed by Irvin for the low Btu coal gasification plant. The map included in the U. S. Geological Survey report mentioned above describes the flow of water through these aquifers across this particular tract of land. Whatever impurities and whatever hazardous substances may be discharged into or onto the ground from the coal gasification plant, the industries it proposes to bring to Georgetown, parking lots for such industries and the like, will be fed into Royal Springs and ultimately into the drinking water water of the people who reside in this area.

Mr. W. H. Pennington
September 12, 1977
Page Five

We refer specifically to the report of Dr. Mary E. Wharton, a copy of which is enclosed and to pages 56 through 64 of the publication of the Council on Environmental Quality, "Environment and Conservation in Energy Research and Development", for a listing of the various potentially hazardous substances from coal conversion technologies which may find their way into the drinking water of the people of Georgetown. Such substances are in many respects carcinogenic, including the phenols, cresols, zinc chloride, nickel carbonyl, nickel, lead, cadmium, beryllium and like listed substances. Add to these the arsenics, cyanides and other substances listed at pages 56-58 of the publication of the Council and a great deal of concern exists in the Georgetown area with respect to the contamination, or potential contamination, of drinking water in the community which would be no doubt disastrous.

Waste Disposal

Many of the substances which come from this kind of a facility are not subject to treatment in the sewer treatment plant. Many of the substances listed in the Council's document mentioned above are toxic, non-biodegradable products. To the extent that these products are placed in the sewer system, adverse effects downstream are expected. The effect of such on recreational uses, agricultural uses and the effect in times of drought, when the receiving stream is used as an auxiliary water supply source for the City, should be studied and commented upon. With respect to secondary effects arising from industrial uses by industrial plants attracted to the proposed park by the availability of low Btu gas, the sizing and availability of sewers for these facilities should be studied. Disposal of the solids, including the ash, should be a subject of the Environmental Impact Statement.

Socio-Economic Impacts

The plan for this low Btu coal gasification plant is integrated with a plan to develop a substantial number of new industries in the immediate vicinity of the pilot plant to use the gas produced. Georgetown, Kentucky, is a relatively small community having an exceedingly low unemployment rate at the present time. A detailed study of the number of new industrial employees required in connection with this proposed development should be made. We are enclosing herewith population projections prepared using a factor of 18 employees per acre (as provided in the Physical Development Plan of Georgetown, Kentucky, published in June 1974) and using a service and family multiplier as suggested by the publications noted therein. The impact of this number of new employees, and new people in the Scott County area, should be studied intensely in connection with the Environmental Impact Statement, in light of the following:

a. the low unemployment rate in Georgetown today;

b. the total lack of housing for a population explosion of this magnitude; and

c. the inability of the school system in Scott County to provide for housing and education of the number of children who will be imported into the community, including the inability of the appropriate school district to extend facilities because of the limitation of the school system to issue bonds for additional construction.

Alternative Sites

We are enclosing herewith a letter addressed to Mr. Bardos under date of March 14, 1977, by a representative of the Sierra Club, raising the question as to why a low Btu coal gasification demonstration plant should be located in Georgetown, Kentucky, far removed from the coal fields of Kentucky, and in an area where unemployment is minimal. As is indicated in the Sierra Club letter, there exists in Eastern Kentucky, in the coal producing areas, exceedingly high rates of unemployment. Water and coal are available in large quantities in these counties where unemployment rates are high and it is inconceivable that a low Btu coal gasification demonstration plant would not be located at a place where coal and water are available and unemployment great, but instead would be located in a community experiencing nearly full employment, located a great distance from the coal fields, with a deficiency in water supplies for current uses.

Impact Upon Farming and Other Existing Industries

The proposed facility is quite close to a new State Park being developed for the horse oriented visitors to Kentucky. The plant is in the heart of the thoroughbred industry and agricultural areas of Kentucky. The impact of this facility on the horse industry, on general agricultural facilities, and the industry itself, and on the new State Horse Park should be covered in the Impact Statement.

Transportation

The proposed gasification plant and the industrial park which it is intending to support is located in a congested area. We are aware of proposals to construct new highway facilities in the area to serve this particular facility. The adverse impact of such new transportation facilities and the adequacy of the facilities proposed, together with the feasibility of providing construction funds, should be treated in the Impact Statement.

The foregoing list of matter which should be included within the study to be made is not all inclusive. At the public hearing, a transcript of which is in the possession of ERDA, other concerns were raised by citizens who attended the same and this document should be reviewed in full by the persons preparing the Impact Statement. We would appreciate these comments, along with the documents mentioned herein being made a part of the record leading to the draft Environmental Impact Statement.

Very truly yours,

C. Gibson Downing

CGD/sa
Enclosures

February 22 1977

Mr. Russell Bardos
Energy Research and Development
  Administration
20 Massachusetts Avenue
Washington, D. C. 20545

Re: ERDA Low Btu Coal Gasification Demonstration Plant, Georgetown, Scott County, Kentucky; ERDA Technical Proposal No. PON-FE4

Dear Mr. Bardos:

In my letter addressed to you under date of February 10, 1977, I advised you that I would forward to you as soon as possible the transcript which was made of the meeting involving Irvin Industrial Development, Inc. held at Garth School in Georgetown, Kentucky, on the evening of January 27, 1977. I am enclosing herewith the transcript which I have just received, along with the exhibits which were tendered to the reporter at that time.

It is my understanding that ERDA has already made a decision to require, prior to distribution of federal funds, the Impact Statement mandated by the National Environmental Policy Act of 1969. I have discussed the preliminary question of the Environmental Impact Statement with Henry Garson, Office of the General Counsel of ERDA, and by copy of this letter, I am advising him of the furnishing to you of these documents.

We have, on several occasions, raised in correspondence with ERDA the requirements contained in 42 USC, Section 5912 with respect to the making of a site specific assessment of availability of adequate water resources. Subsection (a) of 5912 provides that the Water Resources Council shall undertake assessments of water resource requirements and water supply availability when requested by the administrator (ERDA), apparently the question of whether or not to make such request being within the discretion of the administrator. However, under the further provisions of subsections (b) and (c) of 5912, water availability assessments are required. An assessment under (b) apparently is to be made by the administrator as a precondition of federal assistance whenever a demonstration project may involve a significant impact on water resources.

10718

EXHIBIT 12

Mr. Russell Bardos
February 22, 1977
Page 2

The facility proposed by Irvin would seem to fall, however, under the provisions of subsection (c) of 5912, which relates to any proposal for federal assistance for commercial application of energy technologies. Clearly, the Irvin proposal contemplates commercial application of the energy technologies here involved, low Btu gasification. The whole plan of Irvin Industrial Development, Inc. is to construct a plant which will provide a gas supply to existing industries and to an undetermined number of industries which Irvin proposes to attract to the industrial park which Irvin proposes to develop. Under subsection (c) of 5912, there is a mandate that the Water Resources Council shall, as a precondition of such federal assistance, provide to the administrator (ERDA) "an assessment of the availability of adequate water resources for such commercial application and an evaluation of the environmental, social and economical impacts of the dedication of water to such uses."

During my last telephone conversation with Mr. Garson, it was my understanding that the issue of whether or not a site specific water availability study would be made has not been resolved. The documents which are attached to the transcript of the meeting of January 27, 1977, consist of primarily engineering studies conducted with respect to the availability of water in the Georgetown and Scott County area. These studies clearly reflect an inadequacy of raw water supplies in the Georgetown-Scott County area at the present time, without the additional impact of either the gasification plant or the industries which Irvin proposes to attract to the industrial park to use the gas produced.

If the Water Resources Council has not been contacted by ERDA for the purpose of seeking a water availability assessment study pursuant to 5912, I would appreciate it very much if you would let me know the name of the chairman of the Water Resources Council and his address in Washington, so that I may make a direct approach to the Water Resources Council for a study under the provisions of subsection (c). Thanking you for your continued cooperation, we remain

Very truly yours,

C. Gibson Downing

CGD/sa
Enclosures

cc: Mr. Henry Garson

EXHIBIT 12 (Concluded)

GAYLE A. MOHNEY
C. WILLIAM SWINFORD
GLADNEY HARVILLE
C. GIBSON DOWNING
LESLIE W. MORRIS II
LINDSEY W. INGRAM, JR.
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WALLACE MUIR
(1878-1947)
RICHARD C. STOLL
(1876-1949)
WILLIAM H. TOWNSEND
(1890-1964)
RODMAN W. KEENON
(1888-1966)
JAMES PARK
(1892-1970)
JOHN L. DAVIS
(1913-1970)

January 25, 1977

Mr. E. L. Clark
Acting Chief
Gaseous Fuels Project
Management Branch
Energy Research and
Development Administration
Washington, D.C. 20545

Re: ERDA Low Btu Coal Gasification Demonstration Plant, Georgetown, Scott County, Kentucky; ERDA Technical Proposal No. PON-FE4

Dear Mr. Clark:

By letter dated January 19, 1977, Bennett Clark of this firm undertook to advise you that we represented certain citizens of Georgetown, Scott County, Kentucky, who are deeply concerned about the adverse environmental impact which they believe will result if the above-captioned ERDA project is constructed at the presently proposed site in Scott County, Kentucky.

Since Mr. Clark's letter to you, dated January 19, 1977, we have been advised that a public hearing will be held at the Garth School in Georgetown, Kentucky, on the document styled "Environmental Assessment for the Kentucky-Federal Environmental Park, Georgetown, Kentucky" prepared by Mason and Hangar-Silas Mason Co., Inc. for Irvin Industrial Development, Inc., dated January 1976, on Thursday evening, January 27, 1977.

Unfortunately, we are not aware of the involvement of ERDA in the "Environmental Assessment" mentioned above and prepared for the private developer, Irvin Industrial Development, Inc., or what weight ERDA intends to attribute to this document and to matters presented at public hearings thereon. It is perfectly clear that the "Environmental Assessment" is not, and probably does not purport to be, an Environmental Impact Statement within the meaning of the National Environmental Policy Act (42 USC Sec. 4332, as amended). As Mr. Clark indicated in his letter of

January 19, 1977, the "Environmental Assessment" prepared for Irvin Industrial Development, Inc. is at best a promotional device for the proposed gasification plant and its surrounding industrial park. The "Environmental Assessment" is quite long on promotion of the facility and quite short with respect to identifying and treating environmental problems.

Our clients are of the firm belief that the proposals pending before ERDA for federal fund contributions to the proposed coal gasification facility in Scott County involve major federal action significantly affecting the quality of the human environment within the meaning of those terms as contained in the National Environmental Policy Act and that a full and complete Environmental Impact Statement is an integral and essential prerequisite to the commitment of federal funds to this project. For and on behalf of our clients, we respectfully request that ERDA take whatever action is appropriate to require a full and complete Environmental Impact Statement with respect to this proposed project which would satisfy the requirements of the National Environmental Policy Act.

We would like to also call to your attention and to the attention of ERDA, at this point in time, the special problems involved in this project with respect to the water resource requirements for not only the coal gasification facility which is proposed, but for the cumulative number of industries which Irvin proposes to locate in this industrial park, as users of gas which may be produced from the process. The special provisions of 42 USC, Section 5912 are fully applicable to this proposal and, in the opinion of our clients, require, as a pre-condition of federal assistance to the project, an assessment of water resource requirements and water supply availability by the Water Resource Council. In this respect, we would call to your attention and would be pleased to furnish you with certain studies made of the water resources available through the Georgetown municipal water system. These include the following studies:

(1) Water Study for City of Georgetown, Georgetown, Kentucky, completed by Clyde P. Mason, Consulting Engineer, in October, 1968;

(2) Water Resource Plan for City of Georgetown, Kentucky, and West Scott County, prepared by Proctor-Davis-Ray, Consulting Engineers, dated January 19, 1973;

(3) Report of the Bluegrass Area Development District with respect to present and future water and sewer systems in Georgetown, Kentucky, prepared by the Bluegrass Area Development District, dated June, 1973;

(4) An Analysis of Community Water Systems in the Bluegrass Region prepared by the Bluegrass Regional Planning Council, Inc., Lexington, Kentucky, in 1971 (pages III-19-20), with respect to Scott County and the Georgetown municipal system and the regional report with respect to water availability in Georgetown, Kentucky, prepared by Spindletop Research, Lexington, Kentucky, a copy of which, as it pertains to the water supply system of the City of Georgetown, being attached hereto.

The problems inherent in the water availability question are separate and apart but, of course, relate indirectly to the problems of pollution generally by the proposed industrial park, directly affecting the quality of drinking water. You have been and will be furnished additional information relating to the proximity of the proposed industrial park to the water aquifers that charge Royal Spring, the principal source of drinking water for inhabitants of Georgetown and Scott County. The problem of which we are now writing has to do with the availability of water supplies and the undesirability of future taxing of available supplies for industrial users in the Georgetown area, without the development of additional reliable sources of raw water for treatment. It is established in the engineering studies made by Mason and Proctor-Davis-Ray Consulting Engineers, Inc. that the Georgetown area has had a serious need for additional raw water supplies for an extended period of time. Both of these engineering reports reflect that in times of drought, such as was experienced in this particular community in 1953, the dependable supply of Royal Spring would be limited to approximately 500,000 gallons of water per day. It is further established in these reports that existing alternative sources of supply are deficient in times of drought. In 1953, Elkhorn Creek, which furnishes the source of alternative supplies, experienced zero flows for a period of 123 consecutive days. While current indications are that present water supply demands upon the Georgetown system would approximate 1,200,000 gallons a day, the limited flow of Royal Spring and lack of dependability of an alternative source would make it undesirable for additional industrial demands to be added as a result of the coal gasification industry and industries which Irvin intends to locate in the industrial park as users of gas produced. The following quotations are taken from the Bluegrass Area Development District Report of June 1973:

"The present water supply combination of Royal Spring together with the minimal storage behind the Earl Wallace Mill Dam (on North Elkhorn Creek) is considered inadequate even to meet present demands of the system during a prolonged drought.

"The 4.0 mgd capacity of the expanded treatment plant is only a valid figure, however, when there are four million gallons of water per day available to treat."

The study on water availability in Georgetown, Kentucky, which is attached to this letter, at page 4-10, lists the national industrial water users served by the Georgetown water system in 1971. The table at page 4-11 contains a projection of water requirements for the Georgetown service area. The table at 4-17 is an analysis of measured inflow to the reservoir system during the 1953 drought, showing a zero inflow from August 21, 1953, through December 22, 1953. The table at 4-20 reflects a shortage of water availability at Georgetown, Kentucky, in 1970, with projected increases of this shortage becoming steadily worse through the year 2000.

On behalf of our clients, we would respectfully request that, in addition to requiring a full Environmental Impact Statement under the provisions of the National Environmental Policy Act, ERDA take immediate action to request an assessment by the Water Resource Council of water resource requirements and water supply availability, not only for the experimental facility but for the totality of industrial use it will of necessity bring to the community, under 42 USC, Section 5912.

Very truly yours,

C. Gibson Downing

CGD/sa
Enclosure

WATER AVAILABILITY

at

GEORGETOWN, KENTUCKY

EXHIBIT 13 (Continued)

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WATER AVAILABILITY AT GEORGETOWN, KENTUCKY

DESCRIPTION OF STUDY AREA

Georgetown is the county seat and largest city in Scott County. This rapidly growing community is located in the Bluegrass Region, 12 miles north of Lexington. Georgetown, a college town, is located adjacent to two major metropolitan areas which has resulted in a prosperous economy as a result of industrial growth.

The whole of Scott County lies within the Kentucky River Basin. The southern half of Scott County is drained by Elkhorn Creek; the northern half by Eagle Creek. The source of water for the Georgetown Municipal Water System is Royal Spring, a tributary of North Elkhorn Creek. Emergency supplies are also impounded in North Elkhorn Creek behind Elkhorn Creek Dam and DeGaris Dam. North Elkhorn arises outside Lexington in northeastern Fayette County. The stream flows north to Georgetown and then west to Franklin County and the Kentucky River. The study area is shown in Figure 4-1.

POPULATION TRENDS

The population of Georgetown has grown steadily since 1920. This growth is due to the diversity of economic opportunity in Scott County and in adjacent areas. The previous growth of Georgetown and Scott County is shown in Table 4-1.

A-Royal Spring and Water Plant
B-Elkhorn Creek Impoundments

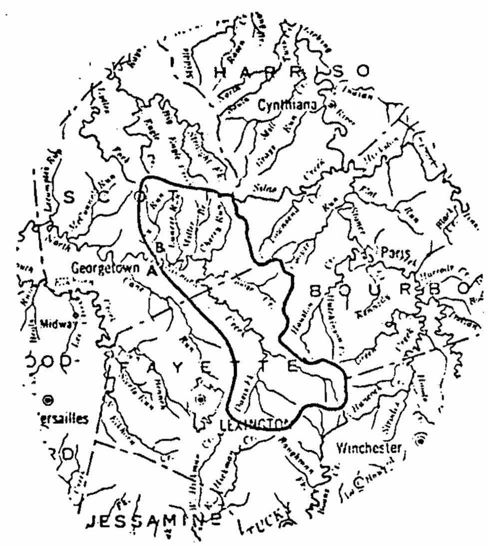

Figure 4-1. Location of the Study Area.

Table 4-1
Population Data for the City of Georgetown and Scott County

	Georgetown		Scott County	
Year	Population	Percent Change	Population	Percent Change
1900	3823		18076	
		18.6		-6.2
1910	4533		16956	
		-13.9		-9.7
1920	3903		15318	
		8.4		-6.0
1930	4229		14400	
		4.5		-0.6
1940	4420		14314	
		24.8		5.8
1950	5516		15141	
		26.6		1.6
1960	6986		15376	
		23.6		16.7
1970	8629		17948	

Source: U.S. Bureau of the Census.

The Georgetown population projections, as developed for WAMIS, indicate that future growth is expected to occur at approximately the same rate as in recent years. The projections for the city and for those suburban areas which will be served by the municipal water system are given in Table 4-2. Much of the unincorporated area near Georgetown is served by the West Scott County Water District. Figure 4-2 is a plot of the historic and projected population for the city.

Table 4-2
Projected Population for the City of Georgetown

Year	Urban Population	Additional Served Population
1970	8629	500
1975	9780	566
1980	11077	642
1990	14171	821
2000	17952	1039

Source: Spindletop Research, Inc.

DEMAND FOR WATER

The Georgetown Municipal Water System supplies the city population, adjacent suburban areas, and the Great Crossing Water District for a total of approximately 9,100 persons. During the calendar year 1971, the average daily demand on the water treatment plant was 1,120,000 gallons per day (Figure 4-3). The maximum

Figure 4-3. Municipal Water Demand, 1971.

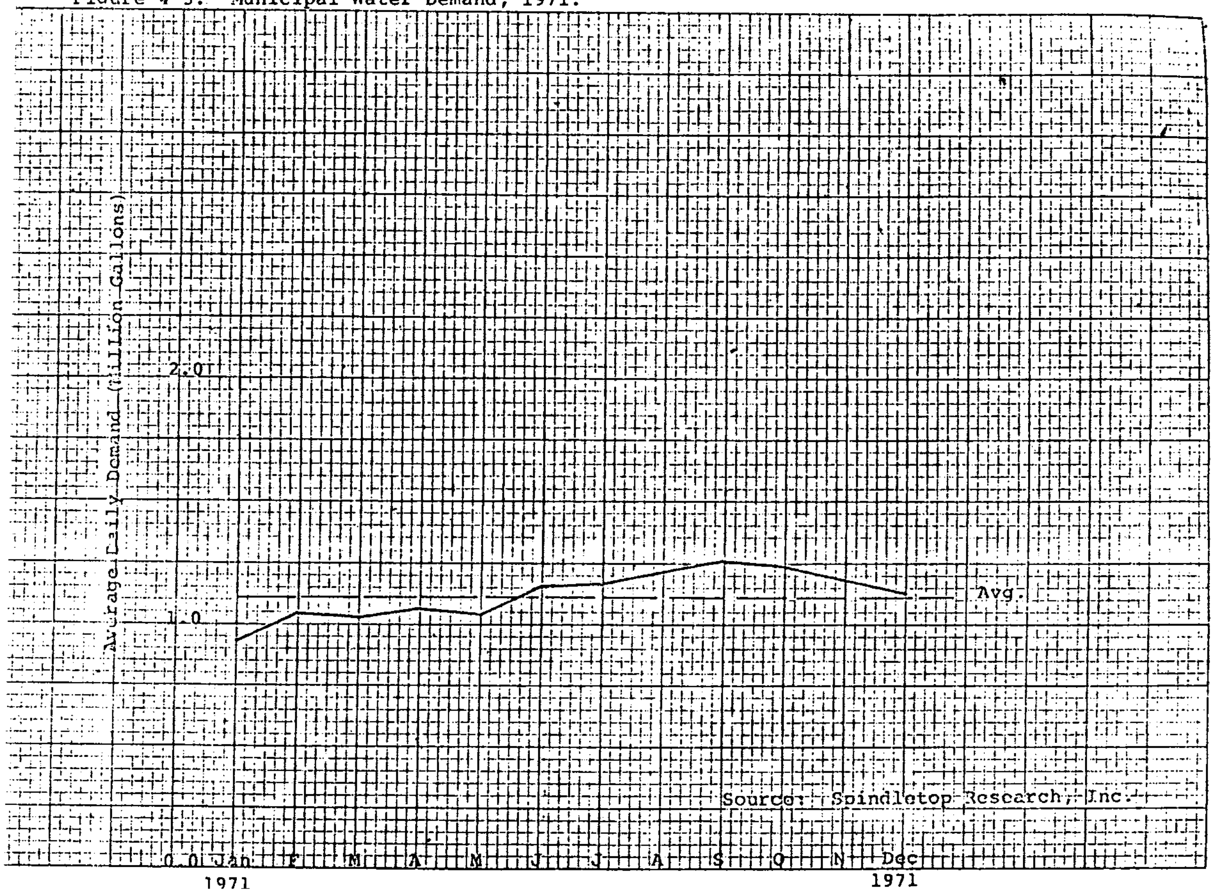

Figure 4-2. Historic and Projected Population of Georgetown, Kentucky

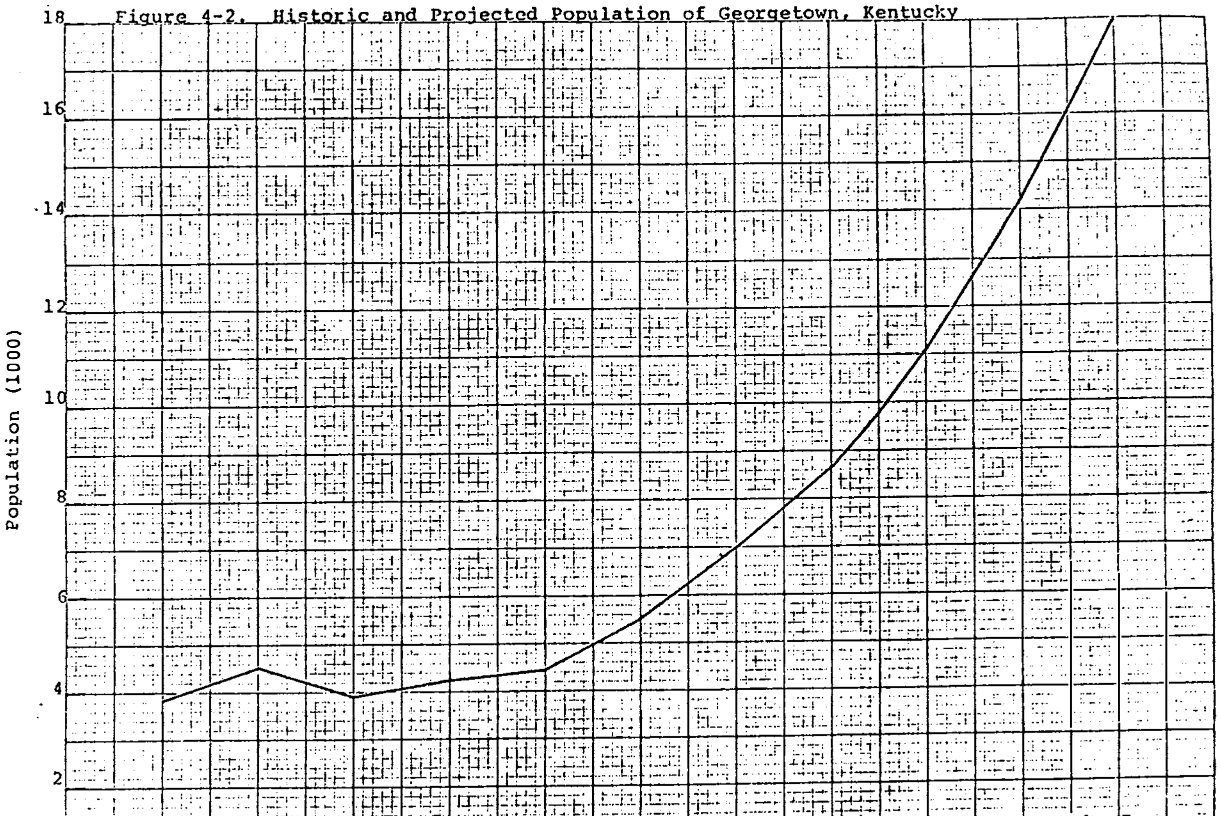

EXHIBIT 13 (Continued)

demand exerted on the system during 1971 was 1,590,000 gallons on August 30.

The amount of water supplied to the system each month since January 1967 is plotted in Figure 4-4. The amount of water supplied to the system has increased slightly during the last two years of that period. The municipal water demand shows a seasonal effect as expected. The average daily demand for each month (1967-71) is plotted in Figure 4-5. As shown, the maximum daily demand occurs in September and the minimum demand occurs in January.

The municipal water system supplies water to numerous industrial establishments. Although water use data for each industry are unavailable, the water company estimates only 10 percent of the average daily output (112,090 gallons) is supplied to industry. This appears to be a very conservative estimate. The major industrial establishments served by the municipal system are listed in Table 4-3.

The projected water requirements of the municipal system are summarized in Table 4-4. These quantities of water are required for domestic, commercial, and industrial users in the Georgetown service area.

TREATMENT AND DISTRIBUTION

The conventional water treatment plant has a present capacity of 1.5 million gallons per day. Raw water is pumped to the plant

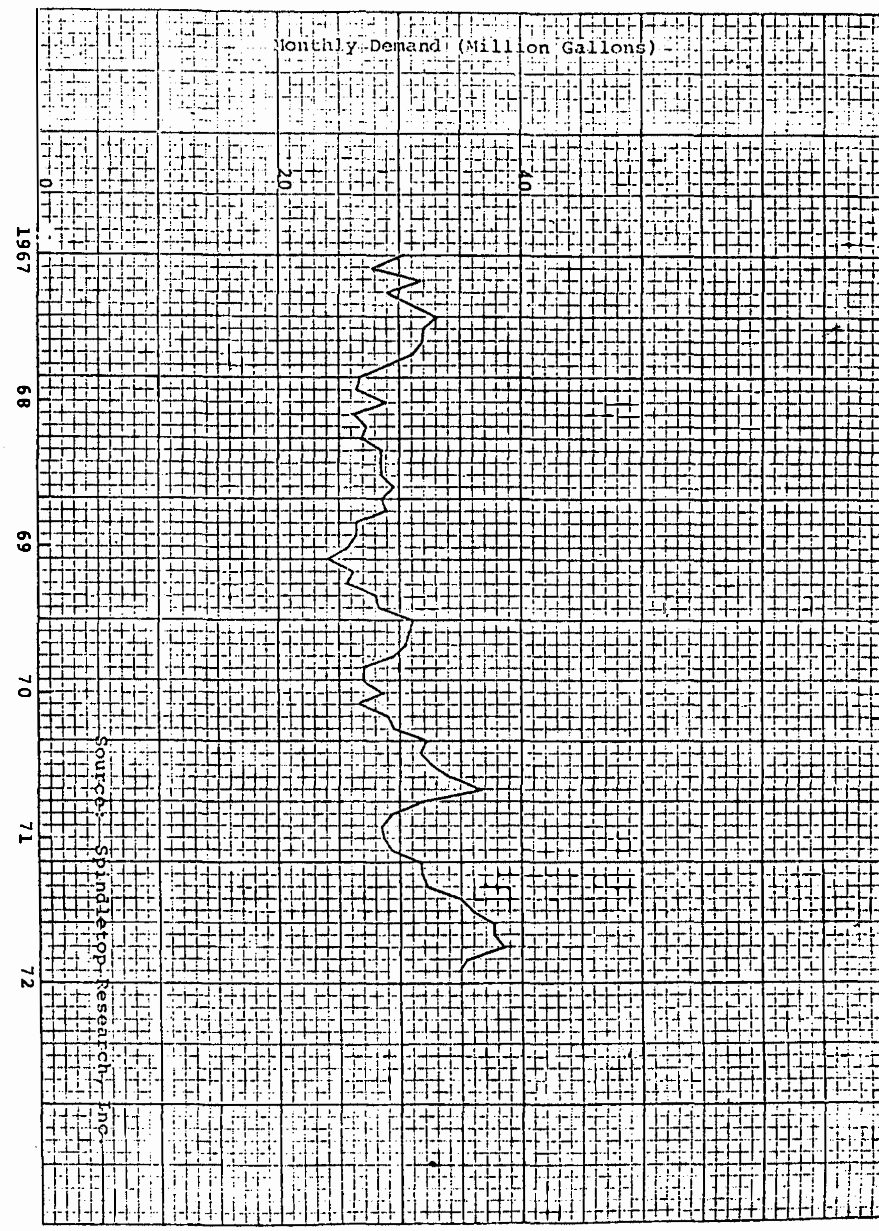

Figure 4-4. Municipal Water Demand, 1967-71

EXHIBIT 13 (Continued)

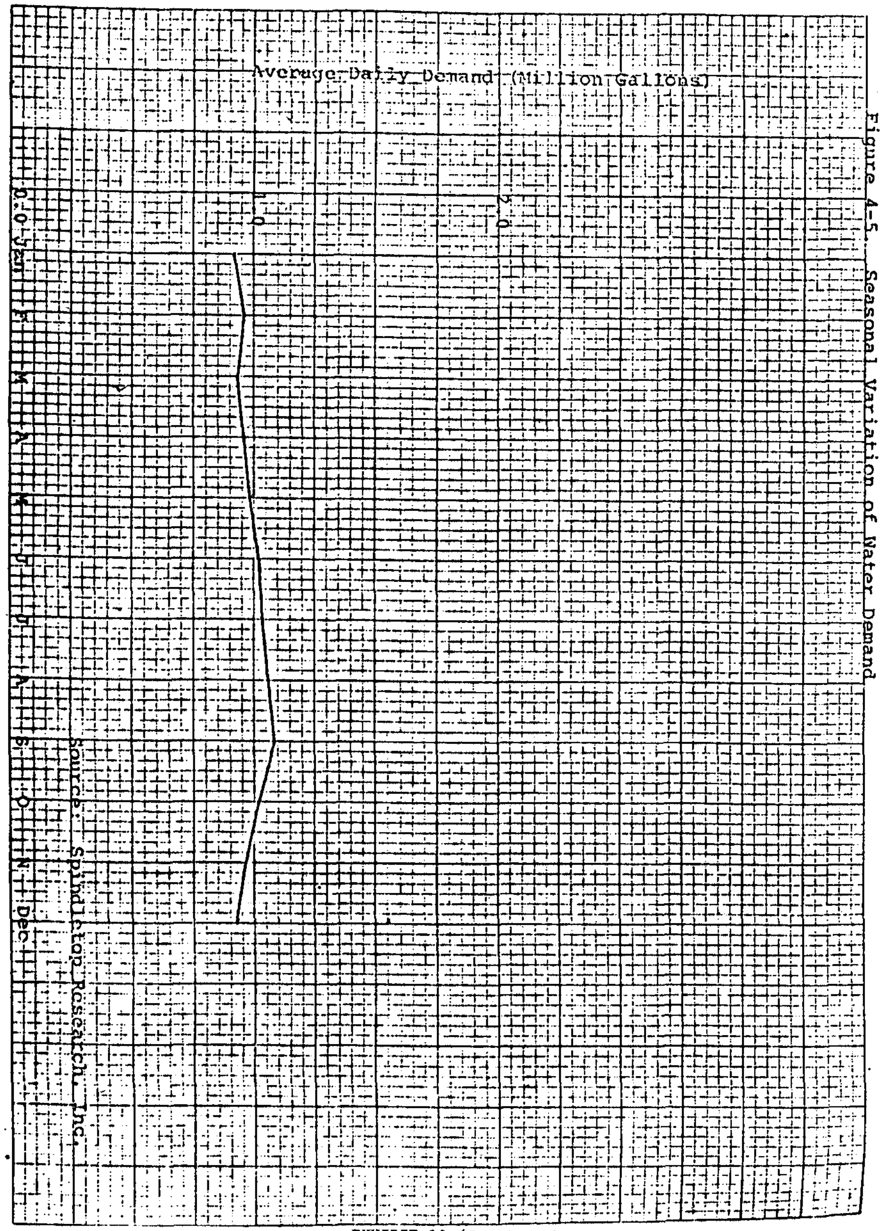

Figure 4-5. Seasonal Variation of Water Demand

Source: Spindletop Research, Inc.

EXHIBIT 13 (Continued)

Table 4-3
Major Industrial Water Users Served by the
Georgetown Municipal Water System

Title	Products	Total Employees
Blue Ribbon Pen & Pencil Co., Inc.	Imprinted pens, pencils	120
C&C Cutter Co.	Cutting tools	16
Carbide Products, Inc.	Carbide tool, accessories	72
Electric Parts Corporation	Electrical wire, wiring harness	291
Georgetown American Swiss Products, Inc.	Motor shafts	60
Georgetown Cable Products, Inc.	Electronic wiring, components	85
Georgetown Industries, Inc.	Ball point pens	58
Georgetown Metal Stamping Co.	Metal stampings	70
Georgetown Tool & Mfg. Co., Inc.	Tools, dies	12
Hydro Plastic Co.	Typewriter parts, plastic parts	65
Johnson Service Co.	Environmental control systems	350
Kentucky Die Casting Corp.	Aluminum die casting	65
Kentucky Heat Treating Co.	Heat treating	20
Mallard Pen & Pencil Co., Inc.	Wood case pencils, ball point pens	160

EXHIBIT 13 (Continued)

Table 4-3 (continued)

Title	Products	Total Employees
Preferred Stampings, Inc.	Metal stampings	70
Stiohn Products Corporation	Tools, fixtures	55
Universal Wire Spring Division, Hoover Ball & Bearing Company	Auto seat springs, furniture springs	390

Source: Kentucky Department of Commerce, 1971 Kentucky Directory of Manufacturors.

Table 4-4
Projected Water Requirements for the Georgetown Service Area

Year	Total Served Population	GPCD	Demand MGD	Demand CFS
1971	9129	123	1.121	1.738
1975	10346	125	1.293	2.004
1980	11719	128	1.500	2.325
1990	14992	133	1.994	3.091
2000	18991	138	2.621	4.062

Source: Spindletop Research, Inc.

from Spring Branch below Royal Spring. The raw water is coagulated with alum and lime, settled, passed through rapid sand filters, and chlorinated. The plant clearwell provides storage for 150,000 gallons until it is needed by the system. Water is pumped into the distribution system by either of two-1,000 gallons

per minute high service pumps. Storage of 300,000 gallons is provided in the distribution system by an elevated tank. Approximately one day's supply is stored in the several miles of water line which form the distribution system. A total of 1.5 days supply of finished water is provided by tanks, lines, and the plant clearwell. This does not include storage in the Great Crossings Water District.

SOURCES OF WATER

Ground Water

The Georgetown vicinity is underlain by argillaceous and siliceous limestones of the Lexington group. This limestone is interbedded with shale. The limestone aquifers yield more than 500 gallons per day to drilled wells in valley bottoms and along streams in upland. Some wells produce as much as 300 gallons per minute from alluvium or thick limestone along large streams. The water is very hard, may contain salt or hydrogen sulfide, especially at depths greater than 100 feet.

The outlet of Royal Spring is developed in the Grier Limestone Member of the Lexington group. Most of the subsurface drainage feeding Royal Spring is also developed in this member. The subsurface drainage system for the spring can be considered as a large branching pattern of solution openings which collect water over an extensive area and funnel the water toward the main trunk of the system at Royal Spring. Sinkholes in the Cane Run and North Elkhorn Basins afford a direct route for part of the precipitation falling on the land surface to descend directly to the water table. Sinkholes in streambeds allow all or part of the flow in small streams to be channeled to Royal Spring during low flow periods. Discharge measurements made by the U.S. Geological Survey in 1968 showed that the entire flow of the upper half of the Cane Run Basin was being discharged into sinkholes which recharge Royal Spring. In addition, it was determined that Royal Spring is receiving recharge from an area much more extensive than the Cane Run Basin. Pumping tests and previous experience indicate that the spring will provide a minimum of 350 gallons per minute during very dry periods such as the fall of 1953.

Ground water will continue to play an important roll in meeting the needs of rural domestic users. Georgetown will continue to use the Royal Spring supply as long as possible. However, the spring will not provide adequate flows to meet the water demand at Georgetown during very dry periods.

Streamflow

North Elkhorn Creek at Georgetown drains an area of 142 square miles. This area includes rolling farmland in the northeastern Fayette County and southeastern Scott County.

Georgetown has made provisions to obtain supplemental water from North Elkhorn Creek during an emergency. A pump station is maintained at Elkhorn Creek Dam and a pipeline connects the pump station to the municipal plant. A stream gage has been maintained on North Elkhorn Creek at Georgetown since October 1949 The stream gage is located east of Georgetown, and monitors a drainage area of 119 square miles. The average discharge at the gage for a 21 year period is 151 cfs. However, flows dropped to 0.0 cfs for 125 consecutive days in the fall of 1953. A flow-duration curve for the gage is shown in Figure 4-6. Low-flow frequency curves for the gage are plotted in Figure 4-7. The daily flows measured at the stream gage during the 1953 drought are given in Table 4-5. Since the stream gage is located just upstream from the DeGaris Pool, these measured discharges are the inflows to the Georgetown reservoir system.

There are no major water withdrawals or water diversions in the North Elkhorn Creek Basin above Georgetown. No changes in existing water use patterns in this area are projected.

Reservoirs

The Georgetown reservoir system consists of two low-level overflow dams on North Elkhorn Creek. These are old mill dams which have been repaired. Although plans and dimensions of the impoundments are unavailable, it is known that the reservoirs

Figure 4-7. Low Flow-Frequency Curves for Elkhorn Creek near Georgetown

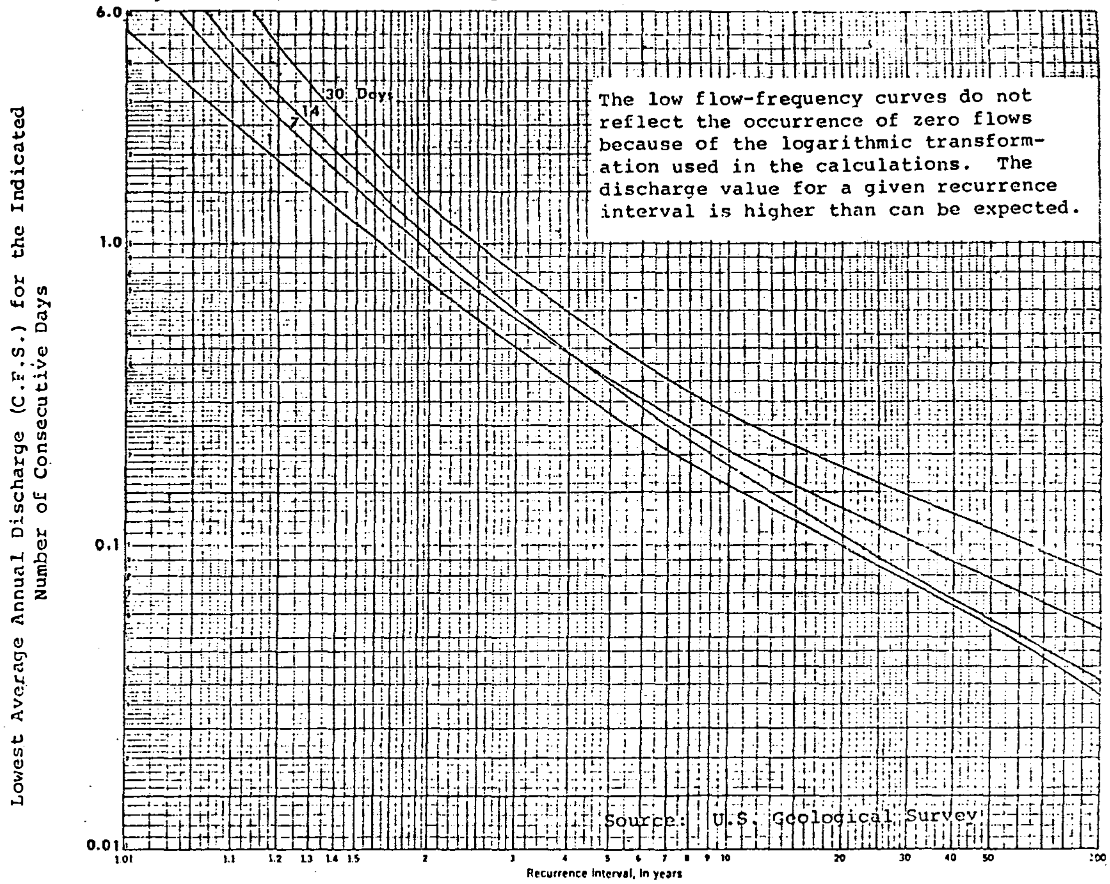

Figure 4-6. Flow-Duration Curve for Elkhorn Creek near Georgetown

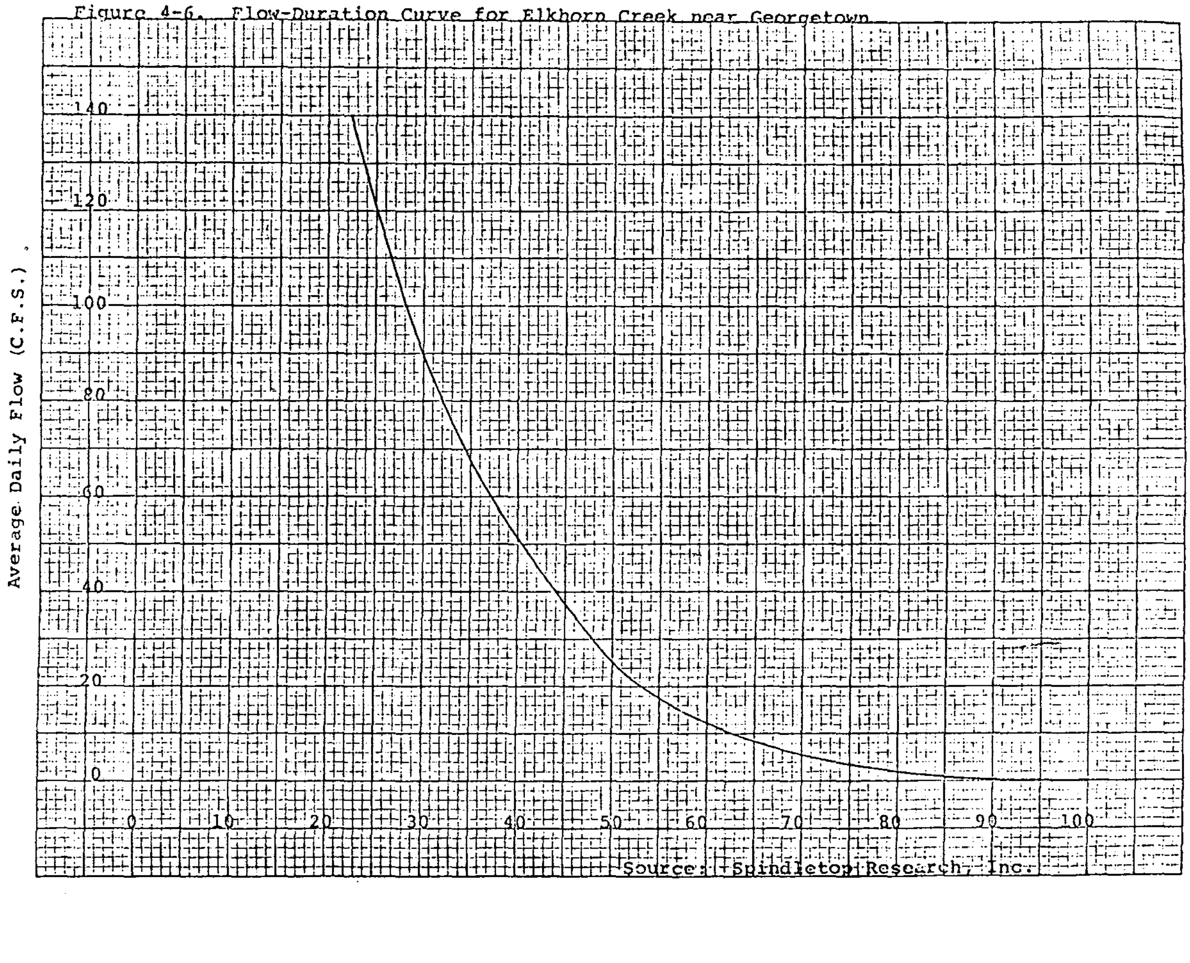

EXHIBIT 13 (Continued)

EXHIBIT 13 (Continued)

Table 4-5
Measured Inflows to the Georgetown Reservoir System
During the 1953 Drought

Day	1953 August	1953 September	1953 October	1953 November	1953 December	1954 January
1	3.3 c.f.s.	0.0	0.0	0.0	0.0	1.0
2	2.8	0.0	0.0	0.0	0.0	1.0
3	2.2	0.0	0.0	0.0	0.0	1.0
4	2.6	0.0	0.0	0.0	0.0	1.0
5	3.5	0.0	0.0	0.0	0.0	1.0
6	2.4	0.0	0.0	0.0	0.0	1.0
7	2.0	0.0	0.0	0.0	0.0	1.0
8	3.5	0.0	0.0	0.0	0.0	1.0
9	4.9	0.0	0.0	0.0	0.0	1.0
10	4.3	0.0	0.0	0.0	0.0	1.3
11	4.3	0.0	0.0	0.0	0.0	1.4
12	3.8	0.0	0.0	0.0	0.0	1.2
13	2.8	0.0	0.0	0.0	0.0	1.1
14	1.0	0.0	0.0	0.0	0.0	1.5
15	0.3	0.0	0.0	0.0	0.0	3.0
16	0.2	0.0	0.0	0.0	0.0	17.0
17	0.1	0.0	0.0	0.0	0.0	68.0
18	0.1	0.0	0.0	0.0	0.0	47.0
19	0.1	0.0	0.0	0.0	0.0	33.0
20	0.1	0.0	0.0	0.0	0.0	138.0
21	0.0	0.0	0.0	0.0	0.0	
22	0.0	0.0	0.0	0.0	0.1	
23	0.0	0.0	0.0	0.0	0.3	
24	0.0	0.0	0.0	0.0	0.6	
25	0.0	0.0	0.0	0.0	1.0	
26	0.0	0.0	0.0	0.0	1.1	
27	0.0	0.0	0.0	0.0	1.2	
28	0.0	0.0	0.0	0.0	1.2	
29	0.0	0.0	0.0	0.0	1.2	
30	0.0	0.0	0.0	0.0	1.1	
31	0.0	--	0.0	0.0	1.0	

Source: U. S. Geological Survey.

Table 4-6
Performance of the Georgetown Reservoir System
When Subjected to the 1953 Drought

Period	Inflow (AF)	Precipitation (AF)	Evaporation (AF)	Demand (AF)	Spill (AF)	End of Period Storage (AF)
July 31- August 9*	--	--	--	--	--	196
August 10- August 19	33.7	5.9	6.8	20.3	12.5	196
August 20- August 29	0.2	2.0	6.3	20.3	0	172
August 30- September 8	0.0	1.8	5.9	20.9	0	147
September 9- September 18	0.0	0.3	5.3	21.0	0	122
September 19- September 28	0.0	1.9	4.7	21.0	0	98
September 29- October 8	0.0	0.0	4.4	19.9	0	74
October 9- October 18	0.0	0.0	4.0	19.6	0	50
October 19- October 28	0.0	2.7	3.3	19.6	0	30
October 29- November 7	0.0	0.0	2.7	18.8	0	8
November 8- November 17	0.0	0.0	2.3	18.5	0	-13
November 18- November 27	0.0	3.3	1.9	18.5	0	-30
November 28- December 7	0.0	2.0	1.5	18.0	0	-47
December 8- December 17	0.0	2.3	1.3	17.8	0	-64
December 18- December 27	8.5	3.6	1.2	17.8	0	-72
December 28- January 6	20.8	4.5	1.1	17.7	0	-65
January 7- January 16	59.0	4.2	1.1	17.7	0	-21 Reservoir continues to fill

*Reservoir is full at beginning of critical period.

Source: Spindletop Research, Inc.

have a total surface area of 40 acres and a total storage capacity of 196 acre-feet (64,000,000 gallons)

The performance of the existing Georgetown reservoir system, if it were subjected to the 1953 drought, is summarized in Table 4-6. The demand is the use not satisfied by the 350 gpm minimum from Royal Spring. It is seen from Table 4-6 that an additional 119 acre-feet are needed to satisfy the 1971 demand for the 1953 drought assuming 350 gpm from Royal Spring. This is a deficiency of 72 acre-feet/130 days = 0.50 AF/DAY = 0.25 cfs = 0.163 mgd = 113 gpm.

The additional storage required to meet the projected demand for the year 2000 is:

2.62 mgd - 1.121 mgd = 4.6 AF/Day = 600 acre-feet for 130 days drawdown

A total of 672 acre-feet would be required by the year 2000.

WATER AVAILABILITY

Georgetown should develop an alternate water supply. Alternatives include purchasing water from Lexington; installing a pump station and pipeline at the Kentucky River; or allocation of water supply storage in the proposed Eagle Creek Lake, a Corps of Engineers project. This last alternative would also require pumping facilities at the reservoir. The demand and supply of water in the Georgetown service area is summarized in Table 4-7.

Table 4-7
Projected Water Availability at Georgetown, Kentucky

Year	Demand (mgd)	Supply (mgd)	Surplus (+) or Shortage (-) (mgd)
1970	1.121	0.96	-0.16
1975	1.293	0.96	-0.33
1980	1.500	0.96	-0.55
1990	1.994	0.96	-1.03
2000	2.621	0.96	-1.66

Source Spindletop Research, Inc.

WATER QUALITY

The Royal Spring aquifer has frequently been contaminated by industrial and municipal wastes. These have been industrial spills in the headwaters of Cane Run. There are numerous septic tanks in both Fayette and Scott Counties which occasionally contaminate subsurface supplies. Future development in Scott and Fayette Counties will increase the severity of this problem. Water quality parameters pertinent to the Georgetown water supply are shown in Table 4-8.

Table 4-8
Quality of Raw and Finished Water at Georgetown, Kentucky
(Units in Milligrams/Liter)

Parameter	Raw	Finished	Recommended Limits Opt.	Recommended Limits Max.	Parameter	Raw	Finished	Recommended Limits Opt.	Recommended Limits Max.
Iron (Fe)	Nil	Nil	0.05	0.40	Chloride (Cl)	21.0	23.0	25.0	250.0
Manganese (Mn)	Nil	Nil	0.01	0.05	Fluoride (F)	0.8	0.8	1.0	1.2
Calcium (Ca)	84.0	85.6	15.0	43.0	Nitrate (NO_3)	3.94	4.78	10.0	45.0
Magnesium (Mg)	5.35	5.35	10.0	29.0	Dissolved Solids	314	352	--	500.0
Sulfate (SO_4)	34.5	40.0	50.0	250.0	Total Hardness ($CaCO_3$)	232	236	80.0	250.0
pH	7.5	7.8	7.0-8.5	6.0-8.5					

Source: Public and Industrial Water Supplies of Kentucky, 1968-69, Kentucky Geological Survey, Lexington, 1971.

STATEMENT

To: The Mayor and City Council of Georgetown

Re: The proposed gasification plant

From: Dr. Mary E. Wharton, Professor Emerita of Biology and Geology at Georgetown College

Having spent 27 years as the Chairman of the Department of Biology and Geology at Georgetown College, I shall always be interested in the welfare of the citizens of Georgetown. As you consider a coal gasification plant and the accompanying industries, I wish to alert you to the cost in health hazards to the community. Among the environmental and health factors, I call your attention to the effect that such a large industrial complex in its proposed location would have on the quality of your water as well as on the quantity.

I trust you realize that water demands would be greatly increased by the whole complex of industries - not just the amount required by the gasification plant - the extent of the increase depending on what industries would be present.

Your remarkable Royal Spring discharges water which entered the ground as rainwater and reaches the spring via a well-developed subsurface drainage system. From a study by D. S. Hull, hydrologist with the United States Geological Survey, entitled Hydrology of the Lexington and Fayette County, Kentucky, Area (Georgetown being in the area) and published in 1968, I attach two pages which concern the sources of the Royal Spring water. This explains that the principal source of intake is in a line extending for 4 miles east-southeast from the spring, between the surface drainage of NorthElkhorn and Cane Run, this being just south of Lemon's Mill Road. Note that the proposed gasification plant and the accompanying industries would be on part of this principal intake area. (A second source area mentioned is just north of Lexington where the headwaters of Cane Run go underground and emerge at Royal Spring instead of following the downstream course of Cane Run.)

What this situation means in relation to the proposed gasification plant and associated industries is twofold: (1) The buildings and paved parking sections would cover over some of the intake area, thus preventing some of the rain from entering its usual subsurface channels and thus diverting some of the runoff to either North Elkhorn or Cane Run, thereby reducing the Royal Spring discharge proportionately. (2) Some of the industrial runoff would enter the ground in the immediate area, thereby entering the trunkline to Royal Spring, and would contain chemicals unsuitable for drinking water and not removed in purification processes. Chemical spills from industry may be inadvertent but they happen; often they are highly toxic and sometimes carcinogenic. Furthermore runoff from parking lots is harmful in drinking water because it contains lead and hydrocarbons in much greater concentrations where automobiles slow down and start up than where they travel at uniform speed on highways. Chlorination of water containing certain hydrocarbons and other organics can form some chlorinated organics which are cancer-inducing.

Therefore, I urge you to make no commitments until a thorough and detailed environmental impact study is conducted.

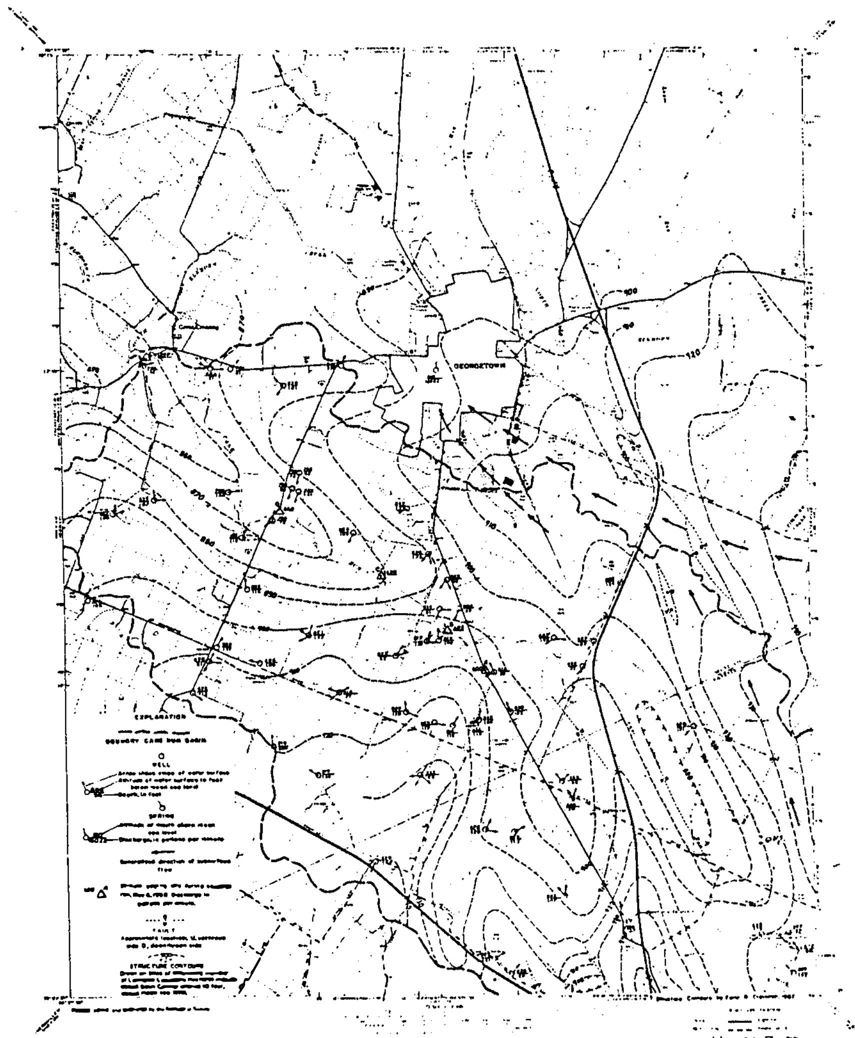

FIGURE 12. MAP SHOWING DIRECTION OF FLOW OF GROUND WATER IN THE CANE RUN DRAINAGE BASIN

itation for the 10-day period preceding the sampling of May was 4.92 inches, of which 4.20 inches fell in the immediately preceding four days. Only 1.68 inches fell in the 10 days preceding the November sampling, with only 0.25 inches falling in the immediately preceding four days.

In addition to samples for chemical analysis, samples were also collected for bacteriological analysis from 20 wells and springs selected at random from the shallow aquifers throughout the study area. Standard tests for coliform bacteria were performed by the Fayette County Health Department. These texts were evaluated using standards for drinking water and the results reported as positive or negative relative to coliform content.

The wells and springs were sampled in December 1967 and in May 1968. The May sample represents high water levels shortly after periods of heavy rainfall. The December sample represents water-level conditions during a period of lesser rainfall. About 40 percent of the samples were negative in December wheras only 25 percent were negative in May. The increase in positive samples in May is probably due to the increased amount of water moving overland which had a greater chance of picking up bacteria from animal excrement and carrying these organisms into local ground waters. This change is noted in spring 13 which was negative in December and positive in May. Wells that obtain water from deeper rocks may be contaminated in much the same manner. For instance, many sewer lines in Lexington are laid within the upper few feet of bedrock. Leakage from these lines enters the underlying water body almost immediately. Hopkins (1963) estimated that leakage from sanitary sewers in the Lexington area is substantial after heavy rains, perhaps as much as 4 or 5 times the normal inflow of 8.5 mgd at the Lexington sewage treatment plant in 1962. Thus, a large amount of bacteria laden water is flowing in the bedrock and undoubtedly, so some of this water mixes with the natural ground water. There is no obvious pattern to the coliform pollution. The wells and springs showing contamination are located in all topographic situations and tap several different aquifers. Only wells 9, 14, 16, and 18 were negative in both the May and December samples. The source of coliform bacteria in each case was not determined, but the presence of coliform bacteria generally indicates pollution from fecal wastes. Such pollution can originate from any of the higher animals such as farm livestock or man. Considering the high density of unsewered areas in Lexington, the leakage that drains from city sewers, and the large area given to grazing of livesrock, it is not unreasonable to assume that much of the bacterial pollution originates in sewage within the Lexington area. Contamination in rural areas suggests improper disposal of domestic sewage or infiltration of surface water that drains pastures or farmyards.

Movement of Water

As stated earlier, the water in shallow aquifers in the Lexington study area moves from points of recharge to points of discharge in structural lows or in the beds of the major streams. Of special interest, is the flow of shallow ground water toward Royal Spring, the municipal supply for Georgetown in Scott County. The exact route of ground water moving toward this spring can not be determined without detailed investigations. However, the generalized path can be described, based on a knowledge of the geology, hydrology, and chemical character of water.

The outlet of Royal Spring is developed in the Grier Limestone Member of the Lexington Limestone about 15 feet below the contact with the overlying Tanglewood Limestone Member. The major part of the subsurface openings transmitting water to Royal Spring are developed at or below the contact. The structural gradient between the southernmost point of known recharge for Royal Spring, which is Cane Run just northwest of Interstate Highways 75 and 64 near Lexington, and the mouth of Royal Spring is about 6 feet per mile. The gradient is based on the change in elevation of the contact between the Grier and Tanglewood Limestone Members.

The subsurface drainage system for the spring can be considered as a large branching pattern of solution openings which collect water over an extensive area and funnel the water toward the main trunk of the system from whence water is discharged to the surface at Royal Spring. Most of the recharge to Royal Spring moves through an area underlying a line of sinkholes trending east-southeast from Georgetown for about 4 miles along the surface drainage divide between Cane Run and North Elkhorn Creek. Although discontinuous at the surface, an examination of water levels and structure contours indicate the presence of subsurface interconnections between these sinkholes. Part of the recharge flows due north from the Cane Run basin and part flows northwestward down the structural dip of the rocks from the North Elkhorn basin. The flow from these areas is intercepted south of Lemons Mill Road and diverted toward Royal Spring by the large solution openings related to the line of sinkholes trending east-southeast from Georgetown. The general direction of subsurface flow is shown by arrows on figure 19. The contributing areas for water discharging from Royal Spring generally are in an east-southeast direction from Georgetown and are within the Cane Run and North Elkhorn Creek basins. The farthest known area contributing water to the spring is the reach of Cane Run just north of Interstate Highways 75 and 64 near Lexington. A series of sinkholes in the bed of Cane Run funnel water from Cane Run directly into the subsurface drainage system. Flow measurements made in Cane Run, upstream and about 0.75 mile south of Interstate Highways 75 and 64 on March 8 and May 6, 1968 showed the discharge to be 228 gpm and 274 gpm, respectively. On these dates, no flow was recorded downstream at the Berea Road site (see table 2). The entire flow of Cane Run above Berea Road was being discharged into the sinkholes in the bed of Cane Run. The discharge of Royal Spring is much greater than 274 gpm and therefore must be receiving recharge from an area much more extensive than the Cane Run basin.

The movement of the water entering the sinkholes in the bed of Cane Run and becoming part of the subsurface drainage system to Royal Spring also has been traced by the chemical character of the water in the system. Several chemical constituents included in large concentrations in industrial and municipal spills in the headwaters of Cane Run have been detected in less concentrated but above normal amounts in the water discharging from Royal Spring. The presence of these chemical constituents, though in lesser concentrations, seems to verify the connection between the Cane Run drainage and Royal Spring.

The Deep Aquifers

The Knox Dolomite and St. Peter Sandstone are potential aquifers that lie 800 to 1,000 feet below land surface in the Lexington study area. Well 18 was the only well inventoried during this investigation that penetrated the deep aquifers. However, the presence of water in these aquifers is shown by successful water-supply wells and tests for oil and gas in adjoining parts of central Kentucky.

The Knox Dolomite is approximately 2,000 feet thick in

EXHIBIT 13 (Continued)

The Environmental assessment for the Kentucky Federal Energy Park as prepared by Mason and Hanger Silas Mason Co. Inc. is inadequate in presenting the impact that the proposed Coal Gasification Plant will have on North Elkhorn Creek. The effluents from the plant and its accompanying industries will be drained into the sewer system and after treatment will be discharged into North Elkhorn Creek.

This assessment does not address itself to the following:

1. Size of stream, its rate of flow, ph and temperature levels, self-purification rates, etc.
2. Recreational use for the community
3. Water supply to farmland for irrigation purposes and drinking water for livestock
4. The use of the stream as an auxillary water supply for the city of Georgetown in years of drought and during other types of emergencies

The impact that the toxic non-biodegradable products from the effluents of a coal gasification plant will have on the above must be taken into consideration if a proper evaluation for the establishment of a coal gasification plant within an agricultural area is to be given.

Genevieve Clark
Associate Professor of Biology
Georgetown College

EXHIBIT 13 (Continued)

mentally. For example, coal extraction, and particularly the associated water needs,[4] have potentially severe impacts requiring priority attention. Appendix D lists important extraction-related research.)

Advanced coal-based energy technologies in ERDA RD&D are of two general types: direct coal combustion and fuel-to-fuel conversion. The elimination of sulfur-related pollutants associated with present coal-burning boilers is a major objective of the research.

Fluidized bed combustion is the direct combustion technology receiving most of ERDA's attention. In this process, crushed coal is rapidly dispersed in a boiler by air blown uniformly through a grid plate; thus it becomes "fluidized." Tiny limestone particles, which are not combustible, are injected; they act as acceptors of the sulfur dioxide. Nitrogen oxide emissions can also be reduced to low levels.

As an alternative to direct burning, production of low-sulfur gaseous and liquid fuels from coal is under active research and development. Gasification generally involves the reaction of coal with air, oxygen, and steam to yield a combustion product containing, but not limited to, carbon monoxide, hydrogen, methane, and nitrogen—and little or no sulfur. The energy content of the product ranges from about 125–175 Btu per standard cubic foot for "low-Btu" gasification processes to about 900–1,000 Btu/scf for "high-Btu" gasification processes. The latter is comparable to the energy content of natural gas.

Liquefaction processes change coal into a liquid fuel while removing most of the ash and sulfur, which pose environmental problems. Reactions in liquefaction processes take place at lower temperatures and often at higher pressures than in gasification.

Numerous potentially hazardous substances are expected to be present in advanced coal conversion process streams (see Table 12): lung irritants (e.g., sulfur dioxide and nitrogen oxides), known or suspected carcinogens (nickel carbonyl and beryllium salts), and others with known serious health effects (e.g., mercury and vanadium).

Focusing the Research Program

If a process produces and releases significant amounts of such substances into the environment, serious health and ecological effects can occur. Our understanding of the presence of these substances and of their potential health and ecological impacts is extremely limited. To establish the feasibility of coal conversion technologies, ERDA and EPA must first set detailed research priorities to fill the gaps in our understanding. This is a difficult task. Inevitably there are conflicting views on allocation of resources. Especially when there are many unknowns, wide differences of opinion will exist within a single discipline, not to mention among the disciplines.

[4] Section 13 of the Nonnuclear Energy Research and Development Act directs the Water Resources Council, at the request of the Administrator of ERDA, to carry out comprehensive (national) and site-specific assessments of water availability and of the impacts on water demand associated with new energy technologies.

EXHIBIT 13 (Continued)

Table 12.—POTENTIALLY HAZAROOUS SUBSTANCES FROM COAL CONVERSION TECHNOLOGIES [1]

More poorly understood	
Higher significance	Lower significance
Benzene: Suspected to cause leukemia	Carbon monoxide: Suspected to alter enzyme activity, cause behavioral changes, and precipitate heart attacks
Beryllium: Suspected to cause bone and lung cancer	Fluoride: Suspected association with blood disorders
Cadmium: Possible relation to prostate cancer	Manganese: Causes brain damage and pneumonia in high doses
Fluorides: May increase sensitivity to chemicals affecting central nervous system	Xylene: inhibition of electrical activity in cerebral cortex at levels below odor threshold
Lead: Suspected occupational carcinogen	Vanadium: Acute respiratory irritation; chronic ingestion produces systemic symptoms
Nickel: Occupational cancer incidence	Zinc oxide: Occupational exposure can cause intestinal, respiratory, skin, and nervous disorders
Nickel carbonyl: Causes lung cancer, possibly asthma	
Nitric acid: Can irritate eyes, lungs, mucous membranes, and skin and corrode teeth	
Nitric oxide: Can cause pneumonia, circulatory system damage; suspected respiratory irritation and tooth corrosion	
Nitrogen dioxide: Suspected to reduce resistance to bacteria; acute exposure causes increased respiratory inhibition	
Phenols and cresols: Occupational carcinogen (skin); may damage central nervous system and liver	
Selenium: Occupational cause of digestive and nervous disorders	
Sulfur dioxide: Correlates with chronic respiratory diseases; synergistic effects with particulates	
Zinc chloride: Possibly carcinogenic	

See footnote at end of table.

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EXHIBIT 13 (Continued)

Table 12.—POTENTIALLY HAZARDOUS SUBSTANCES FROM COAL CONVERSION TECHNOLOGES[1]—Continued

Better understood	
Higher significance	Lower significance
Beryllium: Causes acute and chronic respiratory disorder from short-term exposure	Arsenic: Lethal at high doses
Chromium: Suspected cause of lung cancer	Barium: Eye, nose, throat, and skin irritant; salts and sulfide poisonous
Fluorides: High levels lead to chronic poisoning or fatality; can cause respiratory impairment	Beryllium: Causes chronic berylliosis
Lead: Damages central nervous system	Cadmium: Systemic and fatal effects from inhalation of high concentrations
Mercury: Damages central nervous system	Carbon monoxide: Causes dizziness, fatigue, and coronary dysfunction
Polycyclic aromatic hydrocarbons: Carcinogenic	Chromium: Occupational exposure causes lesions of skin and mucous membranes
Uranium: Insoluble compounds damage lungs; salts damage kidneys and arteries	Cyanides: High concentrations lethal
	Phenols and cresols: Corrodes skin and mucous membranes
	Selenium: Causes dermatitis and respiratory irritation
	Toluene: Chronic exposure can cause brain damage

[1] The basis for the ranking of a substance is a combination of the inherent toxicity of the substance and the degree of human exposure anticipated. The latter is a relative measure, reflecting the increase in concentrations over urban or rural background levels, the concentration expected compared with the level thought to be harmful, and the number of persons who will be affected.

Each effect is placed in the grid according to its ranking of significance and how well it is understood. The list of problems is not comprehensive and does not incorporate all advances to date in the assessment of current knowledge. However, the most important effects are believed to be covered. Some substances are listed more than once depending on the effect and the level of understanding.

Source: Based on draft report by Energy Resources Company, Inc.

In establishing research priorities, ERDA and EPA need to consider:

- Possible severity of environmental impact: Is the substance known to have significant human or ecological effects?
- Current understanding: Has the substance been the subject of characterization and effects research; if so, what can be said about the level and type of potential impacts?

- Effect of additional information on development decisions: Would environmental information alter the course of the technology in the RD&D sequence?
- Information for environmental and health standards: Is the research basic to establishing regulatory standards for a substance?

Setting research priorities should be a formal—albeit evolutionary—process. It involves many disciplines, including those relating to environmental research, technology development, and environmental standard setting.

MAJOR ISSUES

The Council's assessment of research needs related to coal conversion technologies raises major issues that are fundamental to the commercial success of the technologies now in RD&D programs. This section briefly discusses the issues as a basis for assessing procedures for building environment into RD&D.

Environmental Data

Environmental research must be linked to the technology development programs. As shown in Table 13, environmental data are very limited or nonexistent. This deficiency may be traced to the lack of a comprehensive *process characterization* research program. The importance of characterization cannot be overemphasized. It is essential to the focus of effects research. Health effects and control technology research cannot be focused until the pollutants emanating from a technology are identified.[8]

Table 13.—COAL PROCESSES RECEIVING FEDERAL SUPPORT

Process	Development scale	Size	Environmental data
Coal cleaning			
Meyers chemical cleaning (TRW/EPA)	Pilot	750 PPH	Some
Physical cleaning test facility (EPA/Bureau of Mines)	Pilot	480 TPD	None
General public utilities	Commercial	1,200 MW	None
EPA test support	Commercial	650 MW	None
Fluidized bed combustion			
Atmospheric bed (PER)	PDU	Unknown	Some
	Pilot	30 MW	NA
CPU-400, gas turbine (CPC)	PDU	1 TPD	None
Pressurized FBC (Esso)	Unknown	Unknown	Some
Pressurized bed (IEA)	Pilot	30 MW	None
Pressurized FBC (NRDC/BCURA)	Pilot	Unknown	Unknown

[8] Human health effects were accorded high priority for purposes of this discussion. Our assessment also included ecological and materials effects research. Appendix E lists some research needs in these areas.

Table 13.—COAL PROCESSES RECEIVING FEDERAL SUPPORT—Continued

Process	Development scale	Size	Environmental data
High-Btu gasification			
Bi-gas (BCRI)	Bench	1 TPD	Some
	Pilot	120 TPD	NA
Methanator section	PDU	Unknown	Unknown
Clean fuels (Coalcon)	Demon-stration	2,600 TPD	Unknown
Hydrocarbonization (Union Carbide)	PDU	20 PPH	Unknown
CO_2 acceptor (Conoco)	Pilot	40 TPD	Some
Hydrane (Bureau of Mines)	Bench	12 PPH	Some
	Pilot	25 TPD	Unknown
Hygas (IGT)	Pilot	75 TPD	Unknown
Liquid phase methanation (Chemical Systems)	Pilot	2 MM SCFD	Unknown
Synthane (Bureau of Mines)	PDU	40 PPH	Some
(Lummus)	Pilot	75 TPD	NA
High- and low-Btu gasification			
Ash agglomerating (Battelle/Union Carbide)	Pilot	25 TPD	Some
Ash agglomerating (IGT)	PDU	500 PPH	None
	Pilot	250 TPD	NA
Low-Btu gasification			
Boiler fuel gas (Westinghouse)	PDU	12 TPD	Some
	Pilot	120 TPD	NA
Boiler fuel gas (Combustion Engineering)	PDU	120 TPD	NA
Boiler fuel gas (Foster Wheeler)	Pilot	500 TPD	Unknown
Flash pyrolysis (Garrett)	Bench	3 PPH	Some
	Pilot	250 TPD	NA
Molten salt (Kellogg)	Bench	Unknown	Some
Multiple fluidized bed (BCRI)	PDU	100 PPH	None
Liquefaction			
CSF (Consol, Fluor)	Pilot	20 TPD	Some
	Bench	20 PPH	None
H-Coal (HRI)	PDU	200 PPH	None
SRC (Pittsburgh and Midway)	Pilot	50 TPD	None
Synthoil (Bureau of Mines)	Bench	50 PPH	Some
	PDU	10 TPD	NA

MM SCFD = million standard cubic feet per day
MW = megawatts
NA = not applicable
PDU = process development unit
PPH = pounds per hour
TPD = tons per day
Unknown = information was not or could not be obtained during study

Source: Based on draft report by Energy Resources Company, Inc.

Table 14 ranks research priorities for process characterization. The items are general and do not reflect the priorities and characteristics of specific processes. High priority was given to health-related research areas lacking adequate information for rough evaluation of the technologies. Medium priority was given to both the remaining health-related research and to the nonhealth-related research areas believed to affect technology choices significantly. All remaining areas were classified as low priority.

Table 14.—SOME RESEARCH NEEDS FOR PROCESS CHARACTERIZATION

High priority	Medium priority	Low priority
Toxic substances in flue gas	Retention of sulfur in ash of western alkaline coals Toxic substances from gasification quench water	Toxic substances in coal preparation solid wastes Toxic substances left in ash from combustion
Trace elements in gasification and liquefaction	Fugitive emissions from gasification and liquefaction	Fugitive emissions from blowdown and condenser cooling water
Effectiveness of acid gas treatment in removing carbonyl sulfide and CS_2	Emissions from tar separation (gasification)	Toxic substances in ash of fluid beds
Nickel carbonyl in product gas	Relation of emissions to coal composition in conversion processes	Stone fines leaving fluid beds
Toxic trace metals in product gas	Toxic metals in char/ash from conversion processes	
Toxic organics and trace metals in synthetic liquid fuels	High pressure and high temperature sampling apparatus	
Relationship of particle size to composition in combustion and gasification	NO_x levels from fluidized bed and combined cycles	
Toxic organics and trace species	Dust and organics in coal drier exhaust	
	Sulfur and hydrocarbons in CO_2 stream from sulfur removal plants	
	Emissions from catalyst reactivation (gasification and liquefaction)	
	Formation of polycyclic organic materials and oxygenated hydrocarbons from direct combustion	

Source: Based on draft report by Energy Resources Company, Inc.

To date, process characterization efforts have been inadequate. Both ERDA and EPA are initiating studies to improve characterization. Chapter VIII evaluates present efforts.

Information on Health Effects

Table 15 lists some priority areas for health effects research. Briefly, there is too little information to judge almost all effects, except perhaps for the currently regulated "criteria" pollutants.[a] At the present level of understanding, research is needed in almost all categories.

Table 15.—SOME RESEARCH NEEDS FOR HEALTH EFFECTS

High priority	Medium priority
Develop rapid screening techniques for identification of toxic substances	Compile data on health effects
Develop screening techniques measuring effect of total environmental burden of a process on higher animals	Collect background data on content of specific organics and trace metals in foodstuffs
Develop sensitive analytic methods for ambient levels and for tissue and organ residues	Map diseases, study geographical distribution
Elucidate dose-response relationships	Study effects of increases in toxic substance levels due to startup at large coal conversion facilities
Measure and understand role of cocarcinogens	
Measure and understand synergistic effects generally	
Characterize sensitive and resistant subpopulations	
Develop general species-to-species extrapolation methods	

Source: Based on draft report by Energy Resources Company, Inc.

Because with time and budget constraints it is virtually impossible to learn enough to quantify health impacts, screening and toxicological studies indicating the presence or absence of effects and providing qualitative data are especially important. Several critical research needs must be met before screening and toxicological studies can be used to estimate human health impacts with confidence:

- Screening methods must be refined and limitations of the results established.

[a] The six for which national ambient air quality standards have been designated: total suspended particulates, sulfur dioxide, carbon monoxide, photochemical oxidants, nitrogen dioxide, and hydrocarbons.

- Species-to-species relationships must be better understood in order to extrapolate the toxicological data on animals to human beings.

- Methods to measure trace amounts of harmful compounds in air and water and in tissues and organs must be developed.

ERDA's Office of Environment and Safety is working to improve existing techniques, but more emphasis is needed. Its developing health effects program is discussed in Chapter VII.

Coordination of Health Effects and Technology

It is essential that the federal health research program be coordinated with technology RD&D. In short, health effects research should address problems believed to be associated with specific classes of compounds. Some steps are now being taken to effect this kind of coordination.

Related research is conducted not just by ERDA and EPA but by the National Institutes of Health. Many energy-related studies now focus on protection of human health and the environment, but they are generally broad and cover a wide range of impacts. Some address specific effects of identified technologies, but most are more general.

End Use Health Effects

Linking environmental and technology research programs in a systems context requires looking at impacts not just of the conversion process but also of a product's end use. For example, residential use of synthetic fuels is one research area that seems to be receiving little attention. Synthetic gas plants may use nickel as a catalyst in the last step of production. Potentially carcinogenic nickel compounds could then be present in the products of coal gasification plants, with consequent effects at the point of end use. Investigation of the carcinogenicity, teratogenicity, and toxicity of several nickel compounds is being funded by ERDA. However, studies to determine whether these compounds are present in the product streams of coal gasification plants are limited. Although nickel carbonyl is being measured for the synthane process, nickel subsulfide is apparently not being studied.

Careful attention should be given to characterizing potentially hazardous substances in the product streams of all synthetic fuel processes and to ensuring that the necessary research is directed at understanding their health effects.

Standard-Setting Focus

One function of the energy RD&D program is to provide information for setting standards under federal environmental control laws (see Table 16). Under these laws new performance standards will be required for many new technologies before they

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can operate commercially. In addition, ambient air quality standards may be necessary for pollutants not currently regulated by the Clean Air Act.

Data are needed on the nature and magnitude of the emissions or effluents, their potential health and ecological effects, and the costs and effectiveness of alternative control technolgies. *Research and development should be organized to generate the information needed to develop these standards, not to design facilities that meet only current standards.*

Meeting this need will require coordination between ERDA and the regulatory agencies. The research program related to coal technology is not yet adequately organized to develop the needed information.

THE PRESENT PROGRAM APPROACH

We reviewed the environmental planning in ERDA and EPA to determine whether they are comprehensively identifying potential problem areas and translating their findings into priority environmental research. *Our general conclusion is that there is yet no system in place and functioning to meet these objectives.* However, both agencies are aware of the need to reassess the focus of their environmental research programs and have proposed assessment and planning systems that could lead to the needed, technology-focused research program.

ERDA's Office of Environment and Safety

Primary responsibility for environmental research within ERDA rests with the Office of Environment and Safety, primarily the Division of Biomedical and Environmental Research. It is responsible for planning and overseeing research projects at ERDA's national laboratories and at universities.

OES's traditional approach to research identification has been to rely substantially upon laboratory and university researchers to propose projects which it then approves or disapproves on an informal basis. More central direction is necessary. Laboratory researchers may have little sense of needs associated with the many new technology programs being instituted by ERDA, and they may well have no idea of the development, demonstration, and commercialization schedules associated with the technologies. For example, beginning in the late 1940's, the AEC carried out extensive research related to the effects of nuclear releases. This research capability would appear to have value if applied to nonnuclear programs, but it has not yet been specifically redirected in a major way. Substantial redirection may begin in FY 1978.

OES must base research priorities on its own assessment of technology-related problems. With such a framework, it could better evaluate research proposals, and, further, it could identify the areas where environmental research is lacking. Equally

POPULATION PROJECTIONS

EMPLOYEES	
Using the Kentucky average of 18 industrial employees per acre:	172 acres X 18 = 3,096 employees
Total park employees:	3,096
Assuming 50% will relocate in Scott County:	X .50
Employees to relocate in Scott County:	1,548
SERVICE MULTIPLIER	
Using multiplier of 2.7 to cover service persons to accompany those relocating:	X 2.7
Service Persons:	4,180
Add: Employees relocating in Scott County:	1,548
New Workers (Industrial and Service)	5,728
FAMILY MULTIPLIER	
Using multiplier of 3 to cover family members accompanying new persons:	X 3
Family Members	17,184
Add: New Workers (Industrial and Service)	+ 5,728
Total Persons (Workers and Families)	22,912
PERCENT INCREASE	115%

HOUSING PROJECTIONS

FAMILIES:	(New Workers)		5,728
HOUSING:	Inventory per HUD 4/9/75:	7,013 units	
	Units required	5,728	
	Total Housing Units	12,741 units	
PERCENT INCREASE:		81.7%	

Source: 1. Social, Economic and Environmental Impacts of Coal Gasification and Liquefaction Plants, April, 1976.
2. Department of Housing & Urban Development Report, 4/9/75.

AREA POPULATION STATISTICS

County	Percent of Growth 1960 - 1970	Percent of Growth 1970 - 1975
Scott	16.7%	5.3%
Fayette	32.2%	8.8%
Woodford	21.2%	15.0%
Franklin	17.2%	8.2%
Grant	5.4%	17.0%
Owen	(9.3%)	5.8%
Harrison	3.3%	3.1%
Bourbon	1.6%	2.3%

UNEMPLOYMENT

County	1976 Percent
Scott	3.0
Fayette	3.2
Woodford	2.7
Franklin	3.8
Grant	3.6
Owen	3.7
Harrison	3.6
Bourbon	2:6

Source: 1. Industrial Resources 1975, Kentucky Department of Commerce
2. Kentucky Department of Human Resources, Research & Special Projects
3. Population Percentage Change, University of Louisville, Urban Studies Center

CONCLUSION

POPULATION, HOUSING AND UNEMPLOYMENT

POPULATION

Assuming only one half of the new industrial park employees relocate in Scott County, a population increase of 22,912 may be projected. This figure includes industrial employees, service employees, and families of both groups. Compared to 20,000 persons living in Scott County at this time, an increase of 115% is concluded. Area population statistics reveal that Scott County has experienced 16.7% growth in the ten year period of 1960-1970 and 5.3% growth in the five year period of 1970-1975. Growth figures for the seven counties surrounding Scott reveal only moderate growth in the past 15 years. An increase of 115% would be devastating to the economy.

HOUSING

Since the housing vacancy factor in Scott County is quite low, it may be assumed new units would have to be provided to accommodate the 5,728 new families of industrial and service workers. This increase would represent an increase of 81.7% which would be impossible to provide in an orderly manner.

UNEMPLOYMENT

The 1976 unemployment figures for Scott and its surrounding counties reveal a lack of labor supply. In order to accommodate the industrial park, persons will have to relocate in the area, thus presenting the problems of increased population and housing outlined above.

SIERRA CLUB

CUMBERLAND CHAPTER
BLUEGRASS GROUP

March 14, 1977
170 Arceme Avenue
Lexington, Kentucky 40505

Mr. Russell Bardos
Energy Research and Development
Administration
400 First Street, N.W.
Washington, D.C. 20545

Dear Mr. Bardos,

The Cumberland Chapter of the Sierra Club has been observing the preliminary activities related to the proposed coal gassification plant in Georgetown, Scott County, Kentucky. Although Mr. Tom Lohr of Irvin Industries, the proposed developer, has been quite open and informative about the project, the Chapter feels that there are far too many unanswered questions about the proposed project, which would fuel an entire industrial park and possibly precipitate undesirable secondary environmental consequences.

At a public meeting in Georgetown on January 27 of this year the Bluegrass Group of the Chapter went on record as neither flatly opposed to nor in favor of this project, but rather taking the position that the Georgetown City Council should not welcome the plant with open arms until a thorough environmental impact statement was prepared which examined in detail the secondary consequences of this energy-industrial park complex. We stated our belief that the "environmental assessment" prepared for Irvin by Mason and Hanger-Silas Mason Co., Inc. was totally inadequate since it covered only five pages and was extremely superficial.

Subsequently, the Georgetown City Council on February 3, 1977 voted conditional approval of the project, the condition being that a thorough EIS be done and approved by appropriate state and federal agencies. This sounds wise to us, and we recommend that a non-interested research firm be authorized by ERDA to begin this analysis at once. Mason and Hanger should have nothing to do with this study because we understand that they have a continuing interest in the construction phase of the project.

Of particular interest to us are the questions of (1) the adequacy of Scott County's water supply for this industrial expansion and the growth which will accompany it, (2) the socio-economic impact of this industrial park in Scott County, (3) the possibility that alternative siting would make more sense, possibly in an already industrialized county where industry faces natural gas curtailment

SIERRA CLUB

CUMBERLAND CHAPTER

or possibly in a coal-producing county where unemployment may be high and water more available.

Mr. Lohr has emphasized to us the great demand there will be for Irvin's coal gas when the plant is built. If the demand is already pervasive, it would appear that the developers should be able to line up all the future users now so we can see exactly who they would be, what kind of industrial process they would have, how many employees they would need, how much water they would demand, etc. We strongly urge that Irvin be required to detail to you the proposed occupants of the industrial park and their requirements, and that ERDA begin a detailed environmental impact statement which will fully and adequately analyze the socio-economic and pollution potential impact of the proposed industrial park complex.

Sincerely yours,

Gerald A. Thornton

Gerald A. Thornton
Member of the Executive Committee,
On behalf of the Cumberland Chapter.

cc: Mr. Tom Lohr
Mr. Gipson Downing
Mr. Henry Garson

September 13, 1977

Mr. W. H. Pennington, Director
Office of NEPA Coordination
U. S. Energy Research and Development Administration
Washington, D. C. 20545

Re: Proposed Low-BTU Coal
Gasification Facility,
Georgetown, Kentucky

Dear Mr. Pennington:

I have just returned from a meeting of the Georgetown Water Board concerning a future supply of water for Georgetown, Kentucky.

The accelerated population projection for 1997 was 26,444 users of our water supply. Considering this conservative estimate the water board has recommended impoundment of another 200 acres of prime farmland for a dam and reservoir. This will be done through condemnation and annexation of this property in the heart of our best agricultural belt.

The Water Board was not aware of City Council's request for the environmental impact statement. They were unaware of any population increase in this county other than the past estimated growth. I assured them we had requested the water site-specific study and that until all of these documents are completed and presented to the citizens fo Georgetown, it is premature for us to predict our water needs.

I hope you can ascertain that there is no communciation between local government and the various boards in this community concerning the issues of the particular development on Lemon's Mill Road, Georgetown, Ky.

As a newly elected member of City Council, I still maintain that I represent the majority of the citizens in this County in my opposition to the location of Irvin Industrial Development's proposed Coal Gasification Facility and Industrial Park.

Thank you for your cooperation during the preparation of the statement. I believe Mr. Gibson Downing has forwarded the documents together that represent the concerns of this proposal.

I would appreciate your informing me of the next step in the governmental process concerning this project. Thank you and I look forward to receiving my copy of the DEIS.

Very truly yours,

Jane Allen Offutt

Mrs. William N. Offutt, IV
336 East Main Street
Georgetown, Kentucky 40324

cc: Mr. C. Gibson Downing
The Honorable John C. Breckinridge

SIERRA CLUB

CUMBERLAND CHAPTER

Blue Grass Group
c/o W. Henry Graddy, IV
Route #1, Hedden Road
Versailles, KY 40383
September 14, 1977

W. H. Pennington, Director
Office of NEPA Coordination
U.S. Energy Research and
Development Administration
Washington, D.C. 20545

Re: EIS for proposed low BTU
coal gasification facility
at Georgetown, Kentucky

Dear Mr. Pennington:

On behalf of the Blue Grass Group of the Sierra Club, I appreciate the opportunity to comment on the preparation of an environmental impact statement by the U.S. Energy Research and Development Administration (ERDA) for the proposed coal gasification facility for Georgetown, Kentucky.

With reference to the letter dated March 14, 1977, from Jerry Thornton of this organization to Mr. Russell Bardos of ERDA, the Sierra Club applauds the decision of ERDA to prepare a thorough environmental impact statement of this proposal. We are confident that ERDA will commission a disinterested body to prepare a comprehensive study of the proposal of Irvin Industrial Development Company.

Our concern is the scope of the environmental impact statement. Specifically, we urge that the following items receive full consideration:

1. The location of proposed low BTU coal gasification facility on top of Georgetown water aquifier--dangerously close to Royal Springs.

2. The location of the coal gasification facility on prime agricultural land, as determined by the U.S. Soil Conservation Service.

3. The location of the coal gasification facility in an area that produces no coal and is not near the areas in Kentucky that do produce coal.

4. The nature of the industrial park to be developed around the coal gasification plant. This proposed industrial park is part of the impact of the location of the coal gasification plant, and it must not be ignored by the impact statement.

5. The impact of development of the industrial park around the coal gasification plant calling for as many as 1,530 new employees and 5,000 new residents in a community of 20,000 people, without significant unemployment.

6. The impact of development of an industrial park around the coal gasification plant on 169 acres of prime agricultural land, as defined by the U.S. Soil Conservation Service.

7. The anticipated effect on the sewage systems, electrical systems and solid waste systems of the community of Georgetown of full development of the industrial park around the coal gasification plant.

Because the Blue Grass Group of the Sierra Club has a fundamental commitment to this area's environment, the Sierra Club believes in the importance of an environmental impact statement. But our organization has been disappointed with past impact statements that were either incomprehensible or failed to deal with the complete effect of the federal action on the environment. See Kleppe v. Sierra Club, 427 U.S. 390 (1976).

We would hope that, after the environmental impact statement is complete, the citizens of Georgetown could turn to it and obtain a realistic description of the full effect this proposed coal gasification plant will have on their community. Local planning and zoning laws require that the decision belongs to the community of Georgetown. NEPA requires that, with major federal action, these citizens receive your assistance in knowing the full consequences of their choice.

Very truly yours,

Hank Graddy

HANK GRADDY, Chairman
Sierra Club, Blue Grass Group

WHG:jrs

Kentucky Heritage Commission
104 Bridge Street
Frankfort, Kentucky 40601

September 14, 1977

Mr. W. H. Pennington, Director
Office of NEPA Coordination
United States Energy Research and
Development Administration
Washington, D.C. 20545

Dear Mr. Pennington:

Enclosed are lists of historical and cultural resources in Scott County, Kentucky, from the National Register of Historic Places and the Survey of Historic Sites in Kentucky and its Supplement. Many of the sites listed on the Survey of Historic Sites in Kentucky and its Supplement, especially those in the Georgetown vicinity, are considered potentially eligible for listing on the National Register of Historic Places by this office. I hope this information will be of assistance in preparing the environmental impact statement on the proposed Low-BTU Coal Gasification Facility at the Irvin Industrial Development Company Site in Georgetown, Kentucky.

Sincerely yours,

Eldred W. Melton

(Mrs.) Eldred W. Melton
Executive Director and State
Historic Preservation Officer

Enclosures

EWM/pb

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APPENDIX G

GLOSSARY

APPENDIX G

GLOSSARY

Acetanaphthalene - a vinegary hydrocarbon made by distillation of coal tar and used in organic synthesis.

Aerobic Digestion - decomposition into simpler parts by bacteria that live only in the presence of oxygen.

Aerosol Particles - a suspension of fine solids or liquids dispensed from a pressurized container.

Air Flotation - separation of particles of a pulverized mass according to their capacity to float in air.

Alkali - A soluble salt obtained from ashes of plants and having marked basic properties.

Alluvium - unconsolidated sand, silt, gravel, etc. deposited by a stream in its channel or on its floodplain.

Alum - potassium aluminum sulfate.

Ambient - surrounding on all sides; encompassing.

Annealing - to heat for fixing laid-on colors in glass; to heat and cool for softening, forming, and/or strengthening.

Anthracene - a crystalline cyclic hydrocarbon obtained from coal-tar distillation.

Anthraquinone - derived from coal-tar distillate and used in the manufacture of dyes.

Anticline - a fold, the core of which contains older rocks; it is convex upward.

Anticyclone - a system of winds rotating around a center of high atmospheric pressure clockwise in the northern hemisphere and counterclockwise in the southern.

Aqueous - made of, by or with water.

Aromatic - having a strong smell; characterized by presence of at least one benzene ring.

Baghouse - a fabric filter for removing particulates.

Ball Clay - a highly plastic, sometimes refractory clay, commonly characterized by the presence of organic matter, used as a bonding constituent of ceramic wares, so named because of an early English practice of rolling it into balls of about 30-50 pounds.

Barite - a mineral of the composition $BaSO_4$.

Basement - a complex of undifferentiated rocks that underlies the oldest identifiable rocks in the vicinity.

Bedrock - solid rock underlying soil.

Benthic - relating to or occurring at the bottom of a body of water.

Benzene - a colorless, volatile, highly inflammable toxic liquid produced from coal tar or coke-oven gas, used as a solvent, a motor oil, and in the manufacture of dyes, C_6H_6.

Bioclastic - a single fossil fragment; material derived from the supporting or protective structures of animals or plants, whether whole or fragmentary.

Biota - animal and plant life characterizing a given area.

Blowdown - those waters which are too contaminated to recycle.

BOD - biochemical oxygen demand, a parameter for describing the organic pollution load of wastewater effluents and of natural waters, a measure of the amount of oxygen required by bacteria for aerobic decomposition of organic matter in water.

Borax - a white crystalline mineral used as a flux, cleansing agent, preservative, or water softener.

Boron - a nonmetal element that can combine with metal; used in metallurgy.

Borosilicate - an insoluble metal salt used in building material such as bricks, glass, and cement that contains boron.

BTu - British Thermal unit, the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2° F.

Calcareous Shale - shale containing a high lime content.

Carbozle - a basic compound used for making dyes.

Carbonic Acid - a weak acid that occurs only in solution that reacts to form bases, H_2CO_3.

Catalyze - to enable a chemical reaction to proceed more rapidly.

Centrifugal Scrubbers - an apparatus for removing impurities from gases.

Chelated Iron - iron in association with organic matter.

Chert - a hard, extremely dense or compact, dull to semivitreous, crystalline sedimentary rock consisting mostly of silica.

China Clay - a fine usually white clay used in ceramics and refractories.

Chlorides - a compound of chlorine with another element or radical; a salt or ester of hydrochloric acid.

Citric Acid - an acid obtained from lemon and lime juices.

Clarifier - equipment that clears (as a liquid) by removing suspended matter.

Climatology - the science that deals with climates and their phenomena.

CO - carbon monoxide.

Coagulation - (see Flocculation.)

Coal Gasification - transforming coal from its raw solid state to a gas product.

COD - chemical oxygen demand.

Coliform - relating to or being the colon bacterium.

Condensibles - gaseous components which become liquid if temperature lowered sufficiently.

Confluence - coming or flowing together at one point.

Conveyor Apron - a mechanical moving belt that carries material from one place to another.

Creosols - a caustic poisonous crystalline acidic compound obtained from coal and wood tar.

Cullet - broken or refuse glass added to new material for easier melting to make glass.

Cyanides - compounds of cyanogen with electropositive elements or radicals.

Deciduous - vegetation which loses its foliage each year.

Deflocculants - agents that prevent clotting or clumping together of particles.

Demister - apparatus to remove moisture.

Demography - the statistical study of human populations with reference to size and density, distribution, and vital statistics.

Derrick - apparatus for supporting and/or hoisting and lowering.

Desiccant - a drying agent.

Devonian - of the Paleozoic era of geologic time approximately 390,000,000 years ago.

Dew Point - the temperature at which a vapor begins to condense.

Diatomaceous - consisting of or abounding in minute planktonic algae with silicified skeletons.

DOE - Department of Energy

Dolomite - a term referring to a mineral composed of calcium magnesium carbonate; also refers to a sedimentary rock composed of at least 50% of that mineral.

Dome - an uplift in which the rock slopes gently downward in all directions.

Dust Cyclone - a centrifugal device for separating solid particles from liquid or gas.

Ecosystems - a unit in the study of ecology (study of relationships between organisms and their environments).

Effluent - liquid discharged as waste, such as contaminated water from a factory or outflow from a sewage works.

Electrostatic - dealing with the attraction or repulsion of electric charges.

Emulsified - converted (as an oil) into suspension; a liquid suspended within a liquid.

Endothermic - pertaining to a chemical reaction that occurs with an absorption of heat.

Entrained Dust - particles drawn in and transported by the flow of fluid.

Entrenched - eroded downward so as to form a trench; usually refers to streams.

Ethylene Glycol - thick liquid alcohol used as antifreeze.

Eutrophication - rich in dissolved nutrients (as phosphates) but often shallow and deficient in oxygen.

Firebrick - a refractory brick capable of sustaining high temperatures that is used for lining furnaces and fireplaces.

Flocculation - process by which suspended separate particles are formed into small lumps or clusters.

Formation - igneous, sedimentary, or metamosphic rock represented as a unit; sedimentary bed or series of beds represented as a unit.

Fossil Fuels - a general term for any hydrocarbon deposit used for fuel; petroleum, natural gas, coal.

Fossiliferous - containing fossils.

Fluorine - a nonmetallic element yellowish in color; a flammable irritating toxic gas.

Fluospar - a mineral used as a flux and in making opalescent and opaque glasses.

Fluxing - continuous moving on or passing by of fluid; treating with a substance to promote fusion of metals or minerals.

Frit - the partly fused materials of which glass is made; chemically complex glasses used to introduce soluble or unstable ingredients into glazes or enamel.

Galena - bluish-gray mineral with metallic luster; constitutes the principal ore of lead, PbS.

Gasifier - equipment that converts bituminous coal to gas.

Glycerine - a sweet syrupy alcohol obtained from fats and used as a solvent or plasticizer.

Gravity Separator - method of separating solids from aqueous wastes.

Group - a major rock stratigraphic unit next higher in rank than formation consisting of two or more associated formations having significant lithologic features in common.

Heat Exchanger - equipment to convey heat from its usage at one point to another.

Hydrocarbons - organic compounds containing carbon and hydrogen and often occurring in coal, petroleum, bitumens, and natural gas.

Hydrofluoric Acid - an aqueous weak poisonous acid used for finishing and etching glass, HF.

Hydrology - a science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil, in underlying rocks, and in the atmosphere.

Hydrolysis - a chemical process of decomposition involving splitting of a bond and addition of the elements of water.

Influent - flowing in; a tributary stream.

Insolation - solar radiation that has been received.

Inversion - a reversal of the normal atmospheric temperature gradient.

Kaolin - a fine white clay used in ceramics and refractories, as an adsorbent, and as a filler or extender.

Karst - topography formed over limestone by dissolution, characterized by closed depressions and sink-holes, caves, and underground drainage.

Lamination - the process of bonding layers of material (paper, wood, fabric) with heat or resin.

Lime - dry white powder consisting of calcium oxide or hydroxide used in building (mortar and plaster) and in agriculture.

Limestone - a sedimentary rock consisting mostly (more than 50%) of calcium carbonate primarily in the form of calcite.

Methanation - the carbonization of coal into methane to be used as fuel or raw material in chemical synthesis.

Methane - a colorless odorless flammable hydrocarbon that is a product of decomposition of organic matter in marshes and mines and used as fuel or in chemical synthesis.

Methylnaphthalene - an oily liquid used in measuring ignition value of diesel fuel.

Micron - a unit of length equal to one millionth of a meter.

Naphthalene - a crystalline aromatic hydrocarbon obtained by distillation of coal tar and used in organic synthesis.

Nitrogen - a colorless tasteless odorless gaseous element that constitutes 78 percent of the atmosphere by volume and occurs as a constituent of all living tissues in combined form.

NO_x - Nitrogen oxides.

Oil Skimmers - equipment to remove oil floating on the surface.

Outcrop - part of a geologic formation that appears at the surface of the earth.

Oxidation - the process of combining with oxygen.

Pentavalent - having five as the combining power of an element.

pH - used to express acidity and alkalinity on a scale of 0 to 14 with 7 expressing neutrality, lower numbers, acidity, and higher numbers, alkalinity.

Phenol - a caustic poisonous crystalline acidic compound present in coal tar and used as a disinfectant, C_6H_5OH.

Phosphates - a salt of a phosphoric acid.

Photochemical - chemical action from radiant energy, especially light.

Plankton Bloom - densely populated microorganisms occurring in bodies of water.

Precipitator - equipment to separate from solution or suspension; to cause vapor to condense and fall.

Quadrangle - a four-sided tract of land bounded by parallels of latitude and meridians of longitude, used as an area unit in systematic mapping.

Quenching - cooling suddenly by immersion in liquid (as oil or water).

Refractory - heat-resistant ceramic material.

Sandstone - sedimentary rock consisting of quartz sand united by some cement (as silica or calcium carbonate).

Scenario - an account or synopsis of a projected course of actions or events.

Shale - a fine-grained sedimentary rock formed by the consolidation of clay, silt or mud.

Silica - silicon dioxide occurring in quartz, opal, and sand, SiO_2.

SO_2 - sulfur dioxide.

Soda Ash - commercial anhydrous sodium oxide.

Sodium Carbonate - sodium salt of carbonic acid used in making soaps and chemicals, water softening, bleaching, and in photography.

Steam Stripping - air pollution technique to remove ammonia.

Strata - several distinct layers of homogeneous or gradational sedimentary material visually separable from other layers.

Stratigraphy - the study of the definition and description of major and minor natural divisions of rocks.

Sulfur - a nonmetallic element that is a constituent of proteins, is found free and combined in sulfides and sulfates; used in chemical and paper industries, in rubber vulcanization, and in medicine.

Toluene - liquid hydrocarbon produced commercially from light oils from coke-oven gas, coal tar, and petroleum and used as a solvent, $C_5H_5CH_3$.

Vanadate - a salt or ester of vanadic acid.

Viscosity - quality or state of being adhesive; of glutinous consistency; the capability possessed by a solid of yielding under stress.

Volatiles - substances readily vaporizable at a relatively low temperature.

Water Jacket - a cover that encloses space through which water circulates for temperature control.

Xylene - flammable toxic oily hydrocarbons obtained from wood tar, coal tar, or petroleum distillates, used chiefly as a solvent.