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EPA

Region V
230 South Dearborn
Chicago, IL 60604

February 1981

Environmental Impact Statement

Final

Rehabilitation of Wastewater Facilities Streator, Illinois

EPA-5-IL-LASALLE-STREATOR-WWTP AND CSO-1981

FINAL ENVIRONMENTAL IMPACT STATEMENT

REHABILITATION OF WASTEWATER FACILITIES

STREATOR, ILLINOIS

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V

CHICAGO, ILLINOIS

And

WAPORA, Incorporated
Chicago, Illinois

With

Law Engineering Testing
Company
Marietta, Georgia

FEBRUARY, 1981

Approved by:

John McGuire
Regional Administrator

SUMMARY SHEET

ENVIRONMENTAL IMPACT STATEMENT

REHABILITATION OF WASTEWATER FACILITIES

STREATOR, ILLINOIS

Draft ( )
Final (X)

United States
Environmental Protection Agency
Region V

Chicago, Illinois

1. Type of Action: Administrative (X)
Legislative ( )

2. Description of Action Proposed in the Facilities Plan

The action proposed in the draft Facilities Plan for the City of Streator, Illinois, includes sewer separation, and upgrading and expansion of the existing treatment plant. New sanitary sewers would be installed in the present service area and in adjacent areas. The existing combined sewer system would be rehabilitated for use as a storm sewer. The treatment plant would be expanded to accommodate a design average flow of 5.59 mgd and would be upgraded with the addition of tertiary treatment and chlorination. The effluent discharged to the Vermilion River would meet the requirements of the final NPDES permit (4 mg/l BOD_5 and 5 mg/l SS).

The Facilities Plan recommends investigating the need of a mine recharge system to maintain present water levels in the mines located beneath Streator. Recharge may be critical to minimize the potential for ground subsidence. If a mine recharge system were needed, the proposed system would recharge the mines with effluent from the treatment plant during dry-weather periods. During wet-weather periods, the mines would be recharged with stormwater via drop shafts in the existing collection system and via storm sewers installed in the presently sewered and unsewered areas.

Federal financing has been requested by the City of Streator under the statutory authority of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500) and the Clean Water Act Amendments of 1977 (Public Law 95-217). Streator's consulting engineers estimated the total project cost to be $52,334,840 at January 1975 price levels (Warren & Van Praag, Inc. 1975). The total capital cost was recalculated and was estimated to be $56,237,300 at January 1978 price levels.

3. Description of the EIS Proposed Action

The proposed action includes rehabilitation of the existing wastewater facilities at Streator, Illinois. The three major interceptor sewers in the combined sewer system would be replaced (Figure S-1). A Sewer System Evaluation Survey will be conducted to determine the extent of cost-effective rehabilitation of other segments of the collection system, including the amount of infiltration that needs to be controlled. The treatment plant would be upgraded to include nitrification and chlorination. It is assumed that the effluent discharged to the Vermilion River would meet acceptable effluent limitations (10 mg/l BOD_5 and 12 mg/l SS). Combined sewer flows in excess of the plant's capacity would receive primary treatment and chlorination prior to discharge to the River.

Additional "Step I" facilities planning will be required to confirm the cost-effectiveness of the EIS proposed action. Planning, for example, will be necessary to determine how to cost-effectively dispose of wastewater from areas adjacent to the existing sewer service area. The treatment plant's capacity would have to be expanded if sewers were extended and if present industrial discharges of process and cooling waters to the mines were not permitted to continue, and/or if the amount of infiltration remaining after cost-effective sewer system rehabilitation were significant. In addition, a cost-effectiveness analysis will have to be conducted to determine the volume of excess combined sewer flow that needs to be treated and on the required level of treatment.

The mines beneath Streator would be recharged with wastewater and stormwater to maintain present water levels in the mines. During dry-weather periods, the mines would be recharged with effluent from the treatment plant (Figure S-1). During wet-weather periods, the mines would be recharged with overflows from the combined sewer system and with stormwater from additional storm sewers in the presently sewered area. (A recharge option that needs to be considered during additional facilities planning involves continuous recharge of treated effluent, which would not require additional storm sewers and thus would result in considerable cost savings.)

The total capital cost of the EIS proposed action has been estimated to be $22,515,900 (at January 1978 price levels). Average annual operation and maintenance (O&M) costs have been estimated to be $316,300. The EIS proposed action alternative does not include costs for sludge treatment and disposal facilities. Also, costs to minimize subsidence damage to the collection system, including costs for slight changes in interceptor routes, light-weight sewer pipes, flexible joints, timber cradles, and concrete support (Section 5.2.2.1.) are not included. Seventy-five percent of the total capital cost will be eligible for Federal Construction Grant funds. The local costs will include 25% of the total capital cost and 100% of the O&M cost. The average annual local cost over a 20-year period has been estimated to be $833,077. Assuming a population of 12,700 in the sewer service area, the per capita cost will be approximately $66 per year. The additional, necessary cost-effectiveness analysis, however, may alter significantly project costs.

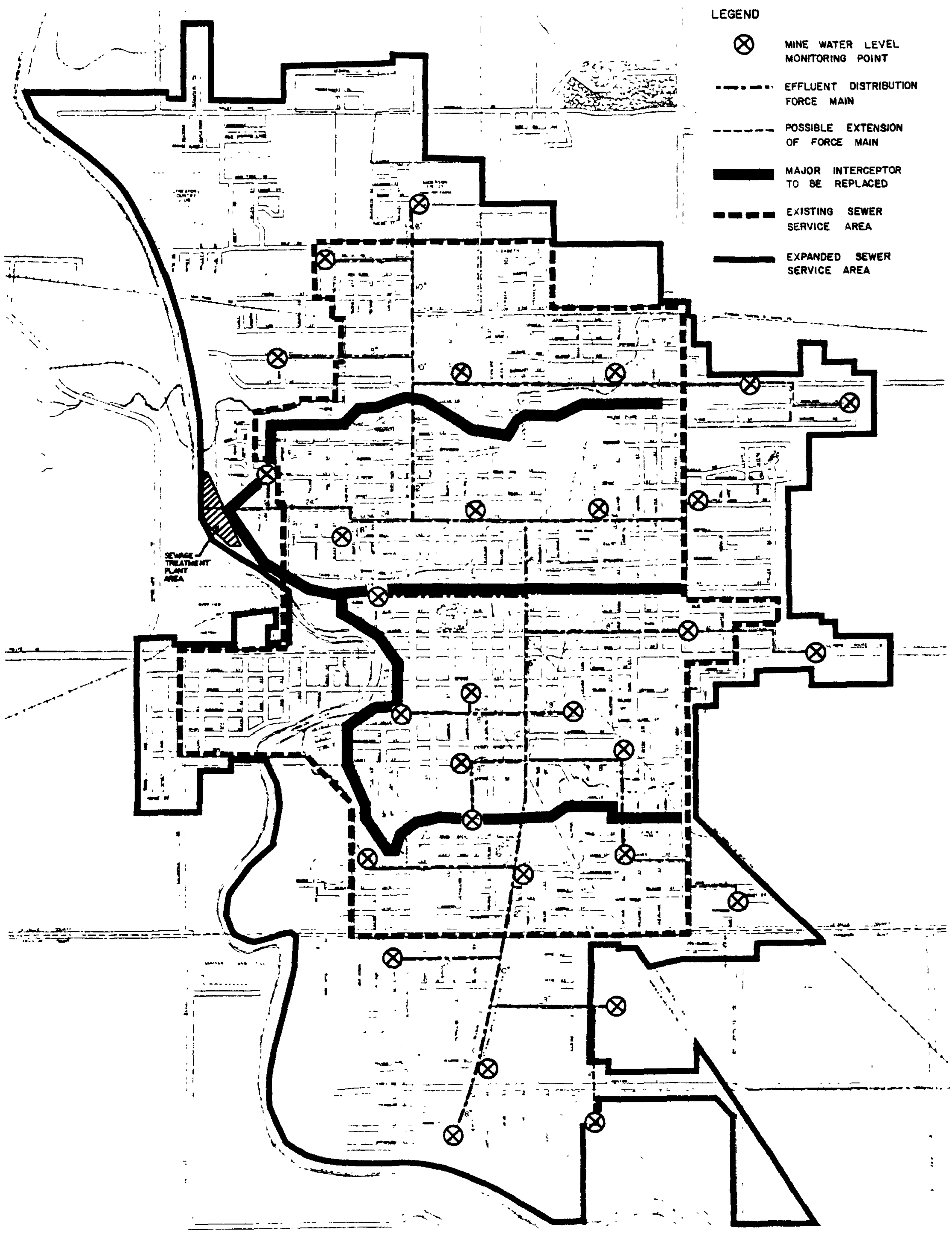

Figure S-1. Location of the major interceptors and the proposed effluent recharge system at Streator, Illinois.

4. Major Environmental Impacts of the EIS Proposed Action

The EIS proposed action would reduce substantially pollutant loads discharged to the Vermilion River from the Streator Facilities Planning Area. Water quality in the Area and downstream, therefore, should improve, especially during periods of low river flows. Combined sewer overflows and discharges from cracked and broken sewer lines would be reduced significantly. In addition, pollutant loads to the mine would be controlled, and thus, the quality of mine leachates would improve over time. All sanitary wastewater discharges to the mines would be eliminated. However, because the water levels in the mines would be maintained by artificial recharge if necessary, the potential for ground subsidence would not be increased.

Temporary construction impacts such as increases in noise and dust, traffic disruption, and erosion and sedimentation would occur along existing interceptor sewer routes and near storm sewer and recharge system construction sites. Measures, however, would be taken to minimize these impacts. Upgrading of existing treatment facilities would not result in any significant impacts. The WWTP site is relatively secluded, and the existing levee would prevent construction-related sedimentation. The manpower, material, energy, and land used in the rehabilitation and construction of facilities would be unavailable for other uses.

The population of the Streator Facilities Planning Area is stable and is not limited by the availability of wastewater facilities. The EIS proposed action, therefore, would not have any significant secondary impacts, such as induced development and economic growth. Secondary impacts would be primarily construction related and, thus, minimal and short-term.

5. Alternatives Considered in the EIS

Alternatives developed and considered included different options for wastewater and stormwater collection, treatment, and mine recharge. The collection options were 1) sewer separation, 2) rehabilitation of the existing combined sewer system, and 3) sewer extensions. The treatment options for the treatment plant influent were 1) tertiary treatment with filtration and chemical coagulation, 2) tertiary treatment without chemical coagulation, 3) upgraded secondary treatment with nitrification and chlorination, and 4) existing treatment with effluent discharge to the mines. Options to treat excess combined sewer flows (if the existing collection system were used to convey sanitary wastewater and storm water) were 1) primary treatment and chlorination, 2) storage, primary treatment, and chlorination, and 3) storage and mine discharge. Options for mine recharge were 1) re-charge of treatment plant effluent during dry-weather periods and discharges from the existing collection system and additional storm sewers and 2) continuous effluent recharge and discharges from the existing collection system.

6. Federal, State, and Local Agencies and Organizations Notified of this Action

FEDERAL

Hon. Charles H. Percy, US Senate
Hon. Alan Dixon, US Senate

Hon. Thomas J. Corcoran, US House of Representatives
Council on Environmental Quality
US Environmental Protection Agency
  Region I
  Region II
  Region III
  Region IV
  Region V
  Region VI
  Region VII
  Region VIII
  Region IX
  Region X
  Facilities Requirement Branch
  Environmental Evaluation Branch
  Office of Public Affairs
  Public Information Reference Unit
  Office of Federal Activities
  Office of Legislature Department of Agriculture Department of Commerce
Department of Defense
  US Army Corps of Engineers, North Central Division
    Chicago District Department of Health, Education and Welfare
  Region V
Department of Housing and Urban Development
Department of the Interior
Department of Labor
Department of Transportation
  Region V
Advisory Council on Historic Preservation
Water Resources Council

STATE

Office of the Governor
Department of Agriculture
  Bureau of Soil & Water Conservation
Department of Business and Economic
Development Department of Conservation
  Division of Long Range Planning
  Office of Preservation Services
Department of Mines & Minerals
Department of Public Health
Department of Transportation
Illinois Bureau of Environmental Sciences
Illinois Environmental Protection Agency
  Planning and Standards Section
  Region 1
Illinois Natural History Survey
Illinois State Clearinghouse
Illinois State Geological Survey
Illinois State Water Survey
Illinois Water Resources Commission

LOCAL

La Salle County Regional Planning Commission
Livingston County Board of Supervisors
City of Streator
City of Ottawa
City of Pontiac
City of LaSalle
Village of Kangley
Village of Cornell

ORGANIZATIONS

Illinois Institute for Environmental Quality
American Water Resources Association
Citizens For A Better Environment
Coalition On American Rivers
Illinois Division of Izaak Walton League
Lake Michigan Federation
National Audubon Society
National Wildlife Federation
Sierra Club
American Water Works Association
Streator Public Library
Illinois State Library
Illinois Institute of Technology, Kemper Library
University of Illinois Library (Urbana)

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BOD_5	5-Day Biochemical Oxygen Demand
cfs	cubic feet per second
CO	Carbon Monoxide
DO	Dissolved Oxygen
FPA	Facilities Planning Area
EIS	Environmental Impact Statement
HC	Hydrocarbon
IEPA	Illinois Environmental Protection Agency
I/I	Infiltration/Inflow
IPCB	Illinois Pollution Control Board
mgd	million gallons per day
mg/l	milligrams per liter
ml	milliliter(s)
msl	mean sea level
NH_3-N	Ammonia-Nitrogen
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen Oxides
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
ppm	parts per million
SO_2	Sulfur Dioxide
SS	Suspended Solids
µg/l	micrograms per liter
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1.0. INTRODUCTION

The City of Streator, Illinois, submitted a draft "Step I Facilities Plan" to the State of Illinois in 1975 that proposed improvements and expansion of existing wastewater facilities. The Plan, entitled Comprehensive Sewerage and Drainage Report, was prepared for the City by Warren & Van Praag, Inc. (1975). It was used to apply for funding under the State and Federal Municipal Wastewater Treatment Works Construction Grants programs. The Illinois Environmental Protection Agency (IEPA) certified Streator's "Step I" grant application in March 1975, and the US Environmental Protection Agency (USEPA), Region V, awarded the City the "Step I" grant in June 1975. In October 1975, IEPA forwarded the draft Plan to USEPA, Region V, before IEPA's certification of the Plan, because it had identified project-related issues that warranted an Environmental Impact Statement (EIS).

The National Environmental Policy Act of 1969 (NEPA) requires a Federal agency to prepare an EIS on "...major Federal actions significantly affecting the quality of the human environment ..." In addition, USEPA published Regulations (40CFR Part 6) to guide its determination of whether Federal funds, which it commits through the Construction Grants Program, would result in a project significantly affecting the environment. Pursuant to these regulations and subsequent guidelines, USEPA, Region V, determined that an EIS would have to be prepared on the proposed project at Streator, Illinois, before a grant for design ("Step II") and construction ("Step III") could be approved.

1.1. Background

The City of Streator is located in La Salle and Livingston Counties in north-central Illinois (Figure 1-1). The City presently is served by a combined sewer system. Developed areas immediately beyond the city limits are without sewers. The existing wastewater treatment plant is an activated sludge plant designed to provide secondary treatment to produce an effluent of 20 mg/l BOD and 25 mg/l suspended solids (SS). Treatment facilities will have to be upgraded to achieve more stringent effluent requirements. The plant's current, final National Pollutant Discharge Elimination System (NPDES) permit (IL 0022004), which was issued in December 1974 and reissued in October 1978, requires an effluent quality of 4 mg/l BOD_5, 5 mg/l, SS, 1.5 mg/l NH_3-N, and fecal coliform counts not larger than 200 per 100 milliters (30-day average).

The City of Streator is situated over abandoned coal mines. Ground surface subsidence has occurred, but it has been limited because the abandoned mines are flooded. Presently, wet-weather combined sewer overflows, some dry-weather flows, and a large percentage of the industrial wastewater flows are discharged to the underlying mines and maintain the flooded condition. These flows enter the mines via drop shafts in the sewers and in areas where there are no sewers.

Discharges of untreated wastewater and/or of combined sewer flows to the mines are prohibited by State regulations. Flows from the mines (leachates) to surface waters also could have adverse effects on water quality and could cause violations of stream water quality standards. Other discharges that should be controlled, but presently occur, include

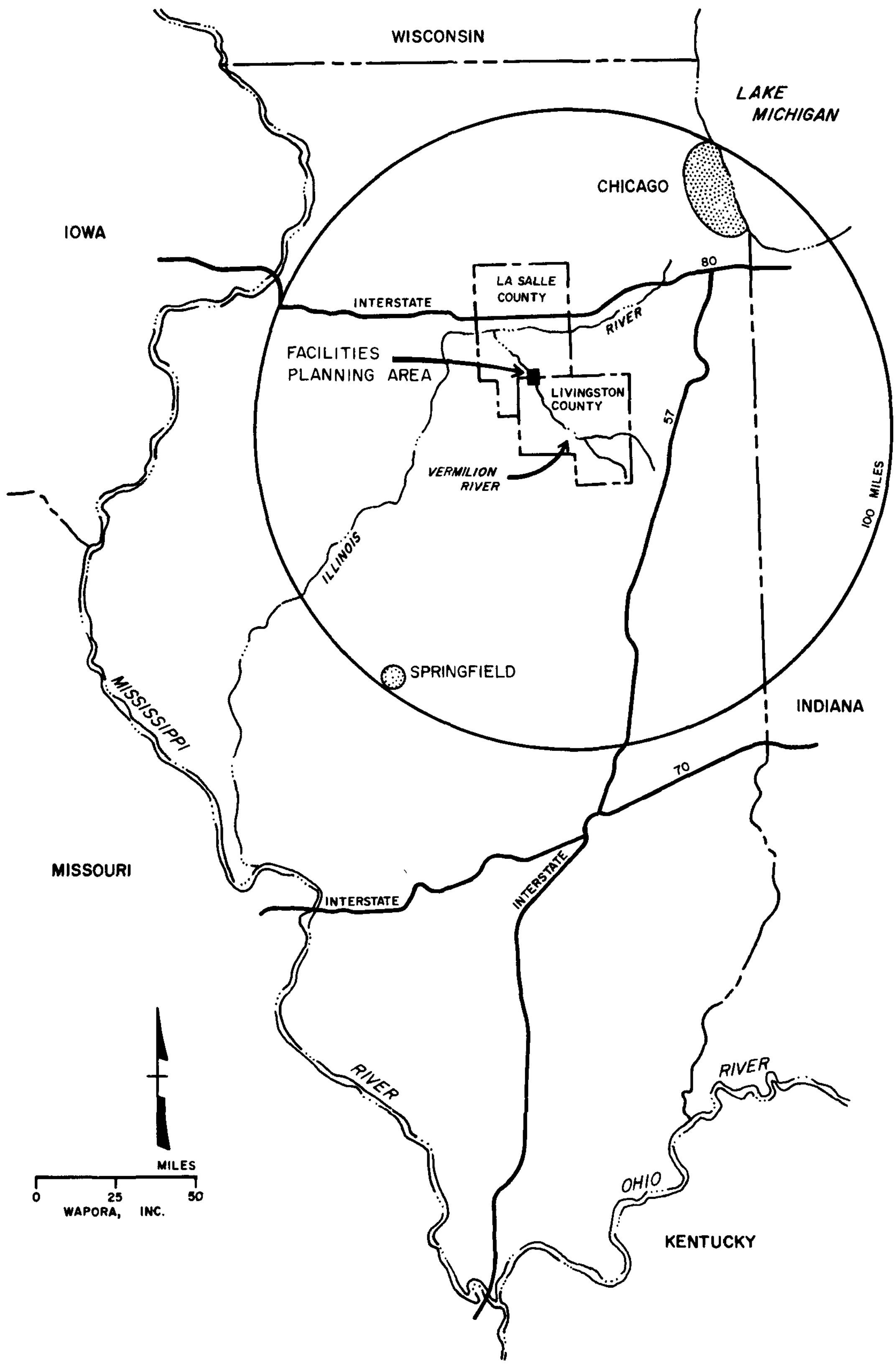


Figure 1-1. The location of the Streator Facilities Planning Area in the State of Illinois.

discharges of untreated combined sewer overflows to surface waters and discharges from broken and cracked sewer lines to surface waters.

1.2. Action Proposed in the Facilities Plan

The draft Facilities Plan for Streator, Illinois, was developed to comply with current Federal and State regulations and to provide sewerage for an expanded service area and for future growth. Sewer separation, upgrading and expansion of the treatment plant, and the discharge of treated wastewater and untreated stormwater to the abandoned mines beneath the City were proposed. Fifty-three miles of new sanitary sewers would be installed in the present service area. The existing combined sewer system would be rehabilitated for use as a storm sewer. New sanitary sewers would be built in areas outside the present service area. The treatment plant would be expanded to accommodate a design average flow of 5.59 mgd and would be upgraded with the addition of tertiary treatment and chlorination.

Sewer separation and extension of sewers would eliminate the discharge of sanitary and combined sewage to the mines. However, to maintain water levels in the mines, the installation of some additional storm sewers in the presently sewered area was proposed. These sewers would not only collect stormwater runoff, but they also would collect flows from downspouts and footing drains. This would ensure that a maximum amount of stormwater would be discharged to the mines and that there would be sufficient stormwater capacity in the existing system. Stormwater also would be discharged to the mines via drop shafts in the existing system. Storm sewers would be built in presently unsewered areas to discharge stormwater runoff to the mines where sanitary wastewaters are discharged presently.

In addition, the possibility of a mine recharge system to pump wastewater treatment plant effluent to the mines was considered in the Facilities Plan. Such a system may be necessary because storm sewers might not discharge the required amount of water to the mines frequently enough due to the uneven distribution of rainfall throughout the year. If required, a pump station and distribution lines would be necessary to supplement the water in the mines during dry-weather periods. Presently, there are few data available on water levels in the mines and on how they fluctuate. A monitoring system was proposed to determine if a recharge system is needed and where it should be installed if needed.

Streator's consulting engineers estimated the total project cost to be $52,334,840 at January 1975 price levels (Warren & Van Praag, Inc. 1975). The total capital cost was recalculated by WAPORA, Inc., and was estimated to be $56,237,300 at January 1978 price levels.

1.3. EIS-Related Issues

USEPA, upon review of the draft Facilities Plan, concurred with IEPA that the proposed project has the potential for significant environmental impacts and that an EIS was warranted. On 9 March 1976, USEPA, Region V, issued a Notice of Intent to prepare an EIS on the proposed Streator wastewater facilities. Specifically, the Agency's concerns were related to the following issues:

- Injection of treated or untreated wastewater into the mines beneath Streator and the possible adverse impacts of mine leachates on the water quality of the Vermilion River

- The need for consideration of additional alternatives to retard mine subsidence other than injection of treated or untreated wastewater into the mines

- The need for additional study related to whether discharges to the mines are actually preventing subsidence and what effect not pumping wastewater into the mines would have on subsidence

- The effect of subsidence on the project life of the present sewer system or a new sewer system

- The project's potential for stimulating development over the mines and increasing the potential for subsidence

- The cost-effectiveness of including the Village of Kangley in the facilities planning area

- The high per capita cost of constructing the proposed project.

Based on the determination to prepare an EIS, USEPA, Region V, obtained the assistance of a consultant, WAPORA, Inc., to collect information on environmental conditions, to consider alternatives to the proposed action, and to evaluate the impacts of the various alternatives. The EIS study area (Figure 1-2) is much larger than the facilities planning area considered by Warren & Van Praag, Inc. (1975).

1.4. The Study Process

The bulk of the work on the preparation of the Draft EIS occurred between August 1977 and September 1978. During that period, WAPORA submitted various interim reports to USEPA, including "Existing Environmental Conditions of the Streator Facilities Planning Area" and "Alternatives for the City of Streator Wastewater Facilities."

Public meetings, sponsored by USEPA, were held at Streator to facilitate public involvement during the preparation of the EIS:

Date	Subject
3 October 1977	The Study Process and EIS-Related Issues
17 April 1978	Significant Environmental Factors and System Alternatives
27 July 1978	The Alternative Selection Process

Four informational newsletters also were prepared during the study period and were mailed to persons who expressed interest in the project. Several interviews were held with the staff of the local newspaper (The

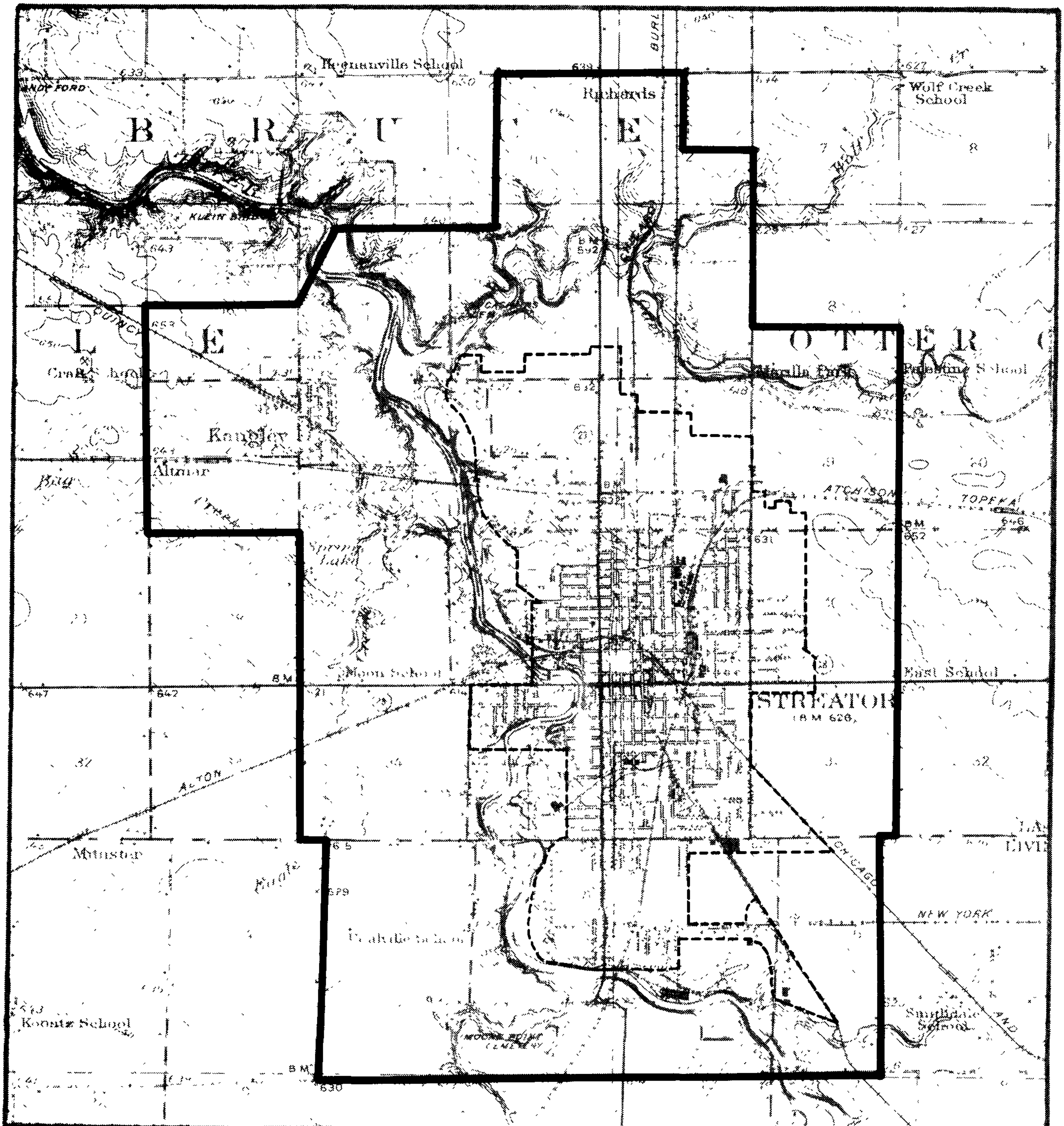
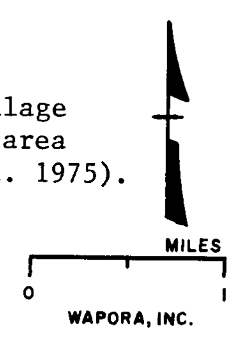


Figure 1-2. The Streator Facilities Planning Area, including the Village of Kangley, Illinois. The previous facilities planning area is indicated by the dotted line (Warren & Van Praag, Inc. 1975).



Streator Times Press) and the local radio station (WIZZ-AM). One radio interview was broadcast in September 1978.

Many issues relevant to the preparation of the EIS on the Streator wastewater facilities were addressed in the reports and newsletters and during public presentations and interviews. In addition to those concerns listed in the USEPA Notice of Intent, the following issues were considered during the EIS process:

- Determination of the most cost-effective alternative to meet project objectives, including identification of areas that contribute to the water quality problem and the cost-effective level of treatment
- The need to treat all flows that cause the water quality problem
- The potential for groundwater contamination from the injection of treated or untreated wastewater into the mines
- The time needed for the quality of mine leachates to improve if sanitary and/or industrial wastewaters were no longer discharged to the mines
- Development of information on the present condition of the mines (e.g. inflow and outflow, direction of flows, mine water levels, pressures, etc.) that is needed to develop water pollution control alternatives that do not increase the potential for subsidence
- Determination of the present condition of Streator's combined sewer system as accurately as necessary to identify its potential use
- The accuracy of the population projections presented in the draft Facilities Plan
- Collection of sufficient information to predict accurately the impacts of various alternatives developed in the facilities planning process and in the preparation of the EIS
- Determination of the costs related to water pollution control, stormwater control, and subsidence control
- Identification of potential mitigative measures to control adverse impacts that could result from the project.

The Draft EIS was published in August 1979. A 45-day comment period ended in early November 1979, pursuant to NEPA and USEPA regulations (40 CFR Part 6). A public hearing on the Draft EIS was held on 29 October 1979 at the Streator City Countil Chambers. The major issues and concerns expressed at the hearing and in letters received during the comment period are discussed in Section 2.0. Copies of the transcript of the hearing are available for reference at IEPA in Springfield, at the Streator Public Library, and at USEPA, Region V, in Chicago. The Record of Decision will be mailed 30 days after the Final EIS is published to those who receive the EIS and to others who request it.

2.0. RESPONSES TO COMMENTS ON DRAFT EIS

There were several comments on the Draft EIS, which were received by mail or expressed at the public hearing. Responses to these comments are presented below. Copies of the letters received are included in Appendix A.

2.1. Correspondence from Federal and State Agencies

Soil Conservation Service, US Department of Agriculture (25 September 1979)

Impacts on prime farmland: comment noted.

Public Health Service, Department of Health, Education and Welfare (22 October 1979)

1. Impacts on the subsidence potential:

    All of the wastewater management alternatives developed for Streator include mine recharge so that the potential for subsidence would not increase. The EIS investigations confirmed that the best method of not increasing the subsidence potential is to maintain present water levels in the mines (Appendix B). The inundated mines should never be allowed to drain, because air entering the mines would cause drying and subsequent deterioration of the pillars and any wooden roof support system. One of the major EIS recommendations is to characterize the hydrology of the mines to determine the extent of mine recharge necessary to maintain water levels (Section 8.3.).

    Subsidence at Streator cannot be permanently controlled cost-effectively. Measures, however, can be taken to minimize the potential for damage to new interceptors, storm sewers, and the recharge system from possible future subsidence (Section 7.3.1.).

    Wastewater management alternatives would not determine the extent and location of future residential, commercial, or industrial development. None of the alternatives, therefore, would affect the potential for subsidence related to future development (Section 6.9.).

2. Discharges to the mines:

    The State would have to approve all proposed discharges to the mines, including combined sewer flows, stormwater, and treated effluent. Some industrial process and cooling waters may be allowed to be discharged to the mines; appropriate permits would have to be obtained from State agencies. The industries would have to provide water quality data to obtain the permits; no data are available at this time to describe the quality of industrial wastewaters currently being discharged to the mines.

    All sanitary wastewater discharges to the mines would be eliminated. In addition, drop shafts in the existing sewer system that are found to be level with the bottom of sewers or manholes would be raised, if possible, to prevent the discharge of dry-weather flows to the mines. Not all of these drop shafts would be located.

3. Impacts on groundwater:

   The alternatives would not adversely affect groundwater resources. The water quality in the mines may improve, and thus, the public health risks related to contaminated groundwater may be reduced (Section 6.3.2.).

United States Department of the Interior (22 October 1979)

1. Impacts on floodplains and wetlands:

   Construction activities would destroy some floodplain habitat, but the impacts generally would be insignificant and/or short-term if mitigative measures were used (Sections 6.2.2., 6.2.3. and 7.3). No wetlands are located in the study area; thus, none would be affected.

   The alternatives would not affect the floodway of the Vermilion River. The site of the existing treatment facilities is not located in the floodway; a levee was constructed to protect it from flooding. The site for the facilities to treat excess combined sewer flows would not be located in the floodway.

2. Impacts on archaeological resources:

   Coordination with Illinois Department of Conservation has been initiated to avoid impacts on cultural resources. Coordination will have to continue during additional facilities planning.

3. Impacts on recreational resources:

   Improved water quality resulting from reduced wasteloads to the Vermilion River may cause recreational use of the river segment downstream from the wastewater treatment plant and Prairie Creek to increase (Section 6.3.1.5.).

   Replacement of interceptors, sewer system rehabilitation, and construction of the mine recharge system may have adverse impacts on parks and other recreation areas. The impacts would depend on the final routes of the interceptors and the mine recharge distribution lines, which would be determined during additional facilities planning. Recreational resources that will be affected and appropriate mitigative measures should be identified by the facilities planners.

4. Impacts of subsidence:

   Subsidence may have created fissures that would allow mine waters to migrate more easily to water-bearing units locally tapped by wells and to surface waters. The alternatives, however, would reduce pollutant loads discharged to the mines, and the water quality in the mines may improve, which would reduce the public health risks.

The alternatives would include stations to record water levels in the mines; these stations would be monitored continuously. Any significant changes in water levels caused by fissures, therefore, would be noticed, and additional recharge could be provided, or other subsidence control measures could be implemented.

Federal Highway Administration, US Department of Transportation (31 October 1979)

Impacts on transportation facilities: comment noted.

Illinois Department of Conservation (14 and 27 September 1979)

Impacts on cultural resources: comments noted.

2.2. Correspondence from Individuals

Unsigned (3 October 1979)

Impacts of costs to homeowners:

The local share of the cost for the proposed action would impose a financial burden on some Streator homeowners, especially those that are on fixed incomes. Based on available income data, however, the proposed action would not be considered a high-cost project (Section 6.5.4.4.) and would be financially feasible (Section 7.2.). USEPA would not force the City of Streator to construct the proposed project. The City could meet State and Federal pollution control requirements by some other means, although the City would not be eligible for a grant under the Construction Grants Program.

Lawrence Benner (30 October 1979)

Impacts from areas upstream from Streator: comment noted.

Irate citizen (November 1979)

1. Need for action:

The City of Streator is not in compliance with State and Federal regulations. Untreated combined sewer overflows and flows from cracked and broken sewer lines are entering area streams. Sanitary wastewaters also are being discharged to the mines, and the effluent from the treatment facilities is not meeting the effluent limits of the final NPDES permit. In addition, some of the elements of the wastewater collection and treatment system are old and deteriorated; they need to be either rehabilitated or replaced. The average life of treatment facilities is 20 years.

2. Ability to pay the local share:

Refer to Sections 6.5.4.4. and 7.2.

3. Areas adjacent to the present service area:

Discharges of sanitary wastewater to the mines from areas adjacent to the present service area must be eliminated. The facilities planners will have to determine if it would be cost-effective to extend sewers into these areas.

2.3. Comments at the Public Hearing

Mayor Theodore Bakalar

1. Compliance with State and Federal laws and regulations: comment noted.

2. State approval of proposed mine discharges: comment noted.

3. Request for a 100% project grant: comment noted.

4. Financial burden on the people of Streator: comment noted.

Edward Nowotarski

1. Justification of costs:

Wastewater-related problems extend beyond the operation of the existing treatment facilities; refer to response #1 to irate citizen's letter.

2. Request for a 100% project grant: comment noted.

James Lynch

1. Equitable payment of local share:

How and who pays the local share of the project costs is a local issue. The mechanism to finance the local share will be determined by the City and its consulting engineers, the facilities planners.

2. Cost-effectiveness:

The EIS proposed action was selected as the most cost-effective alternative. It is the least expensive alternative that would comply with State and Federal regulations and that could be implemented.

The selection, however, was based on some limited data and on some assumptions that need to be resolved. During additional facilities planning, data gaps will be filled, assumptions will be verified, and the actual extent of the project will be determined. The local share of the project cost could be significantly different.

Herman Engle

Project costs: comment noted.

Mr. Dell

Project costs: comment noted.

James Leinike (IEPA)

Concurrence with the findings of the EIS and its recommendations: comments noted.

David Tulp (Warren & Van Praag, Inc., the City's Facilities Planners)

1. Planning area: comment noted.

2. Population projections: comment noted.

3. Plant design for dry-weather flows:

   IEPA indicated during the preparation of the Draft EIS that it was reasonable to proceed with the EIS using effluent limitations of 10 mg/l BOD_5 and 12 mg/l SS (By letter, Mr. Roger A. Kanerva, IEPA, to Mr. Charles Sutfin, USEPA, 18 July 1978). In addition, IEPA indicated that discharges to the mines should meet the same requirement as discharges to surface waters. Therefore, all alternatives that included secondary treatment prior to mine recharge were eliminated in the Draft EIS (Section 7.1.2.2.).

4. Plant design for wet-weather flows:

   IEPA indicated that the combined sewer program recommended in the EIS is quite acceptable to the State, as it provides for compliance with their Chapter 3, Rule 602(c) (By letter, Mr. Roger A. Kanerva, IEPA, to Mr. Charles Sutfin, USEPA, 18 July 1978). IEPA did not make any reference to the Technical Advisory TA-3 in that letter.

   The facilities planners should evaluate wet-weather flows in accordance with TA-3 during additional facilities planning. The need for additional treatment capacity as well as additional sewers should be determined.

5. Alternative treatment processes:

   It was assumed in the EIS that the effluent limitations of 10 mg/l BOD_5/and 12 mg/l SS could be met by upgraded secondary treatment, because no data on influent wastewater strength were available. This assumption should be verified by additional facilities planning.

   The influent should be analyzed after the combined sewer system is rehabilitated and during dry-weather and wet-weather flow conditions.

Treatment must be sufficient to meet effluent limitations during worst conditions.

The method of nitrification included in the EIS alternatives has been changed. Nitrification would be provided by using a single-stage activated sludge process that would be accomplished by the addition of aeration tank capacity, final clarifier capacity, and aeration blower capacity to the existing activated sludge units (Section 5.2.3.2.). The costs for the additional units have been added to the costs of the applicable alternatives (Section 5.4. and Appendix D). A cost-effectiveness analysis should be performed during additional facilities planning among different methods of nitrification to determine if any cost-savings can be realized.

6. Treatment plant design flows:

The actual design flow should be determined during additional facilities planning. The design flow would have to be expanded if sewers were extended, and if present industrial discharges of process and cooling waters to the mines were not permitted to continue and/or if the amount of infiltration remaining after cost-effective sewer system rehabilitation were significant. However, it may not be cost-effective to extend sewers outside the City limits, and some industrial discharges to the mines may be allowed (By letter, Mr. Roger A. Kanerva, IEPA, to Mr. Charles Sutfin, USEPA, 18 July 1978). The design flows in the EIS alternatives include design infiltration (200 gallons per inch of sewer diameter per mile of sewer per day; 0.101 mgd).

7. Storm drainage:

A complete sewer system evaluation survey is one of the recommendations of the EIS. Storm drainage for the area should be evaluated further during additional facilities planning.

8. Cost estimates:

The layouts used in the EIS were the ones presented in the draft Facilities Plan (Warren & Van Praag, Inc. 1975).

9. Cost-effective analysis:

During additional facilities planning, the specific requirements of PRM 75-34 (also referred to as PG-61; USEPA 1975b) should be fulfilled. A cost-effectiveness analysis on the volume of excess combined sewer flow that needs to be treated and on the required level of treatment needs to be conducted.

<u>John Pedelty</u>

Cost assumptions:

The intent of this EIS was to resolve specific issues, not to develop detailed alternative costs (Section 1.3.). Detailed costs will be developed during additional facilities planning.

John Fornof

1. Need for action:

   Refer to response #1 to irate citizen's letter.

2. Ability to pay local share:

   Based on available information, the proposed action would not be considered a high-cost project (Section 6.5.4.4.) and would be financially feasible (Section 7.2.). The detailed costs, including costs to homeowners and industries, will be determined during additional facilities planning.

3. Extent of project:

   It will be determined during additional facilities planning if it would be cost-effective to extend sewers to areas outside the City limits. However, discharges of sanitary wastewater to the mines from these areas will not be permitted by the State. If sewers were extended, the users of the system residing outside the City limits also would pay for sewer service.

4. Impacts of heavy rains on the potential for ground subsidence:

   The areas most susceptible to subsidence are those where thin roof rock and thin glacial overburden exist (Appendix B). Heavy rains increase the potential for ground subsidence in these areas. The overburden becomes saturated and heavy and susceptible to erosion from water flow in the mines. If the mines were not flooded, the potential for subsidence during heavy rains would be greater, because there would be no water to provide support.

Mrs. Edward Hozie

Cost to homeowners:

Refer to response #2 to Mr. Fornof's comments.

Richard Conners

1. Need for action:

   Refer to response #1 to irate citizen's letter.

2. Need for mine recharge:

   In order to not increase the potential for ground subsidence, it is necessary to maintain present water levels in the mines. Therefore, because some discharges to the mines would be eliminated, a mine recharge system may be required (Section 5.2.4.).

3. Condition of the existing combined sewer system:

The three major east-west interceptors are old and in poor condition, and other segments of the sewer system need rehabilitation (Section 4.1.).

4. Ability to pay local share of project costs:

Refer to response #2 to Mr. Fornof's comments.

<u>John Butterly</u>

Impact of homeowner costs on residents on fixed incomes:

Comments noted.

<u>Edward Wyand</u>

Extent of project:

Refer to response #3 to Mr. Fornof's comments.

3.0. THE ENVIRONMENTAL SETTING

3.1. Atmosphere

3.1.1. Meteorology

Streator has a continental-type climate. Thus, it experiences a large annual temperature range and frequent temperature fluctuations over a short period of time. The average annual precipitation is approximately 35 inches. Detailed data on other relevant meteorological conditions, such as wind direction, mixing layer heights, and precipitation, are available in the Draft EIS, Section 2.1.1. and Appendix H.

3.1.2. Air Quality

Although there are no air quality monitoring stations in Streator, data from nearby stations indicate that there are no significant air quality problems in the Streator FPA. Particulate and oxidant levels may be high at times but not because of point-source emissions in the area. Air quality data from nearby monitoring stations, air quality standards, and the principal sources of atmospheric emissions in the Streator FPA are presented in the Draft EIS (Section 2.1.2., Appendix A, and Appendix H).

There are no significant odor problems in the Streator study area. The area is predominantly agricultural, and there are no significant industrial sources. The existing sewage treatment plant is not known to pose any significant odor problem (By telephone, Mr. Richard Goff, IEPA, Division of Air Pollution Control, Region I, to David Bush, WAPORA, Inc., December 1977). This was confirmed by field investigations during 1977.

3.1.3. Sound

Sound levels in Streator were measured and were found to be typical of those found in small cities. The principal sources are automobile, truck, and railroad traffic. Sound levels created by traffic are not subject to the State noise regulations (IPCB 1973). The principal sound sources near the wastewater treatment plant are the plant and the wind. Sound levels at this location are relatively uniform throughout a 24-hour period and are in accordance with the Illinois regulations.

3.2. Land

3.2.1. Geology and Soils

The Streator FPA lies within the Illinois Basin, a structural and depositional basin that extends into Kentucky, Tennessee, and Indiana. Paleozoic rocks overlie a Precambrian basement complex of igneous rocks (Willman and others 1975). The bedrock surface (the uppermost surface of the Paleozoic sequence) consists of Pennsylvanian rocks that generally are covered by glacial drift of Wisconsinan age (Willman and Payne 1942). The topography of the Streator FPA is characterized by gently rolling plains dissected by the valleys of the Vermilion River and several of its tributaries. The geology and soils of the area are described in Appendix B, as well as in Sections 2.2.2. and 2.2.3. of the Draft EIS.

3.2.1.1. Coal Mining

Streator is in the oldest mining district of the State. Coal mining in the area began in the 1860s, reached its peak in the 1890s, and began to decline around 1900. The majority of the mines were abandoned between 1885 and 1917. Some mining activity occurred during the economic depression of the early 1930s.

The two workable coal seams in the area, Herrin No. 6 and La Salle No. 2, were mined extensively. Mine maps (Renz) indicate that the room and pillar method of mining was used and that extraction ratios often exceeded 50%. In the 1930s, many of the abandoned mines were pumped dry and pillars were robbed. There is evidence that the mines may be interconnected partially. The condition of the abandoned mines is discussed in greater detail in Appendix B.

3.2.1.2. Subsidence Potential

There have been numerous accounts of subsidence associated with coal mining in the Streator study area since the initiation of mining. Evidence of subsidence varies from gentle distortions that have cracked plaster and jammed doors and windows to large potholes along streets that have affected as many as three houses. Investigations indicate that the potential for subsidence still exists and appears to be greatest in areas where the mine roof rock and/or the glacial overburden are thin (Appendix B).

The existing water levels in the mines, maintained by stormwater and wastewater discharges, partially support the overlying rock and soil mass. If water levels were to decrease significantly, stresses within the roof rock units would increase and would increase the load carried by the roof, pillars, and floor. Therefore, the subsidence potential could be increased by changing present stormwater/wastewater management practices (Appendix B).

3.2.2. Terrestrial Biota

The Streator FPA consists predominantly of agricultural and urban land uses. There are few remnants of the original vegetation that characterized the geographic region (the Grand Prairie Division) in which Streator is located. Patches of prairie vegetation may be found along railroads and in cemeteries. Examples of previous forest types occur in parks, older residential areas, and along streams. The wildlife in the area, therefore, is limited. The vegetation and wildlife in the Streator FPA are described in Sections 2.2.4. and 2.2.5. of the Draft EIS.

No areas in the Streator FPA have been recognized as "natural areas" during an inventory conducted by the Illinois Department of Conservation and the Nature Preserves Commission (By letter, Mr. Robert Schanzle, Illinois Department of Conservation, to Mr. Gerard Kelly, WAPORA, Inc., 12 December 1977). No plant species extant in this area is known to be endangered or threatened (By telephone, Mr. Charles Sheviak, Illinois Nature Preserves Commission, to Mr. Gerard Kelly, WAPORA, Inc., 10 December 1977). There also are no known species of mammals, birds, reptiles, or amphibians in the Streator FPA currently listed as endangered or threatened at the Federal or State levels (By telephone, Mr. Vernon Kleen, Illinois Department of Conservation, to Mr. Gerard Kelly, WAPORA, Inc., 10 December 1977).

3.3. Water

3.3.1. Surface Water

The Vermilion River Basin includes 1,380 square miles (883,200 acres) and encompasses most of Livingston and La Salle Counties and parts of Marshall, Woodford, McLean, Ford, and Iroquois Counties. The main stem of the Vermilion River rises in Ford County as a drainage ditch and flows northwesterly on a 110-mile course to its confluence with the Illinois River near La Salle-Peru. The Illinois River and its major tributaries, including the Vermilion River, are shown in Figure 3-1. The City of Streator is located on the lower Vermilion River, approximately 25 miles upstream from the mouth of the river.

The characteristics of the Vermilion River change considerably along its course. The upper reaches of the river and its tributaries have been dredged or channelized. Downstream from Pontiac, the scenic character of the middle reach of the river is much improved, but the flow remains slow-moving and the streambed consists mostly of mud. Downstream from Streator, however, the stream gradient is much steeper, causing the flow velocity to increase. The lower reach of the river exhibits numerous riffles and small rapids, and the river bottom is mostly gravel. Bluffs in this reach tower above the river as high as 80 to 100 feet, and the banks are forested. The segment of the river between Streator and Oglesby has been nominated for inclusion as a scenic stream in recent legislative proposals.

There are six minor tributaries that join the Vermilion River in the Streator FPA (Figure 3-2). Most of the urban area is drained by Prairie Creek and Coal Run. Otter Creek, the largest of these tributaries (11 miles in length), has a relatively steep stream gradient of 16.8 feet per mile and joins the main stem from the east, downstream from Streator.

A dam has been constructed on the river just south of Streator near the southern boundary of the FPA. The dam regulates flow and creates a storage pool on the main stem that is the source of potable water for the City.

3.3.1.1. Hydraulics of the Vermilion River

The flow of the Vermilion River is measured on a continuing basis by the US Geological Survey at two locations. One of the gaging stations is situated approximately 30 miles upstream from Streator at Pontiac (Gage No. 5-5545) and has a 34-year period of record. The other gage is 8 miles downstream from Streator (Gage No. 5-5555), near Leonore, and has a 45-year period of record. A summary of the records from the two stations is presented in Table 3-1.

The drainage area upstream from the Leonore gage is 1,251 square miles, compared with a drainage area of 1,093 square miles upstream from

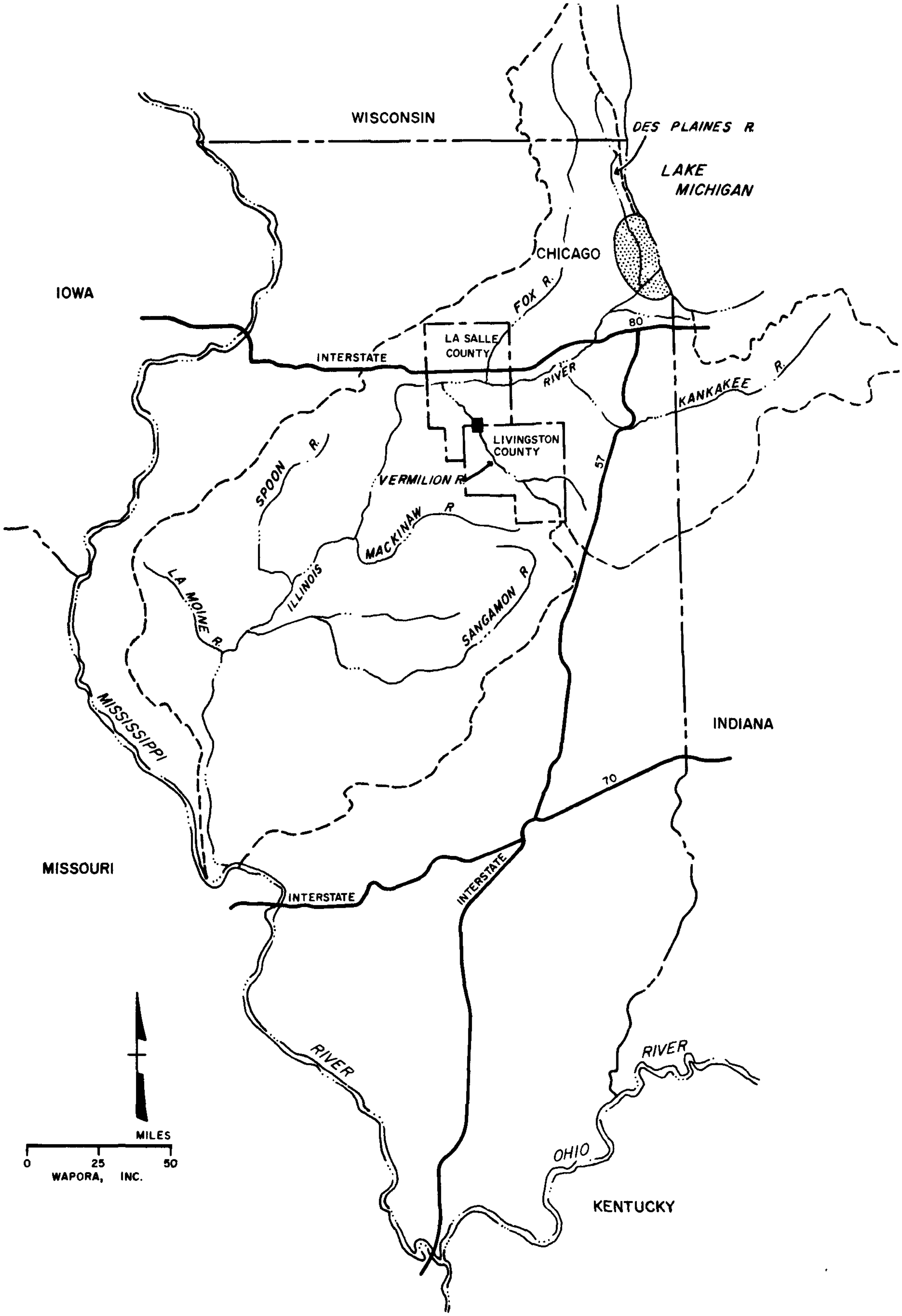


Figure 3-1. The Illinois River Basin (outlined by the dashed line). The Vermilion River flows to the northwest through Livingston and La Salle Counties, Illinois.

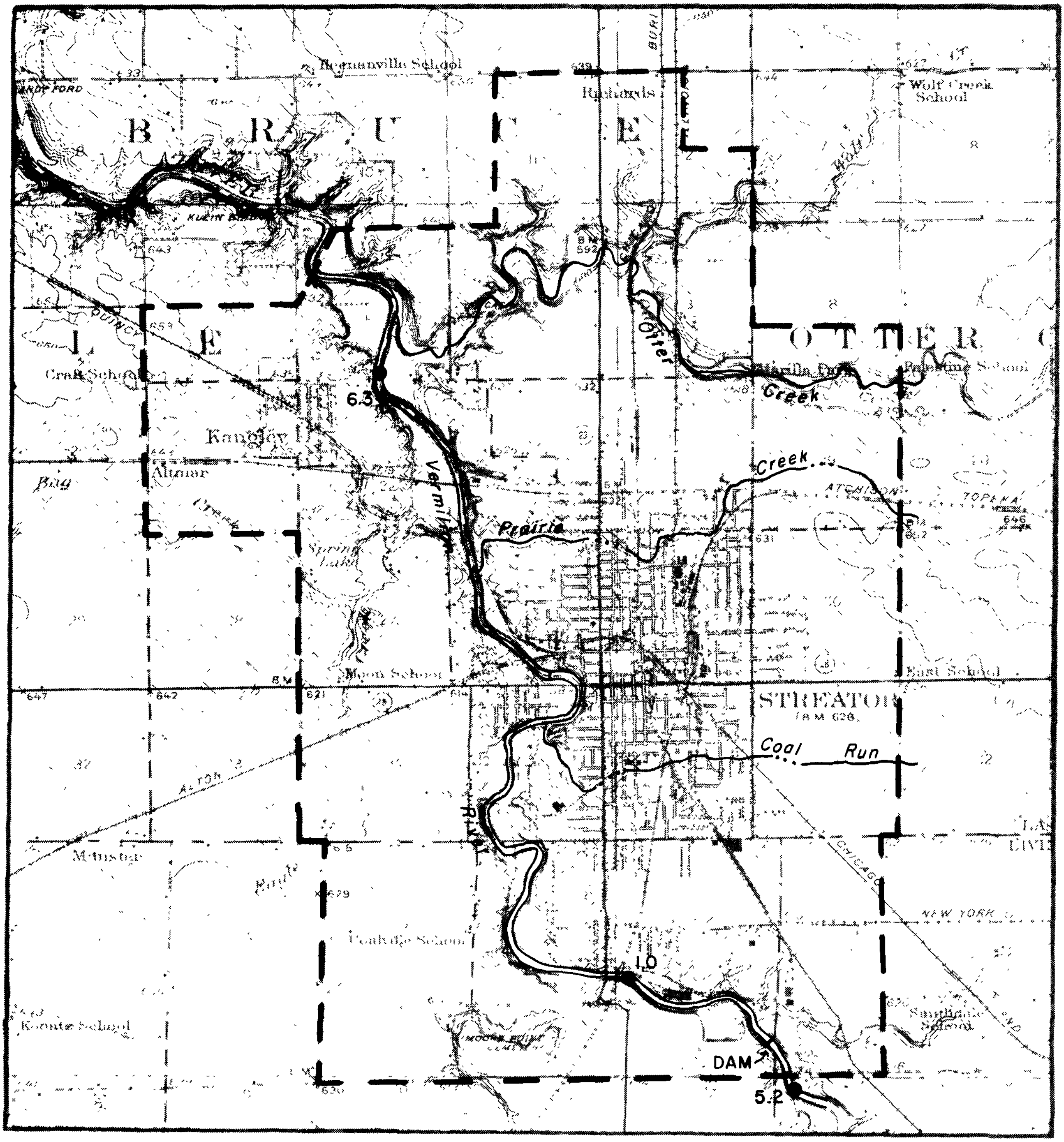


Figure 3-2. Waterways in the Streator FPA and flows (in cfs) reflecting 7-day 10-year low flows plus 1970 effluent flows (Singh and Stall 1973)

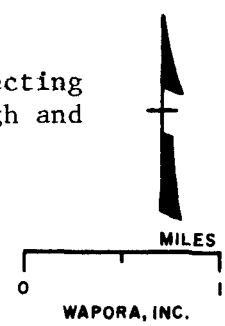


Table 3-1. Summary of flow of the Vermilion River near Streator, Illinois (USGS 1976).

	Near Leonore (cfs)	At Pontiac (cfs)
Average Discharge	774	376
Extremes for Period of Record:		
Maximum Discharge	33,500	13,600
Minimum Discharge	5.0	0
Extremes for 1975-1976 Water Year:		
Maximum Discharge	13,000	6,810
Minimum Discharge	11	5.2

Table 3-2. Vermilion River flows from 1961 to 1976 near Leonore, Illinois (USGS 1962-1976).

	Discharge (cfs)		
Wateryear	Mean	Maximum	Minimum
61-62	1,152	13,400	27
62-63	206	5,340	9
63-64	144	4,060	5.0
64-65	922	12,700	7.6
65-66	296	4,540	5.7
66-67	701	7,720	5.7
67-68	1,078	15,200	10
68-69	437	4,500	8.8
69-70	1,278	21,700	14
70-71	611	5,880	7.6
71-72	884	5,460	7
72-73	2,045	16,000	24
73-74	1,393	16,200	16
74-75	880	7,850	16
75-76	854	12,000	11
Average	859	10,170	11.6

Streator. Thus, gage records at Leonore are adequate to characterize river-flow variations in the FPA. Table 3-2 presents annual flow information for the past 15 years, and Table 3-3 presents a monthly summary of flow for the water year 1975-1976. The lowest flows in recent years occurred during the 1963-1964 water year, the highest flows during 1972-1973. The monthly records illustrate the typical seasonal variations in flow, which correspond to low flow in late summer and fall and to high flows during spring.

Flow in the Vermilion River through the Streator FPA is regulated by the water supply dam. On the average, 3.0 million gallons of water per day are diverted from the storage pool for water supply. This volume of water largely is returned to the river downstream as municipal sewage effluent and industrial wastewater discharge. Additionally, wastewater discharged to the abandoned mines returns to the river as leachate, either directly or via Prairie Creek. Thus, downstream from Streator, flow patterns more closely resemble natural flow patterns.

The 7-day 10-year low flows of the river at several locations within the Streator FPA are noted in Figure 3-2. These flows represent the natural low flow plus the 1970 levels of effluent flow. As shown, the 7-day 10-year low flow at the southern boundary of the FPA is 5.2 cfs but is only 1.0 cfs immediately downstream from the dam. Just upstream from the confluence of Otter Creek, the 7-day 10-year low flow is 6.3 cfs, which accounts for the discharge from the Streator wastewater treatment plant and local industrial discharges. Tributaries are expected to contribute no flow during the 7-day 10-year low flow condition.

The Illinois State Water Survey has computed times-of-travel of contaminants in the Vermilion River for high, medium, and low flow conditions at flow frequencies of 10%, 50%, and 90%, respectively. These values are displayed in Figure 3-3. The calculated values were compared with actual times-of-travel through the use of dye tracers. The high flow computations were the most reliable, becoming less so at reduced flow rates.

Flooding in the Streator area has been reduced significantly through the emplacement of levees to protect flood-prone areas. Flooding of the minor tributaries in the FPA may occur after intense storm events or sudden thaws.

3.3.1.2. Water Uses

As the major surface water resource in the basin, the Vermilion River presently is being used in several beneficial ways. It is the principal source of potable water. In 1976, a total of over 1.38 billion gallons of water was pumped for residential, commercial, and industrial uses. The river also serves as the receiving water for wastewater effluent. It assimilates and disperses both human and industrial wastes discharged from municipalities and industries (see Section 4.3. for a detailed discussion of these wastewater discharges).

In addition, the Vermilion River is a scenic and recreational resource of regional significance. The Illinois Department of Conservation's Illinois Canoeing Guide (n.d.) names the Vermilion River as "the best

Table 3-3. Vermilion River flows for the 1975-1976 water-year near Leonore, Illinois (USGS 1976).

Month	Mean	Discharge (cfs) Maximum	Minimum
October	91.3	214	51
November	61.3	110	41
December	478	1,600	205
January	164	280	131
February	2,140	7,140	117
March	2,895	12,000	628
April	1,453	8,200	329
May	1,535	6,400	490
June	886	3,600	307
July	524	3,720	102
August	51.1	120	14
September	15.9	45	11

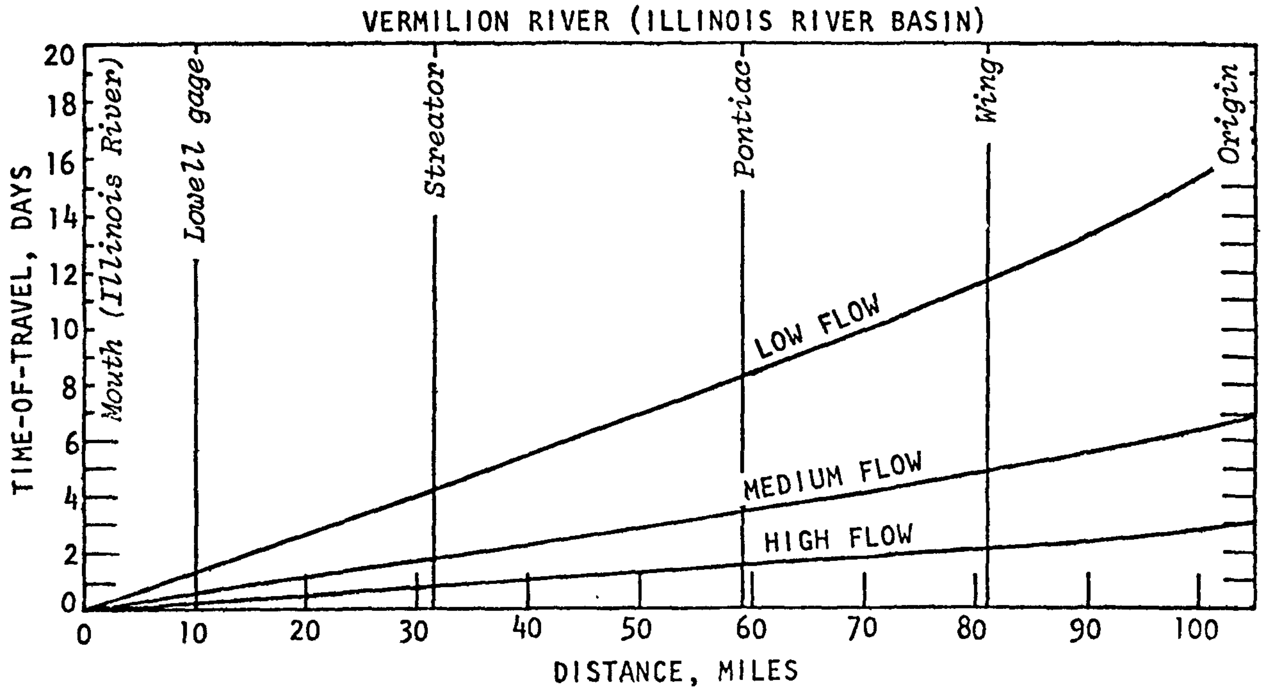


Figure 3-3. Vermilion River times-of-travels during estimated low, medium, and high flow conditions (Illinois State Water Survey 1969).

whitewater stream in Illinois." In addition to outstanding canoeing on the lower river and some boating in the pools upstream from the Pontiac and Streator dams, the river and its adjacent lands provide other important recreational activities, such as fishing, hunting, swimming, hiking, and camping. Game fish that attract fishermen include small-mouth bass, bluegill, green sunfish, white and black crappies, catfish, bullhead, and carp. Hunting on adjacent lands is primarily for squirrel, rabbit, and upland game birds, such as pheasant and quail.

Although the river's recreational potential is of regional significance, access is limited because most of the river and its tributaries are bordered by privately-owned lands. There is a public park near the Pontiac dam; a private campground where Route 23 crosses the river north of Cornell; Matthiessen State Park, which is contiguous to the river several miles downstream from Lowell; and various public rights-of-way at bridge crossings that provide the only public access to the river (Illinois Department of Conservation n.d.). The steepness of the banks along the river in Streator and downstream also hinder access to the river.

3.3.1.3. Water Quality

The Illinois Environmental Protection Agency (IEPA) has responsibility under the Illinois Environmental Protection Act of 1970 to monitor water quality and to investigate violations of established water quality standards (Draft EIS, Appendix A). IEPA, therefore, has developed a statewide network of water quality monitoring stations. Periodic samples to determine water quality in the Vermilion River are collected at five locations under this program. Three water quality monitoring sites are located upstream from Streator. The nearest station upstream from the FPA is designated as Station DS-02 and is located 2.0 miles west of Cornell, or about 12 river-miles upstream from Streator. Data from this sampling site can be considered representative of background water quality in the Vermilion River as it flows into the Streator FPA. Of the two monitoring sites downstream from Streator, the first (DS-05) is located within the FPA, 1.0 mile north of Kangley. Water quality data collected at this station reflect the effects from the addition of contaminants discharged to the river as it flows through the Streator urban area. A summary of recent water quality data obtained at these two sites for the most significant parameters analyzed is presented in Table 3-4.

The extreme ranges in values of several of the parameters indicate occasional unstable water quality conditions in the Vermilion River. Dissolved oxygen (DO) concentrations can be used as an indicator of general water quality conditions, because the level of oxygen in the stream reflects the ability of the river to support aquatic life. The extremely low, minimum DO value measured during low-flow conditions in 1975 (at Station DS-02 upstream from Streator) illustrates this water quality variability. It represents an in-stream oxygen concentration much too low to maintain a diverse fish population. The mean DO values for both 1975 and 1976, however, indicate conditions generally adequate to support diverse aquatic life.

Mean fecal coliform values for both sites indicate significant fecal contamination of the river (Table 3-4). Fecal coliform counts also provide

Table 3-4. Summary of water quality monitoring data during 1975 and 1976 for the Vermilion River in the vicinity of the Streator FPA (IEPA 1975, 1976c). Values in excess of the current state water quality standards are marked with an asterisk (*). State standards are listed in the Draft EIS, Appendix A.

Sampling Site Location	Year of Analyses	Item	Dissolved Oxygen (mg/l)	Fecal Coliform #/100ml	Ammonia-nitrogen as N (mg/l)	Nitrate Plus Nitrite as N (mg/l)	Total Phosphorus as P (mg/l)	Total Dissolved Solids (mg/l)	Total Copper (mg/l)	Total Lead (mg/l)	Total Iron (mg/l)
Station DS-02	1975	No. of Analyses	6	8	8	8	8	8	3	3	3
Upstream from Streator		Maximum	13.3	70,000*	14.0*	13.3*	7.20	680	0.04*	0.01	1.3*
at the Route 23 bridge,		Minimum	2.6*	30	0.03	1.5	0.130	370	0.00	0.00	0.8
2.0 miles west of		Mean	9.1	1,198*	2.01*	9.2	1.115	442	0.02	0.00	1.0
Cornell											
	1976	No. of Analyses	5	5	5	5	5	5	2	2	2
		Maximum	10.2	3,200*	0.44	12.0*	2.60	540	0.01	0.01	0.9
		Minimum	8.7	10	0.04	0.5	0.120	405	0.00	0.01	0.3
		Mean	9.4	736*	0.16	6.2	0.836	447	0.01	0.01	0.6
Station DS-05	1975	No. of Analyses	6	6	6	6	6	6	2	3	2
Downstream from		Maximum	14.0	4,900*	0.60	12.0*	2.00	500	0.09*	0.28*	0.7
Streator (within the		Minimum	5.3	100*	0.00	1.0	0.230	340	0.05*	1.14*	0.5
FPA) at Klein Bridge,		Mean	5.4	837*	0.20	7.9	0.705	416	0.07*	0.21*	0.6
1.0 mile north of											
Kangley	1976	No. of Analyses	10	10	10	10	10	10	4	4	4
		Maximum	15.3	3,000*	3.5*	15.0*	1.80	770	0.22*	0.52*	2.9*
		Minimum	5.0	20	0.00	0.8	0.140	390	0.00	0.00	0.5
		Mean	9.5	877*	0.80	6.5	0.642	526	0.06*	0.13*	1.15*

an indication of the potential presence of pathogenic organisms and, therefore, can be used to determine the relative safety of water for consumption or recreational uses. The extremely high maximum value of 70,000 fecal coliform organisms per 100 milliliters of sample (found in one sample in 1975 at Station DS-02 upstream from Streator) reflects conditions hazardous to public health.

The 1975 maximum ammonia-nitrogen (NH_3-H) concentration of 14 mg/l at Station DS-02 indicates a high level of organic pollution and represents a value in excess of the ammonia toxicity limits necessary to kill fish. The 3.5 mg/l maximum value at Station DS-05 in 1976 also indicates toxic conditions.

Phosphorus concentrations are not in violation of a standard, because the Vermilion River is not directly tributary to a lake or reservoir. The maximum values at both stations for both years, however, represent nutrient-enriched conditions. Phosphorus is considered the nutrient that, if present in sufficient concentration, can stimulate overproduction of algae and result in decreased DO levels. Nitrate also is necessary for the production of algae. The mean concentration values measured at both stations reflect nitrate-enriched waters.

Concentrations of copper, iron, and lead occasionally violated water quality standards. The levels of copper and iron that are in violation of standards present a potential hazard to aquatic life. Elevated lead levels present a health hazard in public water supplies.

Based on data in addition to those presented in Table 3-4, the IEPA concluded that the water quality of the lower Vermilion River has deteriorated from "fair" to "semi-polluted" over recent years (IEPA 1976b). The limited nature of available data on water quality in the Vermilion River, however, precludes the development of a more thorough analysis of water quality trends and problems. The number and location of monitoring stations and the frequency of sampling do not permit determinations of specific causes of water quality degradation.

There are many sources of pollution along the Vermilion River that could be responsible for violations of water quality standards. Of the 21 known point source discharges of pollutants to the Vermilion River, four are located a relatively short distance upstream from Station DS-02 (located near Cornell). Two of these, the Livingston County Nursing Home and the Pontiac wastewater treatment plant, are reported as having discharged effluents with high levels of biochemical oxygen demand (BOD), ammonia-nitrogen (NH_3-N), and fecal coliforms during 1975 (IEPA 1976b). The IEPA states that additional amounts of these substances are contributed by non-point sources immediately upstream from the monitoring station and from other sources farther upstream. Leachates from the Markgraf landfill at Pontiac have contained concentrations of ammonia-nitrogen and iron as high as 285 mg/l and 1,000 mg/l, respectively (IEPA 1976b).

In the Streator FPA, sources of BOD, ammonia, and fecal coliform include effluent from the Streator wastewater treatment plant, combined sewer overflows, discharges from broken and cracked sewer lines, leachates from abandoned mines and septic tank systems, and other non-point sources including livestock farms. Potential sources of copper, iron, and lead include landfills, mine wastes, abandoned mines, other non-point sources, and natural sources. The results of limited field investigations to determine the impact of pollutant sources in the Streator FPA on water quality are presented in Appendix C.

There are no water quality data available for the six tributaries in the Streator FPA. Otter Creek and three unnamed tributaries should have relatively good water quality. The streams receive no municipal or industrial discharges. The only potential pollutant loads are from agricultural runoff and possibly from septic tank leachates.

Prairie Creek and Coal Run, however, drain most of the Streator urban area and receive wasteloads from several pollutant sources (Appendix C). The most significant pollutant contribution to Coal Run is raw sewage from the broken Coal Run interceptor. Mine leachates are the major pollutant sources to Prairie Creek. Both streams also receive pollutant loads from urban run-off, leachates from septic tank systems, and combined sewer overflows.

3.3.1.4. Aquatic Biota

Studies on the aquatic biota of the Vermilion River and its tributaries have concentrated almost exclusively on fish. Results generally indicate that the river has a diverse fish population. Smith (1971) reported that 80 species of fish were present in the Vermilion River but classified the river as "fair" based on its fish population. The Vermilion River has a variety of habitats and should support a richer fish fauna. The elimination of certain native species is attributable to domestic, industrial, and agricultural pollution. Siltation, particularly in the upper reaches of the river, also is a significant factor responsible for reduced species diversity. The effects of siltation include loss of water clarity and subsequent disappearance of aquatic vegetation, and the deposition of silt over substrates that were once bedrock, rubble, gravel, or sand. Feeding and spawning sites thus can be destroyed. Data from inventories of fish in the Vermilion River that were conducted by the Illinois Department of Conservation and the Illinois Natural History Survey are presented in the Draft EIS (Section 2.3.1.4. and Appendix C).

Benthic macroinvertebrates were sampled in the Streator FPA during October 1974 (By memorandum, Mr. W.H. Ettinger, IEPA, to Field Operations Section, 24 October 1974). This sampling was part of a larger study to assess the impacts of mine leachates and wastewater discharges on water quality in the Vermilion River. Both the number of species and the number of organisms generally increased downstream through the Streator study area (Draft EIS, Appendix C). A sharp increase in the number of organisms was found in the sample obtained 30 feet downstream from the Streator wastewater treatment plant discharge. The number of species also increased at this location. The predominant macroinvertebrate species was the Chironomidae larve (midge). The numbers of species and organisms were fewer downstream from this location but were still larger than the numbers found upstream from the treatment plant outfall. Based on the survey, IEPA classified the segment of the Vermilion River in the Streator FPA as "semi-polluted or unbalanced." No conclusions, however, were drawn as to the pollutant sources.

3.3.2. Groundwater

3.3.2.1. Availability

Limited data are available on existing groundwater resources in the Streator FPA. Water supply wells in the study area most frequently penetrate glacial drift aquifers, Pennsylvanian aquifers, the Galena-Platteville aquifer, and the Glenwood-St. Peter aquifer (Willman and Payne 1972; Hackett and Bergstrom 1956; Walton and Csallany 1962; and Hoover and Schicht 1967). Glacial drift in the vicinity of Streator is thin, and groundwater pumpage for wells penetrating sand and gravel deposits is limited to low capacity systems (Sasman and others 1974). Sandstone and creviced dolomite beds in the Pennsylvanian System yield small quantities of water, and the water quality is generally poor. Limestones and dolomites of the Galena and Platteville Groups generally are creviced only slightly and yield small quantities of water.

Most wells in the study area and in the immediate vicinity tap water from the Glenwood-St. Peter aquifer (Hackett and Bergstrom 1956). This aquifer generally consists of fine- to medium-grained sandstones, but its lithology can vary abruptly both horizontally and vertically. Yields from wells in this formation are sufficient for small municipalities and small industries but are usually less than 200 gallons per minute (gpm). The specific capacity of the municipal well at Kangley is 1.1 gpm per foot of drawdown (Walton and Csallany 1962).

3.3.2.2. Quality

Data on groundwater quality in the study area similarly are scarce. The results of twelve analyses conducted by the Illinois State Water Survey during the period from 1934 to 1977 are listed in Table 3-5. Glacial drift wells usually yield waters that are low in dissolved solids. Groundwater from bedrock aquifers has high concentrations of sodium, chloride, and total dissolved minerals. Shallow drift and bedrock aquifers are susceptible to contamination from surface waters, agricultural activities, and sewage disposal practices. Such contamination usually results in elevated nitrate concentrations in the groundwater.

3.3.3. Water in Coal Mines

The majority of abandoned coal mines beneath the Streator study area are flooded. From the time the mines were closed, infiltrating groundwater, stormwater runoff, and wastewaters (residential, commercial, and industrial) have been entering the mines. Measurements of water pressure in the mines indicate that there is a hydraulic gradient toward the Vermilion River (Appendix B). This implies that the mines are not openly interconnected, although water from one mine may flow to an adjacent mine through crevices in thin walls separating the mines. If the mines were connected, water pressure in the mines would be nearly equal.

Table 3-5. Groundwater quality data for the Streator study area (Illinois State Water Survey 1977).

Well No.	Township	Range	Section	Location[1]	Date	Owner	Well Depth (feet)	Aquifer[2]
1	30N	3E	2	100S 3200W	19/11/58	Albert Roy	190	Pennsylvanian System
2	30N	3E	10	2640N 3600W	21/10/65	Donald Bermes	25	Pennsylvanian System
3	31N	3E	11	175N 2500W	29/04/75	Donald LaKach	75	Pennsylvanian System
4	31N	3E	12	50N 1060W	22/02/68	Lester Biehman	20	Glacial drift
5	31N	3E	22	660S 1980E	13/03/63	J. M. Plymire	152	Pennsylvanian System
6	31N	3E	22	660N 660W	22/12/58	Kangley #1	542	St. Peter
7	31N	3E	22	660N 660W	23/09/58	Kangley	350	Galena-Platteville
8	31N	3E	22	660N 660W	09/07/75	Kangley #1	500	St. Peter
9	31N	3E	22	660N 660W	20/04/77	Kangley #1	500	St. Peter
10	31N	3E	26	400N 500E	25/09/36	W. C. Anthony	193	Pennsylvanian System
11	31N	3E	35	1300S 1600E	05/01/34	Streator Brick Co.	664	St. Peter
12	31N	4E	19	1500S 300W	06/01/34	Thatcher Manufacturing	440	St. Peter

Well No.	Hardness (as $CaCO_3$) (mg/l)	Alkalinity (as $CaCO_3$) (mg/l)	Total Dissolved Minerals (mg/l)	pH	Calcium (mg/l)	Magnesium (mg/l)	Sodium (mg/l)	Potassium (mg/l)	Ammonium (mg/l)	Sulfate (mg/l)	Chloride (mg/l)	Fluoride (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	Total Iron (mg/l)
1	60	1,492	3,134	---	---	---	1,262	---	---	---	930	---	---	---	0.1
2	692	296	1,142	---	---	---	---	---	---	---	95	---	60.0	---	0.2
3	148	383	458	---	---	---	---	---	1.6	---	4	---	---	0.2	1.2
4	616	316	853	---	---	---	---	---	---	---	47	---	34.2	---	2.7
5	80	1,960	3,107	---	---	---	---	---	---	---	630	---	1.0	---	0.3
6	324	196	1,401	---	---	---	---	---	---	---	600	0.7	0.8	---	0.3
7	670	732	1,702	---	---	---	---	---	---	---	435.0	0.7	0.5	---	---
8	---	309	1,480	7.7	78.0	38.0	390	23.8	1.5	113.0	585	1.3	0.18	0.00	1.3
9	401	287	1,390	8.0	90.0	42.0	360	21.	1.6	110.0	560	1.0	0.0	---	0.6
10	118	1,000	4,569 0	---	19.2	17.0	1,766	---	0.3	3.0	1,456.0	---	1.4	---	10.4
11	353.5	326	638	---	72.7	41.7	104	---	0.4	133.2	72	---	3.3	---	1.15[3]
12	222.5	360	880	---	46.8	25.7	277	---	1.1	23.7	304	---	0.8	--	0.3

1 Locations are reported in terms of distances (measured in feet) from north or south and east or west section lines.

2 Estimated from well depths and geologic maps.

3 Filtered sample.

It was estimated that during dry-weather periods approximately 1.56 mgd of wastewater is discharged directly to the mines through drop shafts located throughout the study area (Section 4.3.). Most of this flow is from industries (1.03 mgd; Section 4.3.1.). A portion of the residential and commercial flow is from septic tanks that discharge their effluent to the mines. In addition, some dry-weather flow enters the mines indirectly via drop shafts installed in the sewer system (Section 4.1.).

During wet-weather periods, unknown but significant amounts of stormwater and combined sewer flows (wastewater and stormwater) are discharged to the mines. Stormwater enters directly through drop shafts as surface runoff. Combined sewer flows are diverted by drop shafts installed in the sewer system to prevent the system from exceeding its capacity and causing sewer back-ups (Section 4.1.). Because the number of drop shafts (inside and outside the sewer system) is not known, quantities of wet-weather flows discharging to the mines cannot be determined. Recharge due to natural infiltration is estimated to be only 0.03 mgd (Walton 1970).

The principal mechanism for discharge of water from the mines is via natural seepage and drainage from horizontal shafts and seam outcrops along the Vermilion River and Prairie Creek. A small, unknown amount is pumped from the mines for irrigation purposes. Downward leakage to the Galena-Platteville and Glenwood-St. Peter aquifers should be minimal due to the relatively impervious character of the clays and shales of the Pennsylvanian System.

Because the wastewater and stormwater that presently recharge the mines are untreated, discharges may have adverse impacts on the quality of surface waters. The chemical characteristics of mine leachates indicate that waters undergo partial treatment in the mines, but leachates contain high concentrations of fecal coliform bacteria, ammonia, and iron. Field investigations conducted during high river flows showed that leachates did not have a significant impact on the water quality of the Vermilion River. Impacts from leachate pollutant loads, however, may be more pronounced when flows in the Vermilion River are low. A discussion detailing field investigations to determine leachate characteristics and leachate impacts on the quality of surface waters is presented in Appendix C.

Contamination of the Galena-Platteville and Glenwood-St. Peter aquifers due to leakage through confining beds is unlikely. However, leaky well-casings, which extend through Pennsylvanian strata, may provide conduits for vertical flow. Because static levels in the mines are much higher than those in the Glenwood-St. Peter aquifer (Sasman and others 1973), the vertical flow would be downward. Chemical analyses of water in the Streator Brick Company well, which comes from the St. Peter Aquifer, indicate that anomalously low concentrations of chloride, sodium, and total dissolved minerals existed at the time of the sampling (Table 3-5). If the mines at this location were flooded at that time, downward leakage of less mineralized water could have diluted the water in the well.

3.4. Cultural Resources

3.4.1. Archaeological Resources

Prehistoric occupation of the Illinois River Basin has been documented as early as the Paleo-Indian period (prior to 8000 BC; Willey 1966). One of the better-known sites of prehistoric occupation in Illinois is at the present location of the Starved Rock State Park. The park is situated on a bluff along the Illinois River in La Salle County approximately 20 miles northwest of Streator. Occupation of this site dates to Archaic times (8000 BC - 1000 BC). When the French explorers (Marquette and Joliet) reached Illinois in the early 1670s, they found many Indians inhabiting other areas near Starved Rock and a large Indian town at Kaskaskia.

Because the Streator FPA is situated along the Vermilion River and its tributaries less than 20 miles from an area of major prehistoric settlement, the potential for undiscovered archaeological resources in the area is great. Considerable disturbance has occurred in the plow zone over large parts of the study area. There should have been less disturbance on the gently rolling land along the Vermilion River, Otter Creek, and Moon Creek, and in the Eagle Creek-Spring Lake area. These areas, therefore, are potentially promising locations for archaeological finds. Collectors in the Streator area have uncovered many stone implements and projectile points along the Vermilion River and its tributaries (Historical Centennial Program 1968).

3.4.2. Cultural, Historic, and Architectural Resources

Eight sites in the Streator FPA have been documented by the Illinois Historic Sites Survey as having cultural, historic, or architectural significance (Figure 3-4; Historic Sites Survey 1972,1973). These are:

1) Streator Public Library - northwest corner of Bridge Street - Park Street intersection

2) Residence - 408 South Bloomington Street

3) State Armory - south side Bridge Street, near Armory Court

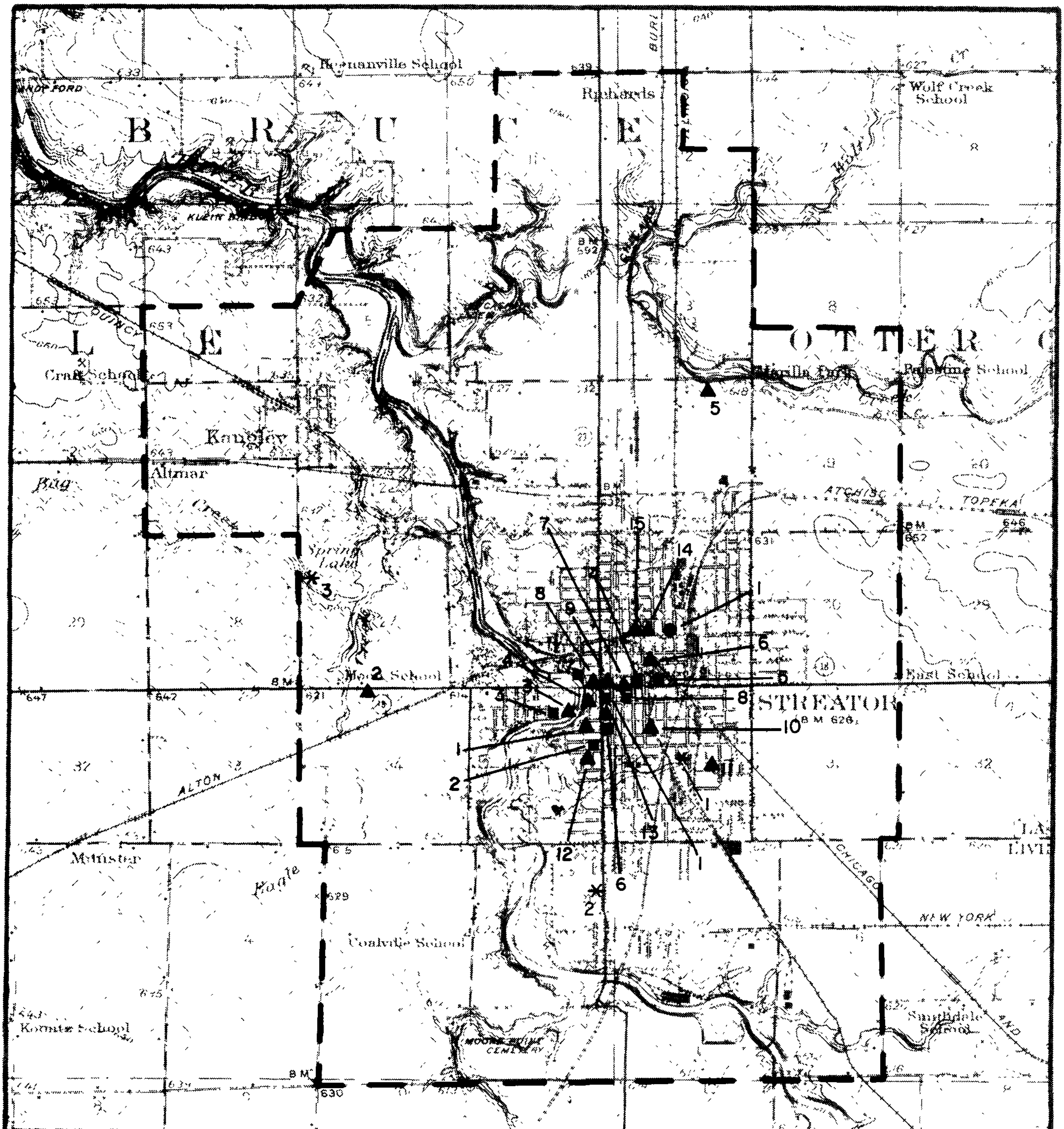
4) Commercial building - north side Main Street, east of Vermilion Street

5) Commercial building - north side Main Street, east of Wasson Street

6) Residence - 312 South Park Street

7) Residence - 108 South Water Street

8) Episcopal Christ Church - intersection of Bridge Street and Vermilion Street, northwest corner.



● National Register Site

▲ Potentially Significant Sites Identified During Field Survey

■ Illinois Historic Survey Site

✱ Potentially Eligible For National Register

Figure 3-4. Cultural, historic, and architectural sites in the Streator FPA.

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WAPORA, INC.

In addition, there is one site in Streator listed in the National Register of Historic Places (Figure 3-4). This site, the Baker House, is situated on the northeast corner lot at the intersection of Broadway and Everett Streets.

As a result of a windshield/on-foot survey, three sites were identified that may possess sufficient cultural, historic, or architectural significance to warrant their inclusion in the National Register of Historic Places (Figure 3-4). These sites are: St. Stephen's Parish, the Slovak Lutheran Church at Old Number Three, and the Crawford Farm west of Streator on Kangley Road (0.75 mile north of Route 18). They are described in Section 2.4.2. of the Draft EIS.

In addition to the three potential National Register sites, numerous sites that possess cultural, historic, or architectural significance of lesser importance were identified in the Streator study area (Figure 3-4).

1) Residence - south side Wilson Street across from Pleasant Street
2) Moon House - west of Streator, 0.5 mile on Route 18
3) Residence on Bridge Street immediately east of Armory
4) Hagi Funeral Home - 205 High Street
5) Barnhart Cemetery - south of Marilla Park, 100 yards south of Marilla Road
6) Residence - intersection of Wasson Street and Kent Street, southwest corner
7) Commercial section of Main Street, including both north and south sides of street from Bloomington Street east to Illinois Street
8) Plumb House (Hotel) - intersection of Bloomington Street and Main Street, northwest corner
9) Heenan Mercantile Company Building - intersection of Main Street and Park Street, northwest corner
10) Plumb School - intersection of Sterling Street and Livingston Street, northeast corner
11) Lincoln School - north side Charles Street between Illinois Street and Powell Street
12) Residence - Court Street across from Wall Street
13) Residence - 213 South Park Street
14) Residence - 510 Broadway Street
15) Residence - intersection of Broadway and Sterling Street, northwest corner.

In conducting the cultural and historic resources survey, three nodes of potentially architecturally significant houses were located. (Apparently these were the "well-to-do" areas of Streator circa 1900.) They are: Broadway Street; south of Main Street; and sections of old Unionville. There are, however, no remaining visible signs of the ethnic neighborhoods present at the turn of the century.

3.5. Population of the Streator FPA

3.5.1. Base-year Population

The Streator FPA contains parts of five townships: Bruce, Eagle, and Otter Creek Townships in La Salle County; and Reading and Newton Townships in Livingston County (Figure 3-5). The study area includes the incorporated areas of Streator and the Village of Kangley. Several nearby unincorporated residential areas plus a considerable amount of presently undeveloped area that may require sewer service from the Streator system also are included. The City of Streator is the largest community in the area and is situated mainly in La Salle County. The populations of various communities in the Streator FPA, as reported in the 1970 Census (US Bureau of the Census 1973), were as follows:

Streator (Bruce, Eagle, Otter Creek, and Reading Twps)	15,600
Kangley Village (Eagle Twp)	290
Streator West (unincorporated, Bruce Twp)	2,077
Streator East (unincorporated, Otter Creek Twp)	1,660
South Streator (unincorporated, Reading and Newtown Twps)	1,869
Total	21,496

The 1970 population of the five townships in which the FPA lies was 25,808. This population was distributed as follows:

Bruce Township	16,747
Eagle Township	2,082
Otter Creek Township	3,003
Reading Township	2,975
Newtown Township	1,001
Total	25,808

Most of the population in the five townships (83%), thus, was located within the boundaries of the Streator FPA.

Some developed areas and some individual residences (mainly farmhouses) in the Streator FPA are not included among the populated areas listed in the 1970 Census (La Salle County Planning Commission 1977; Warren & Van Praag, Inc. 1975). One area is along the western boundary of the FPA about 2.0 miles south of Kangley. It contains about 50 residences, a population of about 150 (based on 3 persons per dwelling unit in the Streator FPA). To account for these outlying areas, a base-year 1970 population of 21,750 for the Streator FPA is a reasonable estimate. The 21,750 figure conforms with the base-year population estimate used in the draft Facilities Plan (Warren & Van Praag, Inc. 1975).

There are, however, certain differences between the base-year population in the EIS and in the Facilities Plan. The base-year population used in the Facilities Plan was taken from the 1967 population estimate for the "Streator Planning Area" used in the Centennial City Plan of Streator, Illinois (Harlan Bartholomew & Associates 1969). Additionally, Kangley was

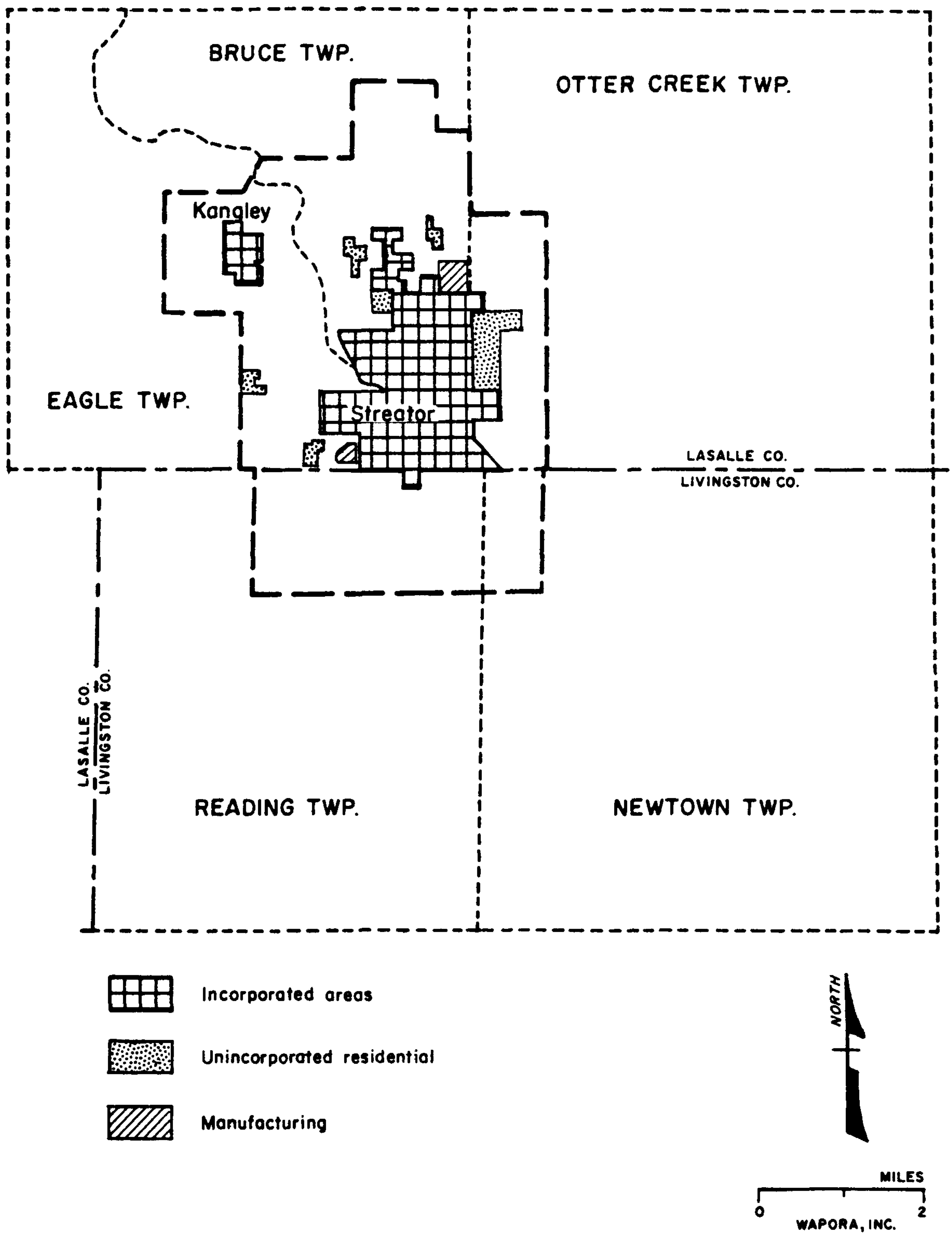

Figure 3-5. The Streator FPA and the 5-Township Area, La Salle and Livingston Counties, Illinois.

not included in the "planning area" of the Facilities Plan. Nevertheless, the 21,750 population figure is considered a reasonable base-year 1970 population estimate for the Streator FPA.

3.5.2. Recent Population Trends

A review of recent population trends for the City of Streator, the Streator metropolitan area (Kangley and incorporated and unincorporated sections of Streator), the five townships in the FPA, and La Salle and Livingston Counties revealed a pattern of little growth to slight decline in population (Draft EIS, Table E-1). The City of Streator has not grown substantially during this century (Draft EIS, Table E-2). Streator's population was slightly over 14,000 in the year 1900 and grew only to 15,600 by 1970. The City's Census-year population peaked at 16,868 in 1960 and declined from 1960 to 1970. The Streator metropolitan area (incorporated and unincorporated communities) increased in population from 1960 to 1970 by 4.5%. This primarily was caused by the addition of Streator West population (2,077 persons) to the metropolitan area. Population that may have resided in the Streator West area was not reported in the 1960 Census. Some residential areas, however, were not included in Census reports of incorporated and unincorporated communities. Estimates were not available for the 1970 to 1975 population change for the Streator metropolitan area.

A pattern of slower growth rates (or accentuated declines in growth rates) for counties and townships was revealed for the 1970 to 1975 period compared to the 1960 to 1970 period. The 1970 to 1975 percent change was calculated at a 10-year rate for comparison with the rate of change over the 10 years, 1960 to 1970. The five-township area declined in population at a rate of 1.9% (per decade) from 1970 to 1975 compared to a 0.7 percent rate of decline from 1960 to 1970. The two counties declined in population at a rate of 3.1% (per decade) from 1970 to 1975 compared to a 0.6% increase from 1960 to 1970. In Grundy County (adjacent to La Salle County on the east; Draft EIS, Figure E-1), population grew by 18.9% from 1960 to 1970 but only grew by 2.8% during the period from 1970 to 1975. In Marshall County, to the west, population declined by 0.4% from 1960 to 1970 and by 2.8% per decade from 1970 to 1975.

During the period from 1960 to 1970, populations declined in several of the communities in the vicinity of Streator. The population and rates of population change for eleven communities within a 25-mile radius of Streator with populations larger than 500 persons (except Kangley) were analyzed (Draft EIS, Figure E-1 and Table E-3). Overall, population declined by 1.3% from 1960 to 1970 in these communities. Declines were experienced mainly in the larger communities. Streator is second in population of the eleven cities in the 25-mile radius area.

Population changes in twenty townships in an approximate 25- by 25-mile square around Streator also were examined (Draft EIS, Figure E-2). Overall population declined at a 10-year rate of 4.4% in this twenty township region (from 41,856 in 1970 to 40,930 in 1975). This compares to a same-period decline of 4.5% for La Salle County and 1.9% for the five-township area containing the Streator FPA. The 4.4% decline from 1970 to 1975 compares with a 0.5% decline from 1960 to 1970 in the twenty-township total population, again showing a dampening (an acceleration in the rate of population decline).

Dampened rates of growth in the twenty-township region are similar to those in Illinois and the US. State of Illinois population grew at a rate (per decade) of 2.3% from 1970 to 1975, compared to 10.3% from 1960 to 1970. Estimated Illinois population declined from 1973 to 1975 (Illinois Bureau of the Budget 1976). In the US, population grew at a rate of 13% during the 1960s but declined to an approximate 8% rate from 1970 through 1975.

In summary, based on recent trends, the population of the Streator FPA either declined slightly from 1970 to 1975 or remained essentially unchanged. Thus, by extension, the use of the estimated 1970 population as a 1977 base-year population figure for the area is justified.

3.5.3. Population Projections to the Year 2000

It appears that no growth or even a slight decline in the Streator FPA population will occur over the period from the present to the year 2000. A projected year-2000 baseline population of 21,750 for the area (the same as the estimated population for 1970 and 1977), therefore, appears reasonable. Such a projection assumes a continuation of the various forces that have been behind the recent population trends in the Streator FPA (Draft EIS, Section 2.5.2. and Appendix E). These include lower birth rates and reduced population growth in the US and Illinois, and limited new employment opportunities in the Streator area. No evidence suggests that new industry may locate in the area.

Minor population fluctuations may occur annually between now and the year 2000. Minor fluctuations, however, are not predictable with any degree of accuracy or reliability. In any event, they would not affect the ultimate projected levels. It is estimated that the population of the Streator FPA will remain essentially stable over the period through the year 2000.

3.6. Financial Condition

3.6.1. Community Services

Persons living in the City of Streator and nearby areas receive a number of community services, such as fire and police protection, garbage collection and disposal, sewer service, and schools. The City of Streator is the major supplier of such services. Schools are administered by school districts, and water is supplied by a private company. The incorporated Village of Kangley supplies water, street maintenance and repair, street lighting, and minor services to its citizens.

3.6.1.1. Costs of Community Services

Total expenditures for services provided by the City of Streator during fiscal year 1977 were a little over $3 million (Draft EIS, Table E-12). The major cost items were police protection, fire protection, construction of local streets, street maintenance, garbage collection and disposal, and sewer service. Both "local" and "non-local" expenditures for streets and bridges were over $1,000,000, or more than twice the expenditures for the next largest item, police protection. The costs for local services, including overhead items, were slightly less than $2.4 million.

Expenditures for sewer service were more than $140,000, or about 6% of all local costs. Unlike other categories, debt amortization is included in this item, because this debt is in the form of revenue bonds. Sewer rentals amounted to approximately 60% of sewer service costs (Draft EIS, Table E-13).

Sewer service is provided to residential, commercial, and industrial customers (Draft EIS, Table E-14). Service is provided to most residences in the City of Streator. There were 4,235 residences served in fiscal year 1977. At about three persons per household, 12,700 persons were served, or about 80% of the City's 1970 population. The sewer rental charge is $4 per quarter per household ($16 per year). Actual receipts were somewhat less, at $15.85 per residence, or about $5.28 per capita.

Water is provided by the Northern Illinois Water Corporation. The company serves Streator and nearby areas, except for Kangley that has its own municipal service. Costs per residential customer were $93.17 during fiscal year 1977 (or about $31 per capita per year assuming three persons per dwelling unit; Draft EIS, Table E-15). Costs for water service, therefore, are slightly less than per capita costs for police protection (Draft EIS, Table E-12).

For Kangley, revenues for water service and meters totalled $9,190 for the year ending 30 April 1976. Based on a 1970 population of 290, this was $31.69 per capita. Revenues in 1976 exceeded operating costs by about $2,000. An analysis of the Village's Financial Statements and Accountant's Report for fiscal year 1976, however, revealed that debt service on the water system totalled about $5,000 (based on an outstanding debt of $58,000; Burkett and Associates, Ltd. 1976). An additional $3,000, therefore, should be added to the cost, making water service costs about $42.03 per capita. The Village currently is investigating the possibility of constructing a water main from the City of Streator and purchasing water from the Northern Illinois Water Company (By letter, Mr. J. J. Yendro, PE, Chamlin & Associates, Inc., to V.S. Hastings, WAPORA, Inc., 5 December 1977).

The people of Streator pay a local share for schools. They also pay a local share for the County's community college, Illinois Valley Community College, located near Oglesby. The combined equalized tax rate for these schools for Bruce Township, where most of the people of Streator live, is 5.6342. It is 5.7779 for Eagle and 5.7679 for Otter Creek Township (La Salle County Clerk's Office 1977). Practically all of the local share comes from property taxes. Total assessment for the City of Streator in 1976 was $55,392,519 (Kincannon 1977). Using 5.7 as the tax rate, the cost to the people of Streator for the local share of all schools was about $3,150,000 (about $202 per capita based on a population of 15,600). Per capita local costs for schools exceed per capita costs for all other local services combined (Draft EIS, Table E-12).

3.6.1.2. Sources of Funds for Community Services

Total revenues of the City of Streator for fiscal year 1977 equaled total disbursements (expenditures) by the City. The major source of funds (almost $1.4 million) is local taxes (Draft EIS, Table E-16). Substantial sums also are received from Federal and State sources (about $1.2 million if funds of approximately $647 thousand for arterial streets and bridges are included). About $355 thousand are received from licenses, fees, and rentals, including sewer rentals.

Local property taxes and fire insurance taxes are paid by City property owners, but sales taxes are paid partially by transients. As a rough estimate, residents of the City pay $1.2 million in total local taxes, or about $77 per capita.

Based on budget information from the local high school, local taxes cover about 60% of the school costs. Most of the remainder is from State sources. Tax sources represent about $279 per capita per year (City, $77, and school services, $202). The source of funds for water service is by direct charge.

3.6.2. Indebtedness

Based on the City of Streator's fiscal-year 1977 Financial Statements and Accountant's Report, the City is sound financially. The major debt, covered by sewer revenue bonds issued in 1961, was for the replacement of the City's wastewater treatment facilities. Bonds outstanding totalled $315,000 on 30 April 1977. The total annual debt service was about $30,000. It will remain at this level through 1992. (Total debt service through 1992 will amount to $443,128.) Funds to cover total sewer costs were derived from sewer rentals ($84,910; Draft EIS, Table E-13) and general funds.

Other indebtedness included $100,000 in tax anticipation warrants, about $130,000 in accounts payable including accrued payroll at the end of the fiscal year, about $70,000 on a fire engine, $65,000 on a garbage truck, and less than $1,000 on parking meters. Partially offsetting this indebtedness were cash balances of over $65,000 in the sewerage revenue bond fund account, $10,000 in the motor fuel tax fund, and over $17,000 in miscellaneous funds. In addition, there is considerable equity in facilities and equipment, specifically fire engines, garbage trucks, and parking meters.

3.6.3. Comparison of Expenditures, Revenues, Assessments, and Debt Among Cities

Municipal finance characteristics of twenty cities in the vicinity of Streator (in the fourteen-county North Central Illinois Region; Draft EIS, Figure E-3) for 1974 were examined and compared with those of Streator (Draft EIS, Table E-17). The cities range in population from 125,963 (Peoria) to 1,232 (Granville). Streator ranks as the seventh largest of the twenty cities, based on a population of 15,600.

Streator's expenditures are at the median level. The level (at $128 per capita) is much closer to the low (at $58 per capita) than to the high (at $508 per capita) finance value. Streator's revenues per capita ($130) are lower than the median level ($141), but its revenues still slightly exceed expenditures. Streator is in a particularly favorable relative position with respect to per capita debt. Its $27 per capita is considerably less than the median of $96 and substantially less than the high of $1,193 per capita. Assessment per capita ($2,154) is somewhat less than median ($3,554) but not by enough to affect Streator's rank among cities with respect to debt. Streator remains at a favorable seventeenth, with only $9 of debt per $1,000 assessed value compared to the high of $298.

Streator's relative position in the rankings remains about the same among the top ten cities in population and among ten cities in the mid-population range (from Normal with about twice Streator's population to Clinton with about half). With respect to expenditures, Streator ranks sixth out of ten in both groupings. With respect to debt (expressed either on a per capita or per $1,000 assessment basis), Streator ranks eighth out of the ten top cities and ninth out of the ten mid-size cities.

The major portion of Streator's 1974 per capita debt, $23 of $27, was in revenue bonds (Draft EIS, Table E-17). This does not represent a general obligation of the City. The revenue bonds are those covering the City's wastewater treatment facilities.

The general picture of indebtedness was about the same in 1977 as in 1974. Based on the analysis of the 1977 Financial Statements, outstanding revenue bond indebtedness was lower than in 1974, the City having reduced this indebtedness during the interim. The revenue bond indebtedness stood at $315,000 or $20 per capita compared to $358,000 or $23 per capita in 1974. Other net indebtedness appeared to be somewhat higher.

If Streator were to increase its debt to the median of the twenty cities, that is from $27 to $96 per capita (or by $69/capita), this would provide about $1.08 million in funds (15,600 x $69/capita). The average (arithmetic mean) debt of the twenty cities at $101 per capita is slightly above the median at $96 (Draft EIS, Table E-18). Raising Streator's debt to this level (by $74 per capita rather than $69) would yield about $1.15 million. Finally, if Streator were to increase its per capita debt to the highest per capita debt level among the twenty cities, that is from $27 to $1,193 per capita, this would provide over $18 million in funds ($15,600 x $1,160/capita). This would raise the debt to $378 per $1,000 of 1974 assessed valuation.

Streator's expenditures, revenues, and debt position also can be compared with the expenditures, revenues, and debt position of large cities in the US (Draft EIS, Tables E-19 and E-20). Streator's financial requirements are very low and its debt position is extremely low compared to large cities. Two cities, New York and Washington, have higher per capita debts than Princeton, which has the highest in the Streator region. One city, Atlanta, has about the same as Princeton. The lowest per capita debt among the thirty largest cities in the US is for San Diego. At $185, this is much higher than Streator's $27. In summary, the financial burden of community services and debt to the people of the Streator area is very moderate compared with the burden in other cities.

4.0. EXISTING WASTEWATER FACILITIES AND FLOWS

4.1. Sewer System

The City of Streator has a combined sewer system that includes approximately 53 miles of sewers. It provides service to most of the City (Warren & Van Praag, Inc. 1975). A small area, west of Bloomington Street and north of 1st Street, is served by a separate sanitary sewer system (about 3 miles of sewers). Both systems are primarily clay sewer tile with okum-sealed joints. There are some brick sewers in the combined sewer system. The location of the sewer service area, the major interceptor sewers, and the treatment plant are indicated in Figure 4-1.

In a combined system, both wastewater (dry-weather flow) and stormwater are transported in the same sewers. Currently, when the capacity of the Streator facilities is exceeded during wet-weather periods, the excess combined flow escapes the sewer system without treatment (Warren & Van Praag, Inc. 1975). Some of this flow is diverted to the Vermilion River or to its tributaries by about fourteen diversion structures. The rest of the excess flow is discharged to the mines via numerous (possibly as many as 600) drop shafts installed throughout the sewer system. The drop shafts generally protrude above base level in the sewers. Some, however, were installed flush, or nearly so, with the bottom of the sewer. In these cases, dry-weather flows are discharged to the mines as well.

The three major east-west interceptors (Prairie Creek, Kent Street, and Coal Run) were inspected during Autumn 1977. All three were very old and were in poor condition. Specific problems included:

- Ponding of sewage/stormwater flow
- Manholes with grit/sludge deposits hindering flow
- Surcharging of raw sewage into adjacent watercourses
- Stream flow entering the sewage system in large quantities
- Numerous by-passes to streams
- Curved pipe alignments along streams to follow natural drainageways
- Presence of toxic gases in manholes caused by gases entering through drop shafts (two men have been killed in Streator by these gases)
- Presence of gasoline in the sewage flow.

A massive rehabilitation program is required if these interceptors are to be used in the future. Findings during the inspections are detailed in the Draft EIS, Appendix F.

The trunk and lateral lines generally are in good condition (Warren & Van Praag, Inc. 1975). Infiltration (groundwater seepage into the lines), however, has become a problem due to the age of the system and the type of materials used to seal pipe joints. Seepage increases flows to the treatment plant, reduces the wastewater capacity in the sewers and at the plant, and increases the frequency and volume of overflows to surface waters.

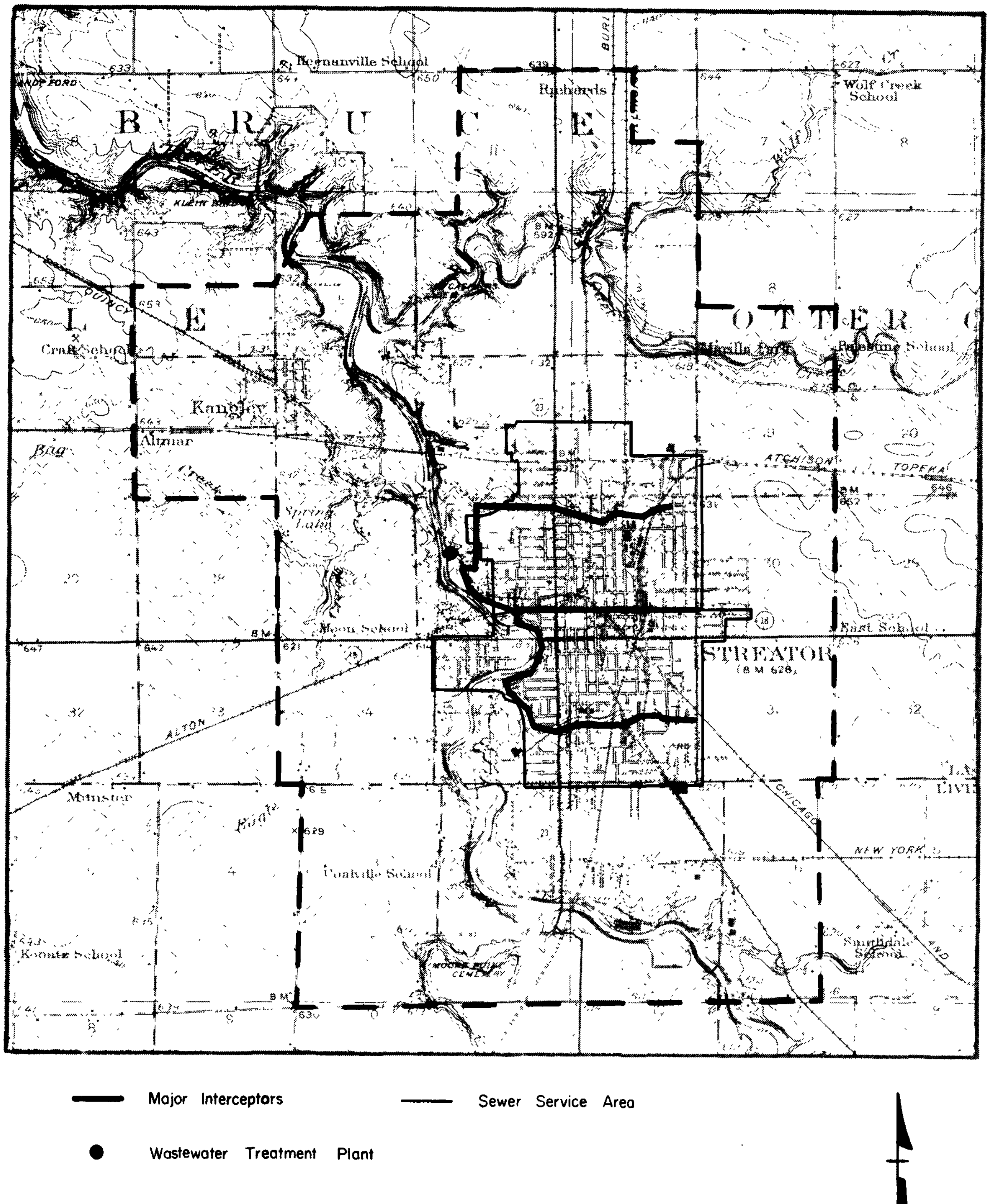

Figure 4-1. Location of the sewer service area, the major interceptors, and the wastewater treatment plant in the Streator, Illinois, FPA.

4.2. Treatment Facilities

The Streator wastewater treatment plant was designed to provide secondary treatment for an average daily flow of 2.0 mgd. Sewage flow is measured with a Parshall flume. Preliminary treatment is provided by bar racks, a barminutor, an aerated grit chamber, and a preaeration tank. Sewage undergoes primary treatment in settling tanks and then is treated biologically by a conventional activated sludge unit. Secondary settling is provided, and the treated sewage is discharged through a cascade aerator. The aerator is used to increase the dissolved oxygen level in the effluent. Sludge is digested anaerobically and is stored on-site in sludge lagoons.

The treatment plant was inspected during October 1977 (Draft EIS, Appendix F). The plant was in excellent condition, reflecting regular maintenance and repair. With minor improvements, the facilities can be incorporated in an upgraded or expanded system. Various components have deteriorated through normal use over a 22-year period, and some areas of the plant do not meet OSHA safety standards.

4.3. Wastewater Flows

4.3.1. Industrial Wastewater Survey

During the facilities planning process, Warren & Van Praag, Inc. (1975), conducted an industrial wastewater survey to determine the quantities and strengths of industrial wastewaters and the methods of discharge. To update and expand the data base, industries that initially responded were contacted again by telephone during Autumn 1977. Most of the industries were unable to supply specific information on the chemical characteristics of their wastewaters. None of the industries contacted expressed any plans for expansions of their plants or for increases in water consumption in the near future.

The latest survey indicated that the documented industrial wastewater flows accounted for 82% of the total industrial water consumption (504 million gallons) in the Streator FPA during 1976 (Table 4-1). Approximately 74.5% of the wastewater was discharged to the mines, and 25.5% was discharged to the sewer system. The glass industries were the major water consumers and dischargers in Streator. Owens-Illinois, Inc., accounted for 72% of the documented industrial wastewater flow, and Thatcher, Inc. accounted for 10%. The respective contributions of this industrial group to drop shafts and city sewers was approximately the same as for the total industrial wastewater flows, 76% and 24%, respectively.

Documented industrial wastewater flows were separated to show the amounts of contaminated process water, clean cooling water, and sanitary wastes discharging to the mines and to the sewers (Table 4-2). For those few industries from which such specific data were not available, estimates were made based on data for similar industries. When this was not possible, the wastewater flows, less estimated sanitary wastes, were assumed to be contaminated process waters. Estimates of sanitary wastes were based on an employee generation of 30 gallons per working day, except in

Table 4-1. Documented industrial wastewater flows discharging to the mines and to the City sewers during 1976 in the Streator, Illinois, FPA.

Company	Total Flow to Mines (Gallons/year)	Total Flow to Sewers (Gallons/year)	Total Wasteflow (Gallons/year)
Anthony Co.	12,337,000	--	12,337,000
Flink	--	570,000	570,000
Knoedler Inc.	--	3,360,000	3,360,000
Myers-Sherman	21,278,000	--	21,278,000
Owens-Illinois	200,500,000	74,500,000	275,000,000
Plymouth Tube	4,333,000	9,711,000	14,044,000
Streator Brick	1,639,000	--	1,639,000
Streator Dependable	4,705,000	--	4,705,000
Sunstar Foods	--	8,944,000	8,944,000
Teleweld	--	319,000	319,000
Thatcher	39,600,000	--	39,600,000
Subtotal	284,392,000	97,494,000	381,796,000
Percent of Total	74.5%	25.5%	100%
Average Daily Flow	0.78 mgd	0.27 mgd	1.05 mgd

Table 4-2. Types of industrial wastewater flows discharging to the mines and sewers in the Streator, Illinois, FPA.

Industry	Contaminated Process Waters	Clean Cooling Water	Sanitary Wastes
Flows to Mines (gal/yr)			
Anthony Co.	9,638,000	546,000	2,153,000
Myers-Sherman	18,282,000	2,216,000	780,000
Owens-Illinois	140,000,000	60,550,000	--
Plymouth Tube	4,333,000	--	--
Streator Brick	110,000	--	1,529,000
Streator Dependable	3,885,000	--	820,000
Thatcher	28,170,000	8,720,000	2,710,000
Subtotal	204,418,000	72,032,000	7,992,000
Adjusted Subtotal	269,681,000	95,029,000	10,544,000
Flows to Sewers (gal/yr)			
Flink	--	--	570,000
Knoedler	2,775,000	--	585,000
Owens-Illinois	55,650,000	--	18,800,000
Plymouth Tube	--	9,360,000	351,000
Sunstar Foods	8,320,000	--	624,000
Teleweld	--	117,000	202,000
Subtotal	66,745,000	9,477,000	21,132,000
Adjusted Subtotal	**88,054,000**	**12,503,000**	**27,879,000**

those cases where available data provided a more accurate determination. The various wastewater flows were adjusted upward (by a factor of 1.319) to account for total 1976 industrial water consumption (the actual amount consumed by industry during 1976 divided by the total amount of industrial wastewater in 1976 equals 1.319; Table 4-1). Industrial flows by category and discharge method are summarized below:

Industrial Wasteflows	Average Daily Flow (mgd)	Million Gallons per year	Percent of Total
Contaminated Industrial Wastes to Sewers	0.241	88.1	17.5
Contaminated Industrial Wastes to Mines	0.739	269.7	53.5
Clean (cooling water etc.) Wastes to Sewers	0.034	12.5	2.5
Clean (cooling water etc.) Wastes to Mines	0.260	95.0	18.9
Sanitary Wastes to Sewers	0.076	27.9	5.5
Sanitary Wastes to Mines	0.029	10.5	2.1
	1.379	503.7	100.0

Approximately 21.4% of the total industrial wastewater flow was uncontaminated cooling water, approximately 7.6% was sanitary waste, and the remaining 71% was wastewater contaminated to some degree by industrial processes.

4.3.2. Domestic Wastewater Flows

Domestic wastewater flows to the treatment facilities were determined from water consumption records. During 1976, a total of 3.0 mgd of water was distributed to all users (Northern Illinois Water Corporation 1977). Thus 1.62 mgd were consumed by commercial, municipal, and residential users (3.0 mgd minus 1.38 mgd for industries). Assuming the population of the water service area was equivalent to the population of the Streator FPA minus the population of Kangley that uses groundwater (21,750 - 290 = 21,460; Section 3.5.1.),[1] the rate of use was approximately 75.5 gallons per capita per day.

In the sewer service area (not as large as the water service area), there are approximately 12,700 residents (Section 3.5.1.), and at 75.5 gallons per capita per day, they used 0.96 mgd. If it is assumed that 80% of the water is discharged to the sewer system (generally 60% to 80%; Metcalf & Eddy, Inc., 1972), 0.77 mgd were directed to the wastewater treatment plant during 1976. Based on the same assumptions, residents in the Streator FPA but outside the sewer service area (21,460 - 12,700 = 8,760) consumed 0.66 mgd of water and generated 0.53 mgd of domestic wastewater. A significant portion of this wastewater flow is discharged to the mines.

4.3.3. Inflow/Infiltration

The wastewater measured at the treatment plant averaged 2.03 mgd during 1976 (Nichols 1977). The difference between the measured, annual

[1] This assumption implies that there are approximately 3 people per residence (21,460 people in the service area ÷ 7,087 residential customers = 3.03). Statistics for Streator show that there are 2.94 persons per household (Draft EIS, Section 2.5.2.2.).

average flow, and the combined, theoretical industrial and domestic wastewater flows (1.12 mgd) is 0.91 mgd. This value represents the estimated average inflow and infiltration (I/I) to the treatment plant. It, however, reflects flows over the entire year during both dry-weather and wet-weather conditions. The I/I flow entering the sewer system and reaching the treatment plant during storm events is considerably higher.

The actual amount of I/I could not be estimated accurately. No subsystem within the sewer system was found in which all incoming and outgoing flows could be measured. The amount of flow from roof and foundation drains, cracked and broken sewer lines, stormwater runoff, and other sources, and the amount of flow discharged from the sewer system to the mines and to surface waters could not be determined. The I/I entering the sewer system could be significantly larger than the I/I reaching the plant.

4.4. Wastewater Quality

The wastewater treatment plant originally was designed to treat an organic loading of 3,400 pounds BOD_5 (204 mg/l) and 4,400 pounds SS (264 mg/l) per day. The design loadings were based on a tributary population equivalent to 20,000 at 100 gallons per capita per day, 0.17 pound BOD_5, and 0.22 pound SS per capita per day. The total daily average loading for the period from July 1976 to June 1977 is presented in Table 4-3, along with treatment plant performance records. The average BOD_5 loading is about 200 pounds per day larger than the loading presented in the draft Facilities Plan (Warren and Van Praag, Inc. 1975). In addition, the average BOD_5 concentration in the plant effluent has increased from 5.5 mg/l in 1973-1974 to 14.5 mg/l in 1976-1977 (Nichols 1977). This is unusual for an area that has achieved little, if any, growth. The increased use of garbage disposals and/or different industrial discharges often can result in an increased organic loading to a wastewater treatment plant.

Using design loading values of 0.17 pound of BOD_5 and 0.22 pound of SS per capita per day and assuming a population of 12,700 within the service area, a total of 2,159 pounds of BOD_5 and 2,794 pounds of SS should reach the wastewater treatment plant. Based on the plant records, however, the influent contains about 60% of the expected BOD_5 and SS loads (Nichols 1977). Some of this load is discharged to the mines and to surface waters. In addition, because wastewater flows are higher than predicted for the population served, significant dilution of wastewater occurs due to I/I.

Table 4-3. Performance of the Streator wastewater treatment plant during the period from July 1976 to June 1977 (Nichols 1977). The average flow was 1.8 mgd.

	Influent	Effluent	Percent Purification
BOD_5	1,310 lbs/day 83 mg/l	218 lbs/day 14.5 mg/l	83
SS	1,651 lb/day 111 mg/l	78 lbs/day 5.2 mg/l	95
DO		7.9 mg/l	

The Streator wastewater treatment plant has authorization to discharge under National Pollutant Discharge Elimination System (NPDES) permit number IL0022004. The discharge presently is meeting the interim effluent limitations of 20 mg/l BOD_5 and 25 mg/l SS, but the wastewater treatment plant will have to meet more stringent effluent requirements in the future. The final NPDES permit requires an effluent quality of 4 mg/l BOD_5, 5 mg/l SS, 1.5 mg/l NH_3-N, and fecal coliform counts not larger than 200 per 100 milliliters (30-day average). IEPA, however, indicated that the effluent limitations for BOD_5 and SS may be changed to 10 mg/l and 12 mg/l, respectively. (By letter, Mr. Roger A. Kanewa, IEPA, to Mr. Charles Sutfin, USEPA, 18 July 1978); ammonia-nitrogen and fecal coliform requirements would remain the same.

4.5. Future Environmental Problems Without Corrective Action

Existing environmental problems associated with the wastewater collection and treatment facilities would persist and could worsen if no corrective action were taken. Presently, pollutant loads to surface waters from the sewer system and the treatment plant are significant and, to a certain degree, are responsible for water quality problems in the Vermilion River and its tributaries in the Streator study area. In-stream conditions sometimes exist that are hazardous to both aquatic life and public health and that could affect downstream uses of surface waters (Section 3.3.1.3.).

Based on the effluent limitations of the final NPDES permit or the less stringent limitations that are acceptable to IEPA, the treatment facilities will have to be upgraded (Section 4.4.). The NPDES permit imposes limitations on combined sewer overflows to surface waters and to the mines. These are:

1) Secondary-tertiary facilities must have capacity for and must treat all flows up to 2.5 times design average flow

2) All flows to combined sewer systems that exceed 2.5 times the design average flow and that cannot be reasonably eliminated must receive at least primary treatment and disinfection for up to 10 times design average flow . . . to be treated by the secondary-tertiary facilities

3) Flows in excess of (2) above may be required to be treated to prevent water quality violations, to remove floating debris and solids, and to prevent depression of oxygen levels below those specified in Rule 203 (d) of the Illinois Pollution Control Board regulations (1977)

(4) The annual average quality of all flows discharged in (1), (2), and (3) above must not exceed 30 mg/l BOD_5 and 30 mg/l SS.

The City of Streator would be in violation of the conditions in its NPDES permit if it were not to provide the treatment necessary to achieve effluent regulations.[1]

In addition, because of the deteriorated condition of the three interceptor lines and the age of the trunk and lateral lines, infiltration to the collection system would increase. This would increase flows discharged to the mines and the frequency and volume of overflows and bypasses to surface waters. Flows to the treatment plant also would increase, as well as the operation and maintenance costs to treat the flows. I/I already contributes 45% of the average daily flow to the plant (Section 4.3.3.).

Discharges of raw sewage from the interceptors to surface waters and ponding of wastewater flows would continue if the deteriorated interceptors were used in the future. Blockages or constrictions in the interceptors because of deterioration or subsidence could cause wastewater flows to back up and create nuisance conditions. Drop shafts in the sewer system that discharge flows to the mines also could become blocked. Reduction in the amount of flow to the mines would result in lowered water levels in the mines and thus would increase the potential for subsidence (Appendix B). If the sources of water for mine recharge and the discharges to the mines were to remain the same, mine leachates would continue to contribute similar pollutant loads to Prairie Creek and the Vermilion River (Appendix C).

[1] These conditions may be modified based on the final determination of a cost-effective solution to the potential mine subsidence problem.

5.0. ALTERNATIVES

5.1. Objectives

Wastewater management alternatives for the Streator FPA, as presented herein, were developed to meet the needs/requirements of the current and future service area population and to conform with State and Federal regulations. The principal objective was to reduce pollutant loads to surface waters (Section 3.3.1.3.). All alternatives must provide treatment to achieve the effluent requirements of the final NPDES permit or those acceptable to IEPA (Section 4.4.). Alternatives also must include measures/facilities to reduce discharges of untreated wastewater from cracked and broken sewer lines and combined sewer overflows to surface waters. In addition, because leachates from the mines mix with surface waters, alternatives must include measures to reduce to varying degrees pollutant loads discharged directly or indirectly to the mines via the sewer system.

Another common objective was to develop alternatives that would not increase the potential for subsidence. Because hydrostatic levels in the mines should be maintained and because water level fluctuations should be minimized (Appendix B), alternatives include measures to continue recharge (inflow) comparable to the domestic, industrial, and stormwater flows currently entering the mines.

The third objective was to minimize costs for construction and for operation and maintenance of the appropriate wastewater control system. All facilities are sized to reflect a zero growth population projection (Section 3.5.3.).

5.2. System Components and Component Options

The development of wastewater management alternatives began with the identification of possible functional components that would comprise feasible and implementable wastewater collection and treatment systems. The functional components considered are:

- Flow and Waste Reduction -- includes infiltration/inflow reduction and water conservation measures
- Collection System -- includes sewer separation, rehabilitation of the combined sewer system, and service area extensions
- Wastewater Treatment -- includes expansion of plant capacity, additional treatment to meet effluent limitations, and construction of facilities to store and/or treat excess combined sewer flows not discharged to the mines
- Recharge to Subsurface Mines -- includes recharge from a storm-water collection system, recharge from the combined sewer system, and recharge of treatment plant effluent

- Mine Leachate Control -- includes collection and treatment of mine leachates

- Permanent Subsidence Control -- includes backfilling of mines with solids.

The methods considered for fulfilling the functions of each of these six system components are termed "component options" or "options."

The selection of options for one component is, to some extent, dependent on options considered for other components. For example, the type of collection system being considered can modify the quality of wastewater entering the treatment plant and, thus, the level of treatment required to meet effluent limitations. If rehabilitation of the combined sewer system at Streator were chosen as a collection system option, the influent would be more dilute than if construction of a separate sanitary sewer system were chosen. This is an example of functional dependence when consideration of one component option may either preclude or necessitate consideration of a dependent option in another component. This type of dependence normally can be distinguished from design dependence when the capacity, length, strength, area, etc., of an option depends on the selection of options in a separate component. For instance, the options for industrial wastewater disposal will affect the hydraulic design of wastewater treatment processes.

In the following sections, component options for the Streator wastewater facilities will be identified and discussed to the extent necessary to justify or reject their inclusion in system-wide alternatives. Reasonable combinations of component options will be combined to define system alternatives. Often a change in an independent option within one component will not affect substantially the overall cost-effectiveness of an alternative. In these instances, sub-alternatives will be identified so that decisions on the specific independent options can be made separately from the comparisons between system alternatives.

5.2.1. Flow and Waste Reduction

5.2.1.1. Infiltration/Inflow Reduction

The actual amount of I/I presently entering the Streator sewer system is unknown. The treatment plant flow records, however, reveal that the amount of I/I is significant (Section 4.3.3.). An average of 0.91 mgd reaches the plant and an unknown quantity enters the mines via drop shafts. Based on characteristics of the combined sewer system such as age, type of joints, and physical condition, the maximum infiltration rate was estimated to be 90,000 gallons per mile of sewer per day, or approximately 5.0 mgd (Warren & Van Praag, Inc. 1975).

The amount of inflow to the sewer system can not be quantified because all sources and their flows are unknown. The amount of I/I that can be eliminated depends on the collection system option utilized (Section 5.2.2.).

Construction of a new sewer system would reduce infiltration significantly. New sewers would be constructed from the most modern materials and would have almost water-tight joints. The maximum infiltration rate for new sewer systems should be 200 gallons or less per inch of sewer pipe diameter per mile per day (Ten States Standards 1978). Based on the length of the Streator sewer system (56 miles) and the average sewer pipe diameter (9 inches), the amount of infiltration to a new sewer system would be approximately 101,000 gallons per day or 1,800 gallons per sewer mile per day. This represents a reduction in the maximum infiltration rate of about 98%.

The use of the existing sewers in collection system options would require a sewer system survey and subsequent rehabilitation work. The average infiltration eliminated by previous rehabilitation work in the Midwest is approximately 62% (Warren & Van Praag, In. 1975). Rehabilitation of the sewer system at Streator, therefore, could reduce the maximum infiltration to approximately 34,200 gallons per mile per day. If the interceptors (4.7 miles of sewers) were replaced and the collector lines were rehabilitated, the infiltration rate could be reduced further.

Inflow would be reduced significantly by rehabilitation and/or construction of a new sewer system. If the interceptors were replaced, a major source of inflow (stream flow into cracked and broken interceptors) would be eliminated. Sewer separation would eliminate all stormwater inflow to the treatment plant.

5.2.1.2. Water Conservation Measures

Because the per capita amount of water consumed in the Streator FPA is relatively small, water conservation measures would be marginally effective in reducing wastewater flows to the treatment plant and, thus, are not necessary. Water consumption for the commercial, municipal, and residential uses averaged 75.5 gallons per capita per day during 1976 (Section 4.3.2.). Assuming that 80% of water consumed in the sewer service area enters the sewer system, an average flow of only about 60 gallons per capita per day was conveyed to the wastewater treatment plant.

5.2.2. Collection System

5.2.2.1. Sewer Separation

Sewer separation would require installation of a new sanitary sewer system. Such a system would reduce significantly the amount of I/I reaching the treatment plant and would eliminate the discharge of untreated sewage to the mines. The existing combined sewer system would be rehabilitated and modified to discharge stormwater to the mines (Section 5.2.4.).

The option for sewer separation is similar to the alternative recommended in the draft Facilities Plan (Warren & Van Praag, Inc. 1975), except that the collector and interceptor sewers were sized to reflect a zero-population growth projection (Section 3.5.3.). Interceptor routes would be changed slightly to avoid areas where the potential for subsidence is high (Appendix B). Light-weight, plastic-type sewer pipes and joints could be used to provide flexibility, and timber cradles and concrete supports could be provided to distribute the weight of the interceptor lines. Such measures would minimize the potential for damage to new sewers from future subsidence.

5.2.2.2. Rehabilitation of the Combined Sewer System

This option includes continued use of the existing combined sewer system after rehabilitation. The three main interceptors would be replaced to reduce the amount of I/I at the treatment plant and to eliminate discharges to surface waters from cracked and broken sections. The interceptors would be sized to convey large storm flows to the treatment facilities, thereby reducing combined sewer overflows to surface waters.

The existing system would continue to discharge combined sewer flows to the mines. This discharge is necessary for mine recharge (Section 5.2.4.). The discharge of combined sewer flows to the mines, however, would require approval from the Illinois Pollution Control Board and the Illinois Mining Board (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978).

If combined sewer flows could not escape to the mines, the entire sewer system would have to be enlarged considerably. Similarly, treatment and/or storage facilities would have to be sized to accommodate all combined sewer flows. Such a project would be prohibitively expensive and would cause extensive disturbance and disruption in Streator.

Rehabilitation of the collector lines also would be required. A sewer system evaluation survey would be conducted to detect significant sources of I/I. In addition, drop shafts in the system that are found to be level with the bottom of sewers or manholes would be raised, if possible, to prevent the discharge of dry-weather flows to the mines. Not all of these drop shafts, however, will be located.

5.2.2.3. Service Area Options

Two service area options are being considered. One is maintaining the present size of the service area. The other is extending sewer service to unsewered sections of the Streator FPA. Areas include South Streator, East Streator, and West Streator (Figure 5-1). The layout of additional sanitary sewers was presented in the draft Facilities Plan (Warren & Van Praag, Inc. 1975). The system, however, has been re-sized for a zero-growth population projection.

Federal funding for the extension of sewer service to unsewered areas depends on compliance with requirements presented in Program Requirements Memorandum (PRM) 78-9 (USEPA 1978). The Village of Kangley does not meet all of the funding requirements. Septic tank systems currently are being used on suitable soils (Draft EIS, Section 2.2.3.1.). Some wastewater may be discharged directly or indirectly as septic tank effluent to mined-out areas beneath the Village. There is no evidence, however, of a public health hazard or a suface water quality violation that can be attributed to wastewater disposal practices in the area. No mine leachates have been observed near Kangley (Appendix C). Potable water is obtained from groundwater sources, but the aquifers are protected from downward contamination

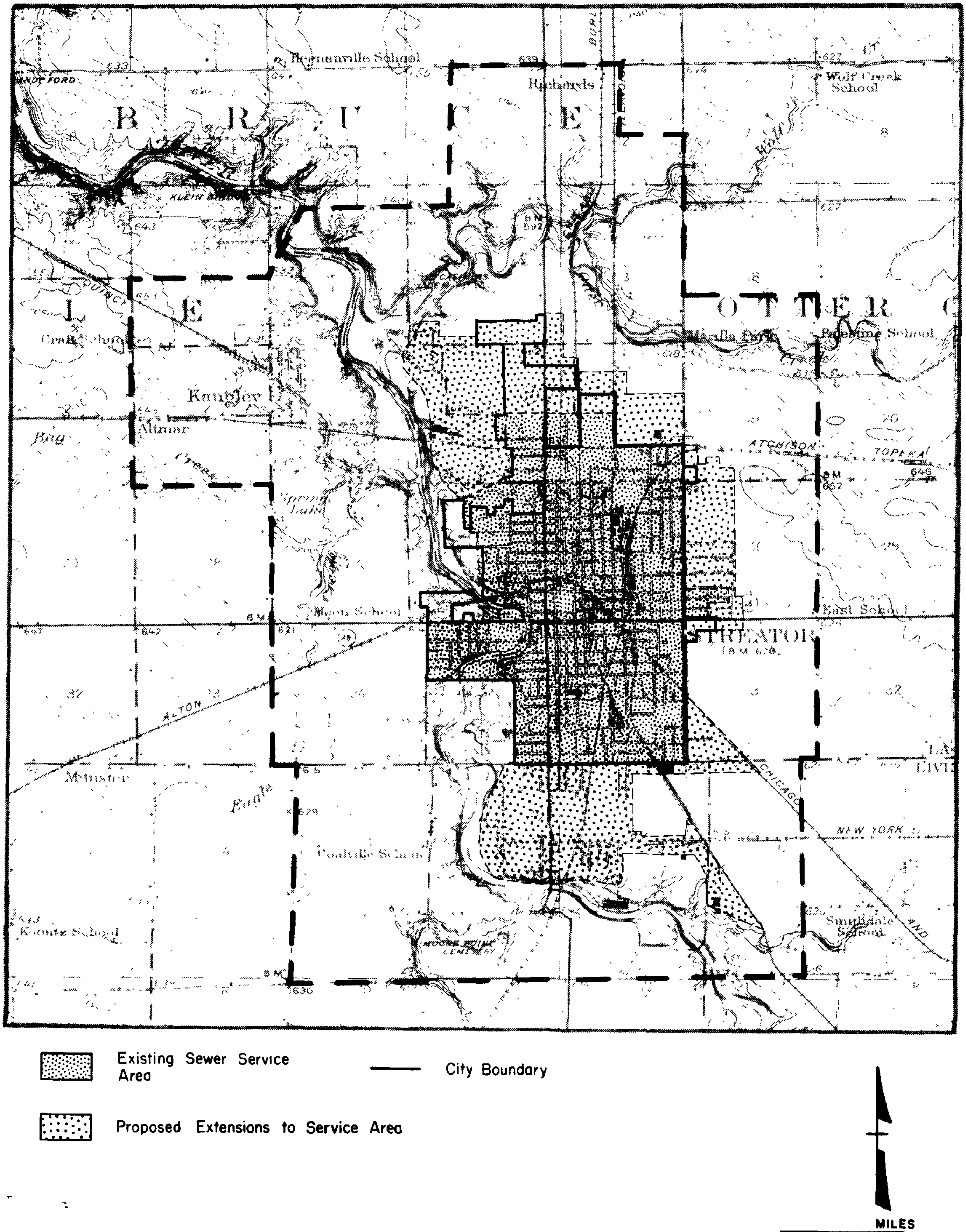

Figure 5-1. The existing sewer service area and the proposed service area extensions in the Streator, Illinois, FPA.

by the relatively impervious character of the clays and shales above them (Section 3.3.3.). Extension of sewers to Kangley, therefore, would not be cost-effective and was eliminated as a viable extension.

Extension of sewers to those areas being considered may be eligible for Federal funding. Many of the lot sizes are too small to be suitable for septic tank systems. Some residential lots have septic tanks without absorption fields that discharge effluents to the mines. It is not known if these discharges cause violations of State water quality standards, because it is not clear to what extent mine leachates adversely affect surface water quality (Appendix C) and to what degree unsewered areas contribute to the pollutant concentrations of the leachates. To comply with the Private Sewage Disposal Licensing Act and Code of 1974 and other State regulations (IPCB 1977), it will be necessary to eliminate discharges of septic tank effluents and other sanitary wasteflows to the mines from the unsewered areas. Additional facilities planning will have to determine whether this can be accomplished most cost-effectively by means of collector sewers or by alternative on-site disposal systems. It would not appear to be cost-effective for the different unincorporated areas to build their own collection and treatment facilities.

5.2.3. Wastewater Treatment

5.2.3.1. Treatment Plant Design Capacities and Industrial Wastewater Disposal Options

Two treatment plant design capacities are being considered. One is the existing 2.0 mgd capacity, and the other is a 2.6 mgd capacity. The capacity options are dependent on the size of the service area and on industrial disposal options.

There are several options for the disposal of industrial wastewaters. The options being considered include:

- Continued discharge of wastewaters (sanitary wastes, cooling water, and contaminated process water) to both the sewer system and to the mines (Section 4.3.1.)

- Continued discharge of cooling and process waters to both the sewer system and the mines, and discharge of all sanitary wastes to the sewer system

- Continued discharge of cooling water to both the sewer system and the mines, and discharge of all sanitary wastes and process water to the sewer system.

The existing treatment plant capacity would be sufficient if current industrial discharge practices (Scenario A, Table 5-1) were continued; if all industrial sanitary wastes were directed to the sewer system (Scenario B); if all industrial sanitary wastes were directed to the sewer system, and if the sewer service area were expanded (Scenario C); or if all industrial sanitary wastes and process water were directed to the sewer system (Scenario D). The treatment plant would have to be expanded if all indus-

Table 5-1. Average daily dry-weather flows to the 2.0 mgd treatment plant and to a 2.6 mgd treatment plant. Flows are based on service area options and industrial wastewater disposal options. Methods used to estimate flows are presented in Section 3.3.

<u>Flows to the 2.0 mgd plant (mgd)</u>

Current flows (Scenario A)

Domestic	0.77
Industrial	0.351
Total	1.121

Current flows plus industrial sanitary wastes presently discharged to the mines (Scenario B)

Domestic	0.77
Industrial	
(existing)	0.351
(additional sanitary wastes)	0.029
Total	1.150

Current flows plus additional domestic flows and industrial sanitary wastes presently discharged to the mines (Scenario C)

Domestic	
(existing)	0.77
(additional)	0.53
Industrial	
(existing)	0.351
(additional sanitary wastes)	0.029
Total	1.680

Current flows plus industrial sanitary wastes and process water presently discharged to the mines but no additional domestic flows (Scenario D)

Domestic	0.77
Industrial	
(existing)	0.351
(additional sanitary wastes)	0.029
(additional process water)	0.739
Total	1.889

<u>Flows to a 2.6 mgd plant (mgd)</u>

Current flows plus additional domestic flows and industrial sanitary wastes and process water presently discharged to the mines (Scenario E)

Domestic	
(existing)	0.77
(additional)	0.53
Industrial	
(existing)	0.351
(additional sanitary wastes)	0.029
(additional process water)	0.739
Total	2.419

trial sanitary wastes and process water were conveyed to the sewer system, and if the sewer service area were expanded (Scenario E).

All discharges to the mines would require permits from the IEPA and the Illinois Mining Board (By letter, Mr. Roger A. Kanerva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978). The State, in attempting to reduce organic loads, may not allow the discharge of sanitary wastes to the mines. Conversely, the State may allow the discharge of cooling and process waters to the mines. Not all of the process water, however, may be considered innocuous and suitable for mine recharge. When industries apply for appropriate permits to discharge to the mines, the process water will be analyzed. Results may show that only a small percentage of the process water is suitable for mine recharge. If this were the case, some of the process water would have to be pretreated prior to mine discharge or conveyed to the treatment plant. Regardless, pretreatment of some process water may be necessary before conveyance to the treatment plant.

The two treatment capacity options are not dependent on the amount of I/I associated with the different collection options (Section 5.2.1.1.). The sewer separation option would contribute a maximum infiltration rate of only 0.101 mgd. The rehabilitation of the combined sewer system would contribute more infiltration than sewer separation, but excess combined flows would be treated at separate facilities, not at the treatment facilities for dry-weather flows. Stormwater inflow would be reduced significantly by rehabilitation of the existing system and would be eliminated by sewer separation. Extension of sanitary sewers would not contribute excessive infiltration.

5.2.3.2. Level of Treatment

Four levels of treatment are being considered for dry-weather flows. The treatment options include:

- Existing secondary treatment (Section 4.2.) with continuous effluent recharge to the mines
- Upgraded secondary treatment -- existing secondary treatment with nitrification and disinfection
- Tertiary treatment -- existing secondary treatment with nitrification, chemical coagulation, multi-media filtration, and disinfection
- Tertiary treatment without chemical coagulation.

Nitrification would be provided by a single-stage activated sludge process that would be accomplished by the addition of aeration tank capacity, final claifier capacity and aeration blower capacity to the existing activated sludge units. Disinfection would be provided by chlorination. Options that involve nitrification and filtration include a side-line flow equalization basin after preliminary treatment to reduce diurnal flow peaks and to optimize the performance of the additional unit processes.

Treatment options with stream discharge are not dependent on plant capacity options, but are dependent on collection system options. Collection options will have different amounts of I/I entering the sewers and, thus, will affect the concentrations of constituents in the treatment plant influent. The level of treatment required to achieve effluent limitations for stream discharge may depend on influent concentrations to some extent.

The use of a separate sewer system would require tertiary treatment to meet the final NPDES permit requirements (Section 4.4.). If the less stringent effluent limitations (10 mg/l BOD_5 and 12 mg/l SS versus 4 mg/l BOD_5 and 5 mg/l SS) were acceptable, chemical coagulation (tertiary treatment) would not be necessary.

The influent should be analyzed after the combined sewer system is rehabilitated to determine the required level of treatment. The influent should be sampled during dry-weather and wet-weather periods. Treatment must be sufficient to meet effluent limitations during worst conditions. For this study, with a rehabilitated combined sewer system, it is assumed that the final NPDES permit requirements could be met by tertiary treatment without chemical coagulation and that the less stringent requirements could be met by upgraded secondary treatment. The ability of the existing secondary treatment to meet effluent requirements is unknown.

Existing secondary treatment with continuous effluent recharge to the mines is an option that would not require upgraded treatment. The effluent would be discharged to the mines and may not have to meet requirements for stream discharge. This option also would use the mines for additional treatment. Analyses of mine leachates indicate that the physical, chemical, and biological processes occurring in the mines effectively remove BOD and suspended solids (Appendix C). The leachates analyzed during wet-weather conditions generally had BOD_5 concentrations that were at levels required by the final NPDES effluent limitations. The recharge of secondary effluent would have to be approved by the Illinois Pollution Control Board and the Illinois Mining Board. In addition, the leachate quantity and quality would have to be monitored during both dry-weather and wet-weather periods to assess the impacts of leachates on the quality of surface waters.

5.2.3.3. Treatment of Excess Combined Sewer Flows

The use of the rehabilitated combined sewer system would require treatment of excess wet-weather flows at the end of the collection system. Some sewer flows during wet-weather periods would be discharged to the mines, but there still would be flows conveyed to the treatment plant in excess of plant capacity. These flows can not be discharged to surface waters without appropriate treatment (Section 4.5.). Treatment options for excess wet-weather flows include:

- Primary treatment (12.3 mgd), followed by chlorination
- Storage (12.3 mgd), followed by primary treatment and chlorination at a slower rate (4.8 mgd)
- Storage (12.3 mgd) and mine recharge (4.8 mgd) without primary treatment or chlorination.

Mine recharge of excess combined sewer flows would require permits from the Illinois EPA and the Illinois Mining Board.

The ultimate storage volume and rate(s) of treatment are dependent on the design storm and the associated amount of excess combined sewer flows after rehabilitation of the combined sewer system. The amount of I/I that would enter the rehabilitated collection system and the amount of combined flows that would be discharged to the mines, however, are not known at this time. Therefore, the amount of excess flow for a design storm can not be determined. Once the sewer system is rehabilitated, the amount of excess flow should be measured to determine the ultimate storage volume and rate(s) of treatment. The excess flow would be larger if sewers were extended to presently unsewered areas and/or if industrial process waters were conveyed to the plant. The final design of facilities would depend on the results of analyses required under PRM 75-34 (USEPA 1975b; also referred to a Program Guidance Memorandum 61).

To compare treatment options and their costs, the amount of excess combined sewer flow that would require treatment was estimated using the Needs Estimation Model for Urban Runoff (USEPA 1977c). A 10-year design storm[1] was assumed. It also was assumed that no combined sewer flows would be discharged to the mines. The amount of excess flow was calculated to be 12.3 million gallons. A storage capacity of 12.3 mgd, therefore, would have to be provided to accommodate this flow. The design discharge rate, based on storm intervals averaged over a 10-year period, was calculated to be 4.8 mgd. Rates of treatment, therefore, could range from 12.3 mgd to 4.8 mgd. Assuming a 10-year design storm, however, is very conservative; a cost-effectiveness analysis will most likely indicate that a much smaller design storm should be used to compute the storage volume and treatment rate(s), which would result in smaller, less expensive facilities to treat excess flows.

5.2.4. Mine Recharge

Mines beneath Streator would be recharged most cost-effectively by discharges from both the collection system and an effluent recharge system. Recharge would depend on collection and treatment options. If sanitary sewers were constructed in the presently sewered area, stormwater collected by the existing sewer system would be discharged to the mines through drop shafts. If the existing system were rehabilitated, combined sewer overflows would be discharged to the mines during wet-weather periods.

Both of the collection options would eliminate flows discharged to the mines during dry-weather periods (Section 5.2.2.). Sewer separation would convey all domestic and industrial (dry-weather) flows to the treatment plant. Rehabilitation of the existing system would eliminate the present discharge of dry-weather flows to the mines. Drop shafts level with the bottom of the collection system would be raised (where possible) to intercept only wet-weather flows. A means to recharge the mines during dry-

[1] A storm that generates an average rate of rainfall for a 30-minute duration that would be equaled or exceeded on the average of once in a 10-year period.

weather periods, therefore, would be necessary to maintain water levels in the mines and to minimize the potential for subsidence. A system to pump wastewater treatment plant effluent to the mines would provide the necessary amount of recharge. Stream flow during periods of low-flow would not be sufficient to provide the required amount of recharge and stream dilution (necessary for pollutant loads discharged from the treatment plant and other sources of pollution in the Streator FPA). The impoundment upstream from Streator does not have a supply large enough for both existing water users and mine recharge during drought periods.

The recharge system would extend to both presently sewered and unsewered areas to ensure sufficient and even distribution of treated effluent in the mines (Warren & Van Praag, Inc. 1975). This would be necessary because the mines are partially interconnected (Appendix B), and thus, mine recharge can not be directed only to areas with a greater subsidence potential. Water recharged only to mines with unstable conditions may diffuse to other mines and may not be sufficient to minimize the potential for subsidence.

Depending on wastewater treatment options (Section 5.2.3.2.), the recharge system would be used on a continuous or intermittent basis. If treatment options include upgraded treatment and stream discharge, treated effluent would be recharged to the mines only during dry-weather periods when stormwater would not be recharging the mines. If treatment only involves existing secondary treatment, effluent would be recharged continuously. The option to store but not treat excess combined sewer flows would require use of the recharge system following wet-weather periods.

If treated effluent were recharged only during dry-weather periods, storm sewers and additional drop shafts would be installed in the presently sewered area to direct more stormwater to the mines (Warren & Van Praag, Inc. 1975). If sewers were separated, storm sewers would be necessary, because only stormwater would be discharged from the existing system to the mines. The flows discharged to the mines would be less than the combined sewer flows currently discharged during wet-weather periods. No dry-weather flows would enter the existing system, and I/I would be reduced significantly after rehabilitation. If the existing sewers were rehabilitated, storm sewers would be necessary, because less flow would be discharged to the mines during wet-weather periods. The amounts of domestic and industrial flows collected by the sewer system would be comparable to present flows, but the amount of I/I that would enter the system and that would be discharged to the mines would be reduced substantially. Storm sewers and additional drop shafts would help minimize the required capacity of new interceptors and facilities to treat excess combined sewer flows. Larger interceptor capacities and treatment facilities would be more expensive than the storm sewers and would result in higher operation and maintenance costs.

Storm sewers would not be installed in the presently sewered area if effluent were recharged continuously or if excess combined sewer flows were recharged to the mines. This would ensure that there would be sufficient capacity in the mines for the recharge of excess combined sewer flows and effluent during wet-weather periods.

If sewer service were extended (Section 5.2.2.3.), storm sewers would not be installed in those presently unsewered areas. If sanitary sewers were constructed, wasteflow (sanitary and industrial) presently discharged to the mines would be conveyed to the treatment plant. During dry-weather periods, this flow would be returned to the mines via the effluent recharge system. During wet-weather periods, this flow would be returned to the mines if treated effluent were recharged continuously, but it would not be returned if effluent were recharged only during dry-weather periods. The dry-weather flow, however, probably would not be significant enough to minimize the potential for subsidence in unsewered areas. The flow was estimated conservatively to be 0.53 mgd (Section 4.3.2.), assuming that all per capita flows from residents presently not receiving sewer service or living in Kangley are discharged to the mines. In addition, not all of this flow is discharged to the mines, and not all of the flow discharged is from those areas considered for sewer extension. The dry-weather flow contributed to the mines from these areas could be considerably less than 0.53 mgd and probably does not need to be replaced by stormwater contributions. In addition, construction of storm sewers would be very expensive and would not be cost-effective. The capital costs for storm sewers in presently unsewered areas, as outlined in the draft Facilities Plan (Warren & Van Praag, Inc. 1975) would be approximately $14.7 million, and operation and maintenance costs would be about $532,500 per year (at January 1978 price levels).

Stations recording water levels in the mines would be installed throughout the presently sewered and unsewered areas, as described in the draft Facilities Plan (Warren & Van Praag, Inc. 1975), and would be monitored continuously. The monitoring program should begin as soon as the existing sewer system is rehabilitated, whether it is to be used as a combined sewer or as a storm sewer. Monitoring would indicate if storm sewers are necessary in presently sewered and unsewered areas to maintain water levels. Monitoring also would show how water levels vary during dry-weather and wet-weather periods, and when and how much effluent should be recharged. If excess combined sewer flows were recharged to the mines (during wet-weather periods) monitoring would be necessary to prevent mine overloading and potential above-ground flooding.

5.2.5. Leachate Control

The impact of mine leachates on water quality can be controlled either by collection and treatment or by reducing pollutant loads discharged to the mines. Collection and treatment does not appear to be cost-effective. Field investigations indicated that leachates may not have a significant adverse effect on water quality in the Vermilion River, at least during high river flows (Appendix C). Construction of a collection system also would be extremely difficult. Leachate discharges to the Vermilion River occur along the stream banks and are under water during high river flows. Leachate discharges to Prairie Creek emerge on steep slopes and are scattered widely. Leachate channels at the base of the slopes are in the floodplain that is inundated during high water conditions.

Component options previously mentioned would reduce pollutant loads discharged to the mines and would improve the quality of leachates over time. Eliminating the discharge of dry-weather flows from the collection system to the mines and reducing direct discharges from residences and industries would reduce the concentrations of BOD_5, ammonia-nitrogen, and fecal coliform in the leachates. Smaller pollutant loads from leachates to the Vermilion River may be sufficient to eliminate any adverse impacts leachates may have on water quality in the river.

5.2.6. Permanent Subsidence Control

The various wastewater and stormwater management options considered in the development of system alternatives included maintenance of the water level in the mines to minimize the potential for subsidence. Such a management program, however, will not eliminate the potential for subsidence. Options for permanent subsidence control are discussed below.

The most widely used method of alleviating subsidence in undermined areas is backfilling the mine voids with mine refuse or other inexpensive materials (US Bureau of Mines 1976). This provides lateral support to mine pillars and vertical support to the mine roof and overburden. The US Bureau of Mines has sponsored such backfilling work in Pennsylvania in conjunction with the Pennsylvania Department of Environmental Resources. From 1964 through 1975, they jointly completed thirteen projects totaling 860 acres of surface area. These efforts cost approximately $9 million to protect property valued at over $121 million.

The Bureau of Mines conducted or participated in numerous demonstration projects during recent years to develop a pumped-slurry technique to fill inaccessible mine voids (US Bureau of Mines 1976). Granular material is injected hydraulically into the mine voids via drop shafts. This eliminates the need for mine dewatering and the subsequent hazard of subsidence during the interim. When resistance to slurry distribution is encountered, the slurry must be injected under pressure (60-80 psi). This ensures adequate distribution of the solids within the mine. The estimated cost per surface acre (assuming 50% extraction and 6-foot ceilings) for filling by this method has ranged from $30,000 to $36,000 (By phone, Mr. Tom Glover, US Bureau of Mines, Illinois State Office, to Mr. Dan Sweeney, WAPORA, Inc., 2 March 1978). This cost, however, assumes that mine-waste solids for fill are available on-site at no cost.

This technique could have some promise for application at Streator but would be plagued by two significant problems. Because of the pressure that must be utilized to inject the slurry, the mine system involved must be a relatively closed one. It would be extremely difficult, however, if not impossible, to cap drop shafts and discharge points from the mines at Streator. Uncapped drop shafts would act as pressure release points, emitting jets of mine water. Secondly, no on-site source of no- or low-cost fill material is readily available in the Streator area. Therefore, transportation and material costs could increase the total cost of the technique considerably.

The US Bureau of Mines has utilized sand for backfill material in instances where mine refuse materials were not available. Sand, when mined commercially, can be purchased for $1 to $2 per ton. Fly ash also has been utilized in Pennsylvania as a backfill material and is usually available at no cost as a waste product from coal burning power plants.

Law Engineering Testing Company (LETCo) estimated the total volume of mine voids in the Streator area to be 148.5 million cubic yards. If the hydraulic fill technique could be applied, the estimated cost would be from $17 to $20.5 million, plus any cost for the solid material and crushing that would be required for the slurry. If sand were available at an average cost of $1.50 per ton and if transportation costs averaged $2 per ton, the cost would be increased by an additional $800 million (148.5 million cubic yards, and 1.5 tons of sand per cubic yard). Although fly ash can be obtained for free and some utilities might even pay to have large quantities hauled away, Streator is not in close proximity to any coal burning power plant (approximately 25 miles distant). Transportation costs, especially with the need for pneumatically sealed bulk tank trucks, would increase the cost of the technique substantially.

Permanent subsidence control in areas that are most susceptible to subsidence would be technically and economically more feasible. A technique that could be used would be to form grout columns in critical mine voids. Grout columns would provide supplemental mine roof support. The procedure involves injecting a mixture of granular material and cement into the mines through drop shafts to form pyramidal shaped columns. After injection, the grout gains strength and becomes incompressible relative to other types of backfill material. The amount of material required per column is roughly equivalent to the cube of the thickness of the void (i.e., a 6-foot ceiling would require 216 cubic feet of material). The presence of water in mine voids and past caving, however, could hinder the use of this technique at Streator.

The costs of any permanent subsidence control measure would be considerably larger than the costs of recharge options. In addition, permanent subsidence control would not be eligible for Federal funding under the Construction Grants Program, because it would be considered much more than a mitigative measure. Recharge options would be grant eligible, because they would minimize impacts of collection options by maintaining water levels in the mines without affecting the current potential for subsidence.

5.3. System Alternatives

Based on the component options, thirty-six alternatives have been developed. The alternatives are combinations of various collection, treatment, and mine recharge component options. Although many of the alternatives contain several of the same options, each alternative contains a unique set of options. The thirty-six alternatives were separated into four general groups (Table 5-2). The nine alternatives in each group share one or more common options.

Alternatives in the first group include a separate sanitary sewer system. The treatment options consist of complete tertiary treatment, tertiary treatment without chemical coagulation, and secondary treatment with continuous effluent recharge to the mines. The last two options assume that effluent limitations less stringent than those of the final NPDES permit would be approved (10mg/l BOD_5 and 12 mg/l SS versus 4mg/l BOD_5 and 5 mg/l SS. Mine recharge would be provided by stormwater dis-

Table 5-2. Alternatives and component options for the treatment of wastewater at Streator, Illinois.

Alternative	Collection System	Treatment Method	Recharge System
1a	Separate sanitary sewers in presently sewered and unsewered areas.	Tertiary treatment[a] with expanded (2.6 mgd) plant capacity.	Mine discharge from old sewers and storm sewers in presently sewered area, and effluent recharge during dry-weather periods.
1b	Separate sanitary sewers in presently sewered area.	Tertiary treatment with existing (2.0 mgd) plant capacity.	same as #1a.
1c	same as #1a.	same as #1b.	same as #1a.
1d	same as #1a.	Tertiary treatment without chemical coagulation and with expanded (2.6 mgd) plant capacity.	same as #1a.
1e	same as #1b.	Tertiary treatment without chemical coagulation and with existing (2.0 mgd) plant capacity.	same as #1a.
1f	same as #1a.	same as #1e.	Same as #1a.
1g	same as #1a.	Existing secondary treatment with expanded (2.6 mgd) plant capacity and additional treatment in the mines.	Continuous effluent recharge, and mine discharge from old sewers.
1h	same as #1b.	Existing secondary treatment with existing (2.0 mgd) plant capacity and additional treatment in the mines.	same as #1g.

[a] Tertiary treatment consists of chemical coagulation and multi-media filtration.

Table 5-2. Alternatives and component options (continued).

Alternative	Collection System	Treatment Method	Recharge System
1i	same as #1a.	same as #1h.	same as #1g.
2a	Combined sewer system in presently sewered area, with rehabilitation and replacement of interceptors. Sanitary sewers in presently unsewered areas.	Flows conveyed to plant treated as in #1d. Excess combined sewer flows treated by primary (12.3 mgd) and chlorination facilities.	Mine discharge from combined and storm sewers in presently sewered area, and effluent recharge during dry-weather periods.
2b	Combined sewer system with rehabilitation and replacement of interceptors.	Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #2a.	same as #2a.
2c	same as #2a.	same as #2b.	same as #2a.
2d	same as #2a.	Upgraded secondary treatment with nitrification and chlorination and expanded (2.6 mgd) plant capacity. Excess combined sewer flows treated as in #2a.	same as #2a.
2e	same as #2b.	Upgraded secondary treatment with nitrification and chlorination and existing (2.0 mgd) plant capacity. Excess combined sewer flows treated as in #2a.	same as #2a.
2f	same as #2a.	same as #2e.	same as #2a.
2g	same as #2a.	Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #2a.	Continuous effluent recharge, and mine discharge from combined sewers.

Table 5-2. Alternatives and component options (continued).

Alternative	Collection System	Treatment Method	Recharge System
2h	same as #2b.	Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #2a.	same as #2g.
2i	same as #2a.	same as #2h.	same as #2g.
3a	System is the same as #2a but different pipe layout to convey excess combined sewer flows to storage.	Flows conveyed to plant treated as in #1d. Excess combined sewer flows conveyed to storage facilities (12.3 mgd) and treated by primary (4.8 mgd) and chlorination facilities.	same as #2a.
3b	System is the same as #2b but different pipe layout to convey excess combined sewer flows to storage.	Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #3a.	same as #2a.
3c	same as #3a.	same as #3b.	same as #2a.
3d	same as #3a.	Flows conveyed to plant treated as in #2d. Excess combined sewer flows treated as in #3a.	same as #2a.
3e	same as #3b.	Flows conveyed to plant treated as in #2e. Excess combined sewer flows treated as in #3a.	same as #2a.
3f	same as #3a.	same as #3e.	same as #2a.
3g	same as #3a.	Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #3a.	same as #2g.
3h	same as #3b.	Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #3a.	same as #2g.

Table 5-2. Alternatives and component options (concluded).

Alternative	Collection System	Treatment Method	Recharge System
3i	same as #3a.	same as #3h.	same as #2g.
4a	Combined sewers in presently sewered area, with rehabilitation and replacement of interceptors. Sanitary sewers in presently unsewered areas.	Flows conveyed to plant treated as in #1d. Excess combined sewer flows conveyed to storage facilities (12.3 mgd) and pumped to recharge system at a rate of 4.8 mgd.	Recharge of excess combined sewer flows, mine discharge from combined sewers, and effluent recharged during dry-weather periods.
4b	same as #3b.	Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #4a.	same as #4a.
4c	same as #4a.	same as #4b.	same as #4a.
4d	same as #4a.	Flows conveyed to plant treated as in #2d. Excess combined sewer flows treated as in #4a.	same as #4a.
4e	same as #3b.	Flows conveyed to plant treated as in #2e. Excess combined sewer flows treated as in #4a.	same as #4a.
4f	same as #4a.	same as #4e.	same as #4a.
4g	same as #4a.	Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #4a.	Continuous effluent recharge and recharge of excess combined sewer flows. Mine discharge from combined sewers.
4h	same as #3b.	Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #4a.	same as #4g.
4i	same as #4a.	same as #4h.	same as #4g.

charges from the existing collection system, an effluent recharge system, and storm sewers and additional drop shafts in presently sewered areas if effluent were recharged only during dry-weather periods.

Alternative la is identical to the alternative proposed in the draft Facilities Plan, except that storm sewers in presently unsewered areas are not inlcuded (Warren & Van Praag, Inc. 1975). These storm sewers would discharge an amount of stormwater to the mines (during wet-weather periods) larger than the amount currently discharged. These sewers, therefore, would not be necessary to maintain existing water levels in the mines. Alternatives that do not include storm sewers in presently unsewered areas would not increase the potential for subsidence. In addition, these sewers proposed in the draft Facilities Plan would increase the total capital cost of an alternative by $18,608,500 (Section 1.2. and Table 5-3).

Alternatives in the second group include rehabilitation of the existing combined sewer system. The three main interceptors would be replaced with interceptors sized to eliminate all overflows to surface waters. The alternatives assume that the discharge of combined flows to the river would be permitted. The mines also would be recharged by an effluent recharge system and storm sewers and additional drop shafts in presently sewered areas if effluent were recharged only during dry-weather periods. Excess combined sewer flows would be treated by a primary treatment (12.3 mgd) system followed by chlorination. The options to treat dry-weather flows include tertiary treatment without chemical coagulation, upgraded secondary treatment, and existing secondary treatment with continuous effluent recharge to the mines. All of the treatment options assume that effluent limitations of 10mg/l BOD_5 and 12 mg/l SS would be approved.

Alternatives in the third group include the same collection system as in the second group. Options to treat dry-weather flows and to recharge the mines also are similar. Excess combined sewer flows would be stored and treated at a rate of 4.8 mgd by a primary system followed by chlorination.

Alternatives in the fourth group include the same collection system and options to treat dry-weather flows as in the second and third groups. Excess combined sewer flows would be stored and conveyed to the mine recharge system at a rate of 4.8 mgd. Storm sewers would not be installed in the presently sewered area to ensure that there would be sufficient capacity in the mines for discharges from the sewer system and the recharge of excess flows and effluent during wet-weather periods.

5.4. Alternative Costs

Alternatives that include sewer separation, extension of sewers, an expanded plant capacity, and/or upgraded treatment are more expensive than those alternatives that do not include these options (Table 5-3). Total capital costs for the alternatives range from $16.1 million (Alternative 4h) to $38.0 million (Alternative la). Total operation and maintenance costs range from $140.5 thousand per year (Alternative 2h) to $454.1 thousand per year (Alternative 3a). Average annual equivalent costs range from $1.5 million (Alternative 4h) to $3.5 million (Alternative la).

Table 5-3. Preliminary costs of system alternatives for the treatment of wastewater at Streator, Illinois (cost in $ X 1,000). Descriptions and cost estimates are presented in Appendix D.

Alternative Number	Total Capital Cost	Present Worth of Salvage Value	Net Capital Cost	Annual Operation & Maintenance Cost	Total Present Worth	Average Annual Equivalent Cost
1a	38,030.1	4,032.8	33,997.3	438.7	38,783.5	3,556.4
1b	36,759.6	2,818.8	23,940.8	403.0	28,337.5	2,598.5
1c	37,151.3	3,952.8	33,198.5	412.6	37,699.9	3,457.1
1d	37,998.4	4,032.9	33,965.5	390.3	38,223.7	3,505.1
1e	26,730.4	2,818.8	23,884.6	364.3	27,859.1	2,554.6
1f	37,122.1	3,952.8	33,169.3	373.9	37,248.5	3,415.7
1g	31,653.7	3,383.5	28,270.2	176.5	30,195.8	2,769.0
1h	20,389.0	2,506.2	17,882.8	151.1	19,531.3	1,791.0
1i	30,780.0	3,327.9	27,452.1	160.7	29,205.3	2,678.1
2a	34,321.7	3,356.2	30,965.5	391.4	35,235.7	3,231.1
2b	23,262.9	2,165.3	21,097.6	365.4	25,084.1	2,300.2
2c	33,654.6	3,299.3	30,355.3	375.0	34,446.5	3,158.7
2d	33,486.5	3,273.9	30,212.6	337.5	33,894.7	3,108.1
2e	22,515.9	2,092.6	20,423.3	316.3	23,874.1	2,189.3
2f	32,907.6	3,226.6	29,681.0	325.9	33,236.6	3,047.8
2g	28,097.5	2,716.6	25,380.9	177.6	27,318.5	2,505.1
2h	17,035.3	1,550.0	15,485.3	140.5	17,018.2	1,560.6
2i	27,426.9	2,683.2	24,743.7	150.1	26,381.3	2,419.2
3a	33,972.8	3,280.9	30,691.9	454.8	35,675.6	3,271.4
3b	22,913.1	2,089.9	20,823.2	437.5	25,596.3	2,347.2
3c	33,305.7	3,224.1	30,081.6	447.0	34,958.4	3,205.7
3d	33,137.6	3,198.6	29,939.0	391.7	34,212.4	3,137.3
3e	22,166.1	2,017.1	20,149.0	388.4	24,386.4	2,236.2
3f	32,558.7	3,151.4	29,407.3	397.9	33,748.4	3,094.7
3g	27,748.6	2,641.4	25,107.2	252.4	27,860.9	2,554.8
3h	16,685.4	1,474.7	15,210.7	228.4	17,702.5	1,623.3
3i	27,078.1	2,608.0	24,470.1	237.9	27,065.6	2,481.9
4a	29,317.3	2,774.7	26,542.6	327.0	30,110.2	2,761.1
4b	18,048.4	1,560.6	16,487.8	301.1	19,772.8	1,813.2
4c	28,441.0	2,694.7	25,746.3	310.6	29,134.9	2,671.7
4d	28,482.0	2,692.4	25,789.6	273.1	28,769.1	2,638.1
4e	17,301.3	1,487.9	15,813.4	252.0	18,562.7	1,702.2
4f	27,694.0	2,622.0	25,072.0	261.5	27,924.9	2,560.7
4g	27,337.9	2,602.3	24,735.6	207.1	26,995.1	2,475.4
4h	16,071.5	1,413.4	14,658.1	199.6	16,835.7	1,543.8
4i	26,464.1	2,546.7	23,917.4	209.1	26,198.7	2,402.4

Seventy-five percent of the total capital cost eligible for funding under the Construction Grants Program will be paid for by Federal and/or State governments. The capital costs eligible for fundings will include the cost for mine recharge. Twenty-five percent of the capital cost and 100% of the operation and maintenance costs will be funded locally by an undetermined combination of municipal bonds, new sewer connection fees, and user charges.

The costs of alternatives, which are summarized below and are presented in detail in Appendix D, have not been updated to 1980 price levels. The cost for materials, construction, and O&M are based on indexes for January 1978. Recently published indexes would increase the alternative costs. However, any index values may or may not correspond with actual project bids because of local economic conditions. What is important is that the costs provide a means to rank alternatives and to determine which is most cost-effective. Updated costs for the selection alternative will be developed during the facilities planning process. These costs will be based on the detailed designs for the facilities.

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[1]Equivalent annual cost is the expression of a non-uniform series of expenditures as a uniform annual amount to simplify calculation of present worth. Present worth may be thought of as the sum that, if invested now at a given rate, would provide exactly the funds required to make all necessary expenditures during the life of the project.

6.0. IMPACTS OF COMPONENT OPTIONS AND SYSTEM ALTERNATIVES

6.1. Atmosphere

6.1.1. Air Quality

The potential atmospheric emissions that could result from the construction and operation of wastewater management alternatives include fugitive dust and other particulates, aerosols, hazardous gases, and odors. Implementation of control measures during the construction and operation of the facilities would reduce the impacts of these atmospheric emissions to negligible levels.

6.1.1.1. Construction Impacts

Fugitive dust emissions may occur in connection with the stockpiling and handling of dry, finely divided materials (such as chemicals for wastewater treatment), but are of concern primarily with respect to project construction. The types of construction activities ordinarily associated with the creation of dusty conditions include land clearing, blasting, demolition, excavation, loading, transporting, unloading, leveling, and grading. In addition, the increased vehicular highway and access road traffic associated with the transportation of the construction crew members, their equipment, and the required materials to and around the project area would be expected to increase the local levels of dust, especially in the case of unpaved access roads. There also would be exhaust emissions of carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides, and particulate matter associated with the increased vehicular traffic, as well as with any stationary internal combustion engine that may be utilized at the construction site. Alternatives that include sewer separation, extension of sanitary sewers, construction of storm sewers, and/or plant expansion would be responsible for more construction-related atmospheric emissions than alternatives that do not include these component options.

6.1.1.2. Operation Impacts -- Aerosols

Aerosols are defined as solid or liquid particles, ranging in size from 0.01 to 50 micrometers (um) that are suspended in the air. These particles are produced at wastewater treatment facilities during the various treatment processes, especially those involving aeration. Some of these aerosols could be pathogenic and could cause respiratory and gastrointestinal infections. Bacteria are between 0.3 and 15 um, and viruses are between 0.015 and 0.45 um (Jacobson and Morris 1976). Both can be found in fine liquid droplets, attached to solid particles, or individually airborne.

Concentrations of bacteria and/or viruses in aerosols that could be generated during various stages of wastewater treatment, however, have been found to be insignificant (Hickey and Reist 1975). The vast majority of aerosolized microorganisms are destroyed by solar radiation, dessication, and other environmental phenomena. There are no records of disease outbreaks resulting from pathogens present in aerosols. No adverse impacts, therefore, are expected from aerosol emissions for any of the alternatives.

6.1.1.3. Operation Impacts -- Gases

Gaseous emissions could be associated with the operation of the wastewater treatment plant. Explosive, toxic, noxious, lachrymose (causing tears), and asphyxiating gases found at treatment plants include chlorine, methane, ammonia, hydrogen sulfide, carbon monoxide, and oxides of nitrogen, sulfur, and phosphorus. Discharges of these gases could be hazardous to public health and/or could affect adversely the environment. The knowledge that such gases could escape from a plant in dangerous or nuisance concentrations might affect adjacent land uses. Gaseous emissions, however, can be controlled by proper design, operation, and maintenance.

6.1.1.4. Operation Impacts -- Odor

Incomplete oxidation of organic material containing sulfur or nitrogen can result in the emission of byproducts that may be malodorous. The most frequently emitted odors found in a study of 300 wastewater treatment plants were methylmercaptans, methylsulfides, and amines. These odors were followed by indole, skatole, and hydrogen sulfide and to a lesser extent by sulfur dioxide, phenolics, and chlorine compounds (USEPA 1976a). Some organic acids, aldehydes, and ketones also may be odorous either individually or in combination with other compounds. Sources of wastewater treatment related odors include:

- Fresh, septic, or incompletely treated wastewater
- Screenings, grit, and skimmings containing septic or putrescible matter
- Oil, grease, fats, and soaps from industry, homes, and surface runoff
- Gaseous emissions from treatment processes, manholes, wells, pumping stations, leaking containers, turbulent flow areas, and outfall areas
- Chlorinated water containing phenols
- Raw or incompletely stabilized sludge.

No odor problems associated with any of the alternatives are expected to occur if the wastewater treatment facilities are designed, operated, and maintained properly. Upgraded treatment with nitrification and chlorination would result in fewer odors than the existing secondary treatment. The option to treat the excess combined sewer flows would result in fewer odors than the option to store the excess flows before treatment.

6.1.2. Sound

Noise would be associated with each of the alternatives. Possible impacts on local sound levels would be related primarily to construction activities and, thus, would be of relatively short duration. The extent of the impacts would vary depending on the amount of construction required for each alternative. Illinois noise regulations do not apply to noise caused by construction (IPCB 1973).

Noise generated at the treatment plant site would be related to upgrading and/or expansion of treatment facilities and to construction of storage and/or treatment basins for excess combined sewer flows. The highest sound levels would occur during excavation, which would produce approximately 55 dBA 1,000 feet from the center of activity. This level would be in accordance with USEPA guidelines to protect public health and welfare (USEPA 1974).

Noise created by the construction of sanitary and storm sewers and the mine recharge system would have more widespread impacts, as construction would extend into residential and other noise-sensitive land use areas. Alternatives that include sewer separation would have the most severe impacts, because a new sanitary sewer system would be installed throughout the entire presently sewered area.

It was estimated that sewer line construction (8-hour construction day) would produce the equivalent daytime sound level of 57 dBA at 500 feet. This estimate was made based on equipment generally used during sewer line construction and sound levels that result from the use of the equipment (Table 6-1). The day/night sound level during sewer line construction would be approximately 65 dBA. Such levels would exceed USEPA guidelines by 10 decibels (USEPA 1974). Streator, however, is an urban area, and the existing day/night sound level at locations surveyed (Section 3.1.3.) was 62 dBA, which exceeds the USEPA guidelines by 7 decibels.

Table 6-1. Equipment used and resultant sound levels during construction of sewer lines (USEPA 1975a).

Equipment	No. of Units	A-weighted sound level (dBA) at 50 feet	Usage Factor[b]
Backhoe	1	85	0.4
Truck	1	88	0.16
Air Compressor	1	81	0.5[a]
Paving Breaker	1	88	0.25[a]
Crane, Mobile	1	83	0.16
Welding Machine	1	83[a]	0.25[a]

[a]Estimated.

[b]Fraction of time equipment is operating at its loudest mode.

Noise during the operation of the wastewater treatment facilities would be generated predominantly by pumps and aeration equipment. Some alternatives would generate more noise than others, depending on the treatment processes. Upgraded treatment with nitrification would require an additional blower. The recharge system would require pumps, and the extent of sound level impacts would depend on whether recharge was on a continuous or an intermittent basis. Pumps also would be required for storage of excess combined sewer flows, but not for their treatment.

No adverse impacts due to operation are anticipated. A typical pump (above ground and not enclosed) generates a sound level of 70 dBA at 50 feet. The noise contribution of such a pump at the nearest residential property line would be approximately 44 dBA. If such a pump were to operate continuously, it would increase daytime sound levels from 46 decibels to 48 decibels and nighttime sound levels from 43 decibels to 47 decibels at the property line. Both of these levels are in accordance with Illinois noise regulations (IPCB 1973). The day/night equivalent sound level, Ldn, is estimated to increase from 50 dBA to 54 dBA. This level is less than the level recommended by EPA to protect public health and welfare with an adequate margin of safety (USEPA 1974). Nevertheless, above-ground pumps would be enclosed and installed to minimize sound impacts.

6.2. Land

6.2.1. Subsidence Potential

The alternatives being considered would have no adverse effect on geologic conditions in the study area. Each alternative has been designed to maintain the present hydrostatic head in the mines (Section 5.2.4.), and therefore, none of the alternatives would increase the potential for subsidence. The alternatives would have the same potential for subsidence as the "no action" alternative, because the amount of mine recharge would be approximately equivalent to the current amount.

6.2.2. Terrestrial Vegetation

Alternatives would have adverse impacts on vegetation, including direct vegetation losses from clearing and indirect losses caused by soil compaction and by soil erosion. The extent of disruption would depend on the amount of construction required for the different alternatives. Impacts would be associated with the following component options:

- Construction of a new sanitary sewer system (sewer separation)
- Rehabilitation of the combined sewer system, including replacement of the major interceptors
- Extension of sanitary sewers
- Construction of a recharge system.

Component options would involve construction activities in residential areas, along streets and city rights-of-way, and adjacent to streams. Agricultural lands would not be affected by any of the component options.

Similarly, park vegetation would not be disturbed by construction activities. No endangered or threatened plant species are known to occur in the Streator FPA (Section 3.2.2.).

6.2.2.1. Sewer Separation

Sewer separation would result in the greatest amount of disruption to terrestrial vegetation. It would involve installation of sanitary sewers throughout the presently sewered area. In addition, because the new sanitary sewer system would parallel and/or transect the Vermilion River, Prairie Creek, and Coal Run, construction would result in more floodplain habitat disruption than the other collection system options. Approximately 4.5 miles of floodplain would be disturbed if sanitary sewers were installed. Assuming a 60-foot construction right-of-way, about 33 acres would be affected. Impacts on vegetation could be more extensive if construction accelerates erosion in adjacent areas.

The floodplain forests in the study area are dominated by bur, black, and white oaks, with scattered cottonwoods and weeping willows (Draft EIS, Section 2.2.4.2.). The subcanopy and understory, however, are dominated by river, silver and sugar maples, and black cherry. This indicates that the original oak-hickory forests of this region are being replaced by more mesic forest associations. Large openings in the forest canopy would be created by construction clearing. These openings would tend to favor the reproduction and growth of oaks over maples, because oaks are shade intolerant and sprout quickly.

6.2.2.2. Replacement of Interceptors

The effects of construction activities for this collection option would be similar but less extensive than those from the construction of a new sanitary sewer system. The major interceptors intermittently follow the Vermilion River, Prairie Creek, and Coal Run. Approximately 3.2 miles of floodplain would be disturbed if the major interceptors were replaced. Assuming a 60-foot construction right-of-way, about 23 acres would be affected.

6.2.2.3. Sewer Extensions and Recharge System Construction

Activities related to the extension of sanitary sewers and construction of a recharge system would occur primarily along streets and city-owned rights-of-way. Impacts on vegetation should be minimal.

6.2.3. Wildlife

Wildlife would be affected by construction activities. Impacts would depend on the amount of construction. Most birds and mobile mammals, reptiles, and amphibians that reside on or near proposed construction sites would migrate from disturbed areas. In residential areas, birds, squirrels, raccoons, rodents, and other animals that are acclimated to human activities would reoccupy the disturbed areas shortly after construction activities cease.

Construction along segments of interceptor routes would affect animals that reside in or partially depend on habitats bordering streams. White-tailed deer, beavers, squirrels, rabbits, and several migratory and non-migratory bird species utilize these habitats. The smaller mammals and reptiles would incur the highest mortality rates under stressed conditions. Displacement of most animals, however, would be temporary, coinciding with the duration of construction. Currently, there are no animal species inhabiting the Streator study area that are listed as endangered or threatened at either the State or the Federal levels (Section 3.2.2.).

6.3. Water

6.3.1. Surface Water

Wastewater management alternatives developed for the Streator FPA would reduce pollutant loads discharged to surface waters and would result in improved in-stream water quality, especially during periods of low flow. All of the alternatives provide a level of wastewater treatment in excess of the current level of treatment. The alternatives also reduce significantly discharges of untreated sewage to surface waters from deteriorated sewer lines and combined sewer overflows. In addition, mine leachate quality could be improved by eliminating direct wastewater discharges from residences in the present sewer service area to the mines and by minimizing discharges of dry-weather wastewater flows from the combined interceptor sewers to the mines.

Specific water quality improvements from alternative wastewater management programs can not be predicted and compared. The data on in-stream water quality, flow and physical characteristics of the Vermilion River and its tributaries, and pollutant loadings from the various sources in the Streator FPA are insufficient or are not available (Section 3.3.1.3.). Wasteloads generated by the different alternatives and/or component options, however, are estimated and compared in the following sections.

6.3.1.1. Effluent Quality and Pollutant Loads of Alternatives

The quality of the wastewater treatment plant effluent and the quantity of pollutants that would be discharged to surface waters and underground mines in the Streator FPA would vary according to the component options selected for wastewater collection, treatment, and recharge to the mines. Wastewater pollutants of primary concern include oxygen consuming materials (measured as BOD_5), suspended solids (SS), ammonia-nitrogen, and fecal coliform bacteria. Concentrations of these pollutants in the effluent would be regulated by effluent limitations imposed by the conditions of the final NPDES permit or by less stringent limitations acceptable to IEPA (Section 5.3.).

<u>Discharges to Surface Waters</u>

<u>Treated Effluent</u>

Wasteloads from the treatment plant would depend on the effluent requirements and the treatment plant capacity. The existing 2.0 mgd plant, upgraded to meet requirements of the final NPDES permit (4 mg/l BOD_5 and 5 mg/l SS), would discharge 66.7 pounds of BOD_5/day and 83.4 pounds of SS/day. A 2.6 mgd plant meeting the same effluent concentrations would discharge 86.7 pounds of BOD_5/day and 108.4 pounds of SS/day. The 2.0 mgd plant, upgraded to meet the less stringent effluent requirements (10 mg/l BOD_5 and 12 mg/l SS), would discharge 166.8 pounds of BOD_5/day and 200.2 pounds of SS/day. A 2.6 mgd plant meeting the less stringent requirements would discharge 216.8 pounds of BOD_5/day and 260.2 pounds of SS/day.

Treated Excess Combined Sewer Flow

Alternatives that use the combined sewer collection system provide treatment of excess combined sewer flow produced during wet-weather periods prior to discharge to the Vermilion River. It was estimated using the Needs Estimation Model for Urban Runoff (Section 5.2.3.3.) that the excess flow reaching the end of the collection system during a typical 10-year storm would discharge 1,673 pounds of BOD_5/day to the Vermilion River after primary treatment. If the excess combined sewer flow were stored for 2.1 days (the 10-year mean number of days between storms) and then treated, the BOD_5 load to the Vermilion River would be 794.3 pounds/day. Both of these BOD_5 loads were estimated assuming that 4,289 pounds of BOD_5 would enter the combined sewer system during a 10-year storm, that approximately 35% of the wet-weather flow in the collection system (12.3 mgd X 0.35 = 4.3 mgd) would be discharged to the mines, and that primary treatment would have a 40% BOD_5 removal efficiency. The BOD_5 concentration of the treated excess flow would be 25 mg/l for both of the treatment options. Wasteloads discharged would not be any larger if sewers were extended, because I/I into the new sewers would be insignificant.

Discharges to the Mines

Treated Effluent

Alternatives that utilize the existing secondary level of treatment include continuous discharge of treated effluent to the mines for additional treatment. No ammonia-nitrogen control or disinfection is provided. The effluent would have BOD_5 and SS concentrations of 20 mg/l and 25 mg/l, respectively, regardless of the treatment plant capacity. The existing 2.0 mgd plant would discharge 333.6 pounds of BOD_5/day and 417 pounds of SS/day to the mines. The 2.6 mgd plant would discharge 433.7 pounds of BOD_5/day and 542.1 pounds of SS/day.

During dry-weather periods when the mines would have to be recharged to maintain water levels, all alternatives that normally include effluent discharge to the Vermilion River would provide discharge of treated effluent to the mines. The effluent discharged to the mines would have the same concentrations as the effluent discharged to the Vermilion River. Loads to the mines would depend on the required frequency and rate of recharge.

Treated Excess Combined Sewer Flow

One group of alternatives that uses the combined sewer system includes storage and discharge of excess combined sewer flow to the mines. Assuming that excess flow would contain 2,788 pounds of BOD_5/day (without primary treatment; 4,289 lbs X 0.65) during a 10-year storm and that storage would be for 2.1 days, excess flow would contribute 1,328 pounds of BOD_5/day.

Combined Sewer Overflows

Approximately 35% of the wet-weather flow collected in the combined sewer system would overflow to the mines. During a 10-year storm, an estimated 1,501 pounds of BOD_5/day would enter the mines.

Stormwater

New additional storm sewers in the presently sewered area would discharge stormwater to the mines. Based on the EPA model (USEPA 1977c), approximately 1,042 pounds of BOD_5 would enter these storm sewers during a 10-year storm. Assuming that 50% of the stormwater runoff would be discharged to the mines, approximately 521 pounds of BOD_5 would enter the mines.

Domestic Discharges

For those alternatives that do not include sewer extensions, residences in presently unsewered areas (Figure 5-1) would contribute 1,489 pounds of BOD_5/day to the mines. This loading was estimated assuming that approximately 8,760 residents are not in the presently sewered area (Section 4.3.2.) and that 0.17 pounds of BOD_5 are discharged per capita per day (Section 4.4.).

Summary of Pollutant Loads

Estimated BOD_5 loads that would be discharged to underground mines and surface waters in the Streator FPA during a 10-year storm are listed in Table 6-2 for each alternative. Wasteloads to surface waters would be largest for alternatives that include the treatment and discharge of excess combined sewer flow without storage. Alternatives that include sewer separation and continuous effluent recharge would involve no direct discharges to surface waters. Alternatives that include continuous effluent recharge and recharge of excess combined sewer flow also would have no discharges to surface waters. All alternatives that include intermittent effluent recharge to the mines would eliminate discharges to surface waters during dry-weather periods.

Wasteloads to underground mines would be largest for alternatives that include discharge of excess combined sewer flows to the mines and no expansion of the sewer service area. Wasteloads to mines would be smallest for those alternatives that include sewer separation and stream discharge.

Industrial wasteloads to the mines were not predicted for alternatives. Some process water, cooling water, and sanitary wastes currently are discharged to the mines (Section 4.3.1.). The quality of most of these industrial wastewaters is unknown. IEPA may determine that present industrial wastewater disposal practices should not continue (Section 5.2.3.1.).

Table 6-2. BOD_5 wasteloads that would be discharged to surface waters and underground mines during a 10-year storm for each alternative. BOD_5 loads presently discharged to the mines from industries are not included. BOD_5 loads in stormwater runoff and mine leachates that would discharge to surface waters similarly are not included.

	BOD_5 Wasteloads (lbs/day)		
Alternatives	Discharges to Surface Waters	Discharges to the Mines	Total
1a	86.7	521	607.7
1b	66.7	2,010	2,076.7
1c	66.7	521	587.7
1d	216.8	521	737.8
1e	166.8	2,010	2,176.8
1f	166.8	521	687.8
1g	-	433.7	433.7
1h	-	1,822.6	1,822.6
1i	-	333.6	333.6
2a	1,759.7	2,022	3,781.7
2b	1,739.7	3,511	5,250.7
2c	1,739.7	2,022	3,761.7
2d	1,889.8	2,022	3,911.8
2e	1,839.8	3,511	5,350.8
2f	1,839.8	2,022	3,861.8
2g	1,673	1,934.7	3,607.7
2h	1,673	3,323.6	4,996.6
2i	1,673	1,834.6	3,507.6
3a	883.2	2,022	2,905.2
3b	863.2	3,511	4,374.2
3c	863.2	2,022	2,885.2
3d	1,013.3	2,022	3,035.3
3e	963.3	3,511	4,474.3
3f	963.3	2,022	2,985.3
3g	796.5	1,934.7	2,731.2
3h	796.5	3,323.6	4,120.1
3i	796.5	1,834.6	2,631.1
4a	86.7	2,829	2,915.7
4b	66.7	4,318	4,384.7
4c	66.7	2,829	2,895.7
4d	216.8	2,829	3,045.8
4e	166.8	4,318	4,484.8
4f	166.8	2,829	2,995.8
4g	-	3,262.7	3,262.7
4h	-	4,651.6	4,651.6
4i	-	3,162.6	3,162.6

6.3.1.2. Quantity and Quality of Mine Leachates

The quantity and quality of mine leachates that discharge to surface waters in the Streator FPA depend to a large extent on the flows and wasteloads discharged to the mines. The mined-out areas under Streator, however, are extensive, and the volumes of minewater are large (Appendix B). The specific hydraulics of minewaters and processes in the mines that affect leachate quality largely are unknown. In addition, leachates have not been monitored over a period of time sufficient to characterize leachate quality and flow during dry-weather and wet-weather periods. Available data (Appendix C) only represent conditions existing during field investigations by WAPORA on 7 September, 3 October, and 19 December 1977. More detailed investigations are required to characterize both average and extreme conditions.

Leachate flows and possibly the number of leachate sites may vary according to the amount of inflow to the mines associated with the different alternatives. Leachate flows during dry-weather periods should be similar for all alternatives, because recharge would consist only of treated effluent. Alternatives that rely more heavily on mine discharges during wet-weather periods may result in larger leachate flows.

Because alternatives would reduce pollutant loads to the mines, all alternatives should improve the quality of mine leachates. The process, however, would take a long time. Alternatives that involve smaller discharges of pollutant loads to the mines (Section 6.3.1.1.) may cause leachate quality to improve at a faster rate. It is expected that all alternatives that include upgraded treatment would reduce ammonia-nitrogen concentrations in mine leachates, which presently are considered high (Appendix C).

6.3.1.3. Non-point Source Pollutant Loads Generated by Construction Activities

Construction activities can contribute significant pollutant loads to surface waters. The major non-point source pollutant is sediment. Other pollutants include organic matter, plant nutrients, and pesticides. Impacts from siltation and sedimentation, however, should be of short-term duration. Water quality and riverbed characteristics would revert quickly to present conditions.

Collection system options and mine recharge options could have adverse impacts because they involve construction over large areas. Work along present interceptor routes adjacent to Prairie Creek and Coal Run could result in significant sediment runoff. Alternatives that have the most potential for sediment-related impacts include sewer separation. They would require extensive construction activities throughout the present service area.

Upgrading and/or expansion of the treatment plant and construction of storage facilities for excess combined sewer flows also could increase sediment loads to surface waters. Because the topography at the plant site is flat, the potential for significant siltation and sedimentation can be minimized by conventional control measures.

6.3.1.4. Aquatic Biota

All alternatives developed for the Streator FPA would reduce wasteloads discharged to surface waters and, therefore, would improve water quality. Improvements could be most significant in Prairie Creek and Coal Run where combined sewer overflows and discharges of untreated sewage from deteriorated sewer lines would be reduced considerably. Based on an IEPA survey of benthic macroinvertebrates, the Vermilion River in the Streator FPA is classified as "semi-polluted or unbalanced" (Section 3.3.1.4.). Whether this status could be changed by wastewater management alternatives can not be determined. Alternatives that would result in smaller discharges of pollutant loads would have a greater potential to affect positively the aquatic biota.

Localized, short-term impacts on the aquatic biota could result from increased sediment loads caused by construction activities. Short-term impacts could be most significant along Prairie Creek and Coal Run where much construction would occur. Most fish and mobile macroinvertebrates would avoid the areas of in-stream disturbance. Sedimentation, however, would bury and suffocate macroinvertebrates and other organisms that have limited mobility. In general, siltation and sedimentation can degrade or destroy habitats and can be responsible for reduced species diversity.

Adverse impacts to the aquatic biota may result from alternatives that include chlorination prior to stream discharge. Presently, the effluent from the existing treatment plant is not chlorinated. Tsai (1973) documented the reduced occurrence of fish and macroinvertebrates downstream from plants discharging chlorinated sewage effluent. No fish were found in water with a chlorine residual greater that 0.37 mg/l, and the species diversity index reached zero at 0.25 mg/l. A 50% reduction in the species diversity index occurred at 0.10 mg/l. Arthur (1972) reported that concentrations of chlorine residual lethal to various species of warm water fish range from 0.09 to 0.30 mg/l. Many wastewater treatment plants have effluents with chlorine residual concentrations of 0.5 to 2.0 mg/l. A study of 20 plants in Illinois showed that effluent concentrations ranged from 0.98 to 5.17 mg/l (Snoeyink and Markus 1974). Those alternatives that include chlorination will require especially careful operation and routine monitoring to ensure that concentrations of chlorine residual do not exceed 0.09 mg/l.

6.3.1.5. Water Uses

Improved water quality resulting from reduced wasteloads to the Vermilion River may cause recreational use of the river segment downstream from the wastewater treatment plant and Prairie Creek to increase. The recreational activity that might benefit the most is fishing if the species diversity and population sizes increase. The knowledge that the water quality of the river is improved also might result in more canoeing and swimming. Those alternatives that would result in the most significant quality improvements would have the greatest effect on recreational uses. The alternatives would not affect the other uses of surface waters in the Streator FPA (Section 3.3.1.2.).

6.3.2. Groundwater

The groundwater quality of underlying aquifers is dependent on both the renovation of minewaters and the vertical leakages through the relatively impermeable clay and shale layers in the Pennsylvanian strata. Recharging the mines with treated wastewater would not be expected to have any immediate effects on minewater quality due to the slow movement of water. A gradual improvement of the minewater quality, however, may occur. Impacts on the quality of groundwater resources would be negligible due to the slow renovation of minewaters and the low rate of leakage to usable groundwater sources. Any impact on groundwater quality would be similar for each of the alternatives.

6.4. Cultural Resources

6.4.1. Archaeological Resources

No known or documented archaeological sites exist in the presently sewered area or adjacent areas that may receive sewer service. The files of the Illinois Historic Sites Division, however, indicate two unidentified archaeological sites in the Streator service area (By letter, Ms. Anne Manuell, Illinois Department of Conservation, Historic Sites Division, to Mr. George Bartnik, WAPORA, Inc., 21 December 1977). No information is available concerning the occupation period(s) of these sites. The first site is situated along Prairie Creek north of Bluff Street and east of Kelly Street. The second site is situated north of the Vermilion River in the vicinity of Barr Street. A survey would be necessary to determine the exact locations of these sites and if they would be impacted by construction activities.

6.4.2. Cultural, Historic, and Architectural Resources

Eight sites in the Streator FPA have been documented by the Illinois Historic Sites Survey as having cultural, historic, or architectural significance (Section 3.4.2.). Another site, the Baker House, is listed on the National Register of Historic Places. In addition, a windshield/on-foot survey located two sites that potentially are eligible for nomination to the National Register of Historic Places. None of these sites would be impacted directly by any of the proposed alternatives, because construction activities would be limited to street corridors.

Construction activities, however, could involve disturbance of up to 7.0 miles of brick streets. The majority of brick streets are aggregated in four areas:

- An area roughly bounded by Monroe Street to the east, Van Buren Street to the west, Sumner Street to the north, and La Rue Street to the south

- An area rougly bounded by Park Street to the west, Illinois Street to the east, Bridge Street to the north, and Spring Street to the south

- An area roughly bounded by La Salle and Washington Streets to the north, 12th Street to the south, Bloomington Street to the east, and Coal Run to the west

- A 1.0-mile stretch of Main Street from Bloomington Street on the west to Otter Creek Road on the east.

The brick streets are not historically significant, but they are aesthetic reminders of the city's past. There is local interest in Streator concerning preservation of the remaining brick streets.

Certain areas of the city may possess cultural resources of sufficient significance to warrant establishment of historic districts. These areas are: Old Unionville, Broadway Street, Main Street, and an area roughly corresponding to the third brick street area listed above. In these areas, the brick streets would function as an integral facet of the potential district's integrity. An in-depth survey would be needed to ascertain the feasibility of establishing historic districts.

6.4.3. Coordination with the State Historic Preservation Officer

Consultation and coordination with the State Historic Preservation Officer (SHPO) concerning cultural resources is mandatory. This coordination should occur as detailed plans for construction of the collection system and the recharge system are developed.

6.5. Socioeconomic Characteristics

6.5.1. Construction Impacts

All alternatives would require some excavation of streets in the City of Streator. The construction activities would disrupt temporarily normal traffic patterns and could increase local travel costs. Road detours also would disrupt business and shopping patterns temporarily, possibly adversely affecting those businesses in close proximity to construction sites and benefiting those along the detour routes. Those alternatives that include sewer separation, installation of storm sewers, and extension of sewers to presently unsewered areas would have a more extensive and longer excavation phase than other alternatives that do not include these component options. Local economic losses related to construction, however, would be short-term and could be offset by economic gains generated by the construction labor force spending in Streator. In general, no significant net loss in City sales tax receipts is expected.

Construction requirements would include building materials, sewer pipes, and equipment. Streator was a major producer of clay products and still produces bricks as well as concrete blocks. Successful bidding for some of the building materials by local producers could stimulate temporarily the City's economy. The impacts of this stimulus, however, would be small.

6.5.2. Employment Impacts

Employment related to the construction and the operation and maintenance of wastewater facilities in Streator would not generate enough income to stimulate the local economy. The existing contract construction labor force in LaSalle and Livingston Counties would not need to expand to construct the facilities, and the number of new employees needed to operate and maintain the facilities would be insignificant (Draft EIS, Sections 5.5.2. and 5.5.3.).

6.5.3. Project Benefits

All of the alternatives developed for the Streator FPA would improve substantially the city's sewer system and would reduce pollutant loads discharged to surface waters. The water quality of the Vermilion River would improve, especially during low-flow conditions. This improvement could increase the recreational use of the river and adjacent lands. Improved collection of storm and wastewaters could reduce local flooding of yards and basements. These improvements would tend to increase property values and make Streator generally more attractive. Any financial benefits resulting from improvements, however, are expected to be minimal when compared to the cost of even the lowest cost alternative. The community's ability to fund any of the alternatives would not be improved.

Because all alternatives eliminate some discharges to the mines, they all include a mine recharge system. The intent of the recharge system is to maintain water levels in the mines. The potential for subsidence would not change, therefore, providing a recharge system would not result in any new benefits.

6.5.4. Costs

6.5.4.1. Local Costs

Total estimated costs for wastewater collection and treatment facilities are presented in Appendix D and are summarized in Table 5-3 (Section 5.4.). Seventy-five percent of the total capital cost eligible for funding under the Construction Grants Program would be funded by Federal and/or State government. Twenty-five percent of the total capital cost and 100% of the operation and maintenance (O&M) costs would be funded locally by an undetermined combination of municipal bonds, new sewer connection fees, and/or user charges. Alternatives 2h and 1a represent the lowest and highest local cost alternatives. The average annual equivalent cost of the local share over a 20-year period would be $531,000 for Alternative 2h and would be $1,310,500 for Alternative 1a (at an interest rate of 6.625%; Table 6-3). The annual local costs would depend on the actual interest rate paid on bonds. The current interest rates for municipal bonds range from about 5% to 7%.

In addition to the local costs for alternative wastewater management programs, there is an annual cost to retire the remaining debt on the existing facilities. The debt was $300,000 at the end of fiscal year 1978. If the debt were paid off over the next twenty years, the annual cost would be $15,000.

Table 6-3. Local costs for Alternatives 2h and 1a over a 20-year period ($ X 1,000).

Alternative 2h	
Present Worth	
Capital Cost	4,258.8
O&M Cost	1,532.9
Total	5,791.7
Average Annual Equivalent	
Capital Cost	390.5
O&M Cost	140.5
Total	531.0
Alternative 1a	
Present Worth	
Capital Cost	9,507.5
O&M Cost	4,786.2
Total	14,293.7
Average Annual Equivalent	
Capital Cost	871.8
O&M Cost	438.7
Total	1,310.5

Note: The local, total present worth is determined by adding 25% of the total capital cost to the present worth of the O&M cost over the 20-year analysis period. The present worth of salvage is not deducted because the local share of the total capital cost must be financed. The present worth of O&M is determined by multiplying the uniform or equal payment series factor (10.91) by the average annual O&M cost. The average annual equivalent capital cost is determined by multiplying the capital recovery factor (0.0917) by the present worth of the capital cost. In all calculations, an interest rate of 6.625% was used.

6.5.4.2. Per Capita Costs

The per capita costs of alternatives would depend on the size of the population served. The annual per capita costs over a 20-year period would be $42 for Alternative 2h and would be $62 for Alternative la. Alternative 2h does not provide service for presently unsewered areas, and therefore, per capita costs are based on the population currently being served (12,700). Alternative la provides a separate collection system for both presently sewered and unsewered areas. The per capita costs for this alternative are based on 1970 population statistics for Streator, Streator West, Streator East, and South Streator (21,206 persons, Section 3.5.1.).

6.5.4.3. Per Capita Income

The 1978 constant dollar per capita income was estimated to be $5,500 for the presently sewered areas and $5,800 for the combined sewered and unsewered areas. These figures are based on the average estimated 1972 constant dollar per capita income for 1970, 1975, and 1980 in the five townships in the Streator FPA (Langford 1977). The estimated 1972 per capita income was adjusted to 1978 dollars by using the average annual increase in the Consumer Price Index (6.5% from 1972 to 1977) over the 6-year period from 1972 to 1978. The average annual equivalent cost per capita would be 0.76% and 1.07% of the estimated per capita income for Alternatives 2h and la, respectively.

6.5.4.4. Allocation of the Average Annual Equivalent Cost

Costs for the existing wastewater collection and treatment facilities at Streator are being paid for by sewer rental billings (user charges) and general revenue funds. During fiscal year 1977, 80% of the sewer rental billings were allocated to residential customers, 12% to industrial customers, and 8% to commercial customers. Assuming that the allocation of the total average annual equivalent cost were similar to the allocation of sewer billings, the annual costs to the different customers for the lowest and highest O&M cost alternatives (Table 5-3) would be as follows:

	Alternative 2h	Alternative la
Residential	$424,800	$1,048,400
Industrial	63,720	157,260
Commercial	42,480	104,840

There are an estimated 4,235 households in the presently sewered area and a total of 7,069 households in the combined sewered and unsewered areas. The annual cost per household, therefore, would be $100 for the lowest O&M cost alternative and $148 for the highest O&M cost alternative.

High-cost wastewater treatment facilities may place an excessive financial burden on users. The Federal Government has developed criteria to identify high-cost wastewater projects (USEPA 1979). A project is identified as high-cost if the annual user charges are:

- 1.5% of median family income if median family income is less than $6,000
- 2.0% of median family income if median family income is between $6,000 and $10,000
- 2.5% of median family income if median family income is greater than $10,000.

None of the alternatives can be classified as high-cost at this time, because no current data on median family income are available. If the median family income were $6,000 or less, however, all alternatives would be considered high-cost. If the median family income were $7,500 or greater, none of the alternatives would be considered high-cost. Because the average per capita income in 1978 was approximately $5,500, the median family income was probably equal to or greater than $7,500, and therefore, the local residential user charges may not exceed the Federal criterion.

A significant percentage of the households in the watershed may experience financial burden or even displacement pressure, even if the Federal criteria were met. A financial burden generally is imposed if the annual residential costs exceed 2.5% of the family income. A displacement pressure, the pressure to move out of a service area, generally is felt if the annual residential costs exceed 5% of the family income. The percentages of households that would experience financial burden or pressure to move cannot be determined, because no data on local income distribution are available. The percentages would be higher if Alternative la were implemented and lowest if Alternative 2h were implemented.

6.6. Financial Condition

6.6.1. Debt Financing

All of the wastewater management alternatives would require capital financing. At the end of fiscal year 1977, the City of Streator had insignificant liquid assets and, thus, would have had to issue bonds for the entire present worth of the local capital cost of the chosen alternative. This assumes that O&M costs would be offset by user charges, connection fees, and/or general funds without incurring debt.

Revenue bonds probably would be issued to finance the capital costs. This type of financing would commit sewer system revenues toward debt payment. Revenues would have to be sufficient to retire the debt within a given time period. There are no State restrictions on revenue bonds or rate limitations for debt payment. In addition, a referendum would not be required. This type of financing currently is being used to finance the existing debt on sewer facilities.

6.6.2. Debt Criteria

The amount of debt a local government may incur safely depends on several criteria, which include (Moak and Hillhouse 1975):

- The community's population dynamics and economic stability
- The community's financial management system
- The amount of debt overlapping governments incur
- The residents' willingness to support the debt.

In general, Streator's economic base appears secure enough to incur some debt. The population is stable, but there is no indication that population will increase (Section 3.5.3.). Similarly, there is no indication that employment in Streator will increase. The major source of employment is manufacturing, and within this, one major industry, glass. Streator, therefore, does not have a diversified economic base, and the long-term ability to support debt depends on the viability of one industry. The glass industry, however, has a valuable resource base in the form of high quality sand, and it appears that it will continue to be viable in the foreseeable future.

The City of Streator has been able to obtain the revenues necessary to meet its debt obligations incurred to date. The amount of revenue requirements needed to meet commitments for any of the alternatives, however, will be large compared to previous revenue requirements.

If sewer service were extended beyond the existing service area, commitments from potential users to appropriate charges would be required. The City would prefer to incorporate the potential sewer service extension areas. This would solve the problem of securing charge commitments. Revenues, however, could be assured by outside authorities, such as IEPA or the Illinois Department of Public Health, requiring hookup to the sewer system. Such hookups would require that appropriate payments be made for service.

There are no significant, long-term, overlapping government debts in the area that would compete for general revenue funds. The debt on the high school will be paid off in early 1979. The debt on the elementary school includes a fire prevention bond issue that will be paid off in 1981 and a building bond issue that will be paid off in 1984. Because the elementary school debt will be retired in the near future, resources presently committed to this debt will be available for sewer service debt payments.

Users of the wastewater facilities would not receive any significant direct financial benefits from improvements. Improved facilities, however, would enhance the environment and would tend to result in increased property values. Residents might be more willing to support a debt issue if they believed that their property values would go up as a result of system improvements. No attempt has been made, however, to assess the impacts of alternatives on property values.

6.6.3. Debt Ratios

In addition to qualitative criteria used to assess the financial feasibility of incurring debt, there are standard debt ratios used by credit-rating agencies, investment bankers, and large institutional investors.

These quantitative measures generally are used to analyze full-faith and credit debt limits. Full-faith and credit debts are financed by general obligation bonds that are retired by tax revenues. Revenue bonds that would be issued for improvements to wastewater facilities, on the other hand, would be retired by revenues generated by the service (i.e., user charges and connection fees). These revenue bonds for sewer service depend on the general economic resources and health of the community and, thus, have the same base of support as general obligation bonds. Therefore, quantitative criteria for general obligation bonds are used in this analysis.

The debt ratios used to evaluate financial feasibility of alternatives are:

- Net direct and overlapping tax-supported debt per capita
- Net direct and overlapping tax-supported debt to adjusted assessed valuation of property
- Net direct tax-supported debt service to revenue (budget)
- Net direct and overlapping tax-supported debt to personal income.

The net direct and overlapping tax-supported debt for this analysis is the present worth of the capital cost plus the outstanding debt on the existing facilities ($300,000). The present overlapping government debt on the elementary school is not included, because it will be retired very early in the life of any implemented alternative. The debt service is the average annual equivalent capital cost plus the debt service on the existing debt, which is $15,000 when refinanced over a 20-year period. Estimates of population, adjusted assessed valuation of property, revenue, and personal income used in the debt analysis are as follows:

	City of Streator	Existing Service Area	Expanded Service Area
Population	15,600	12,700	21,206
Property Value ($ X 1,000)	166,179	---	---
Revenue ($ X 1,000)	3,024	not applicable	not applicable
Personal Income ($ X 1,000)	85,800	69,850	122,995

Estimates of property value for the existing and expanded service areas could not be determined because of insufficient information.

The debt ratios resulting from the lowest and highest O&M cost alternatives were estimated for the City of Streator, the existing service area, and the expanded service area (Table 6-4). Estimates indicate that the debt that would be incurred if the lowest O&M cost alternative (2h) were chosen would be financially feasible. The debt would not exceed the criteria for local government debt (Table 6-5).

The highest O&M cost alternative does not appear financially feasible, based on debt ratios. The debt per capita and the debt to personal income would be high, and the criterion for debt service to revenue would be exceeded.

6.6.4. Comparative Debt Per Capita

The 1975 debt per capita estimates for 20 cities in the North Central Illinois Region are presented in Table 6-6. The total debt per capita for Streator was $25. This debt is very low compared to the debt per capita estimates for most of the 19 other cities. The new debt per capita for Streator, however, would be considerably higher once an alternative is implemented. This debt per capita will include the present worth of the capital cost and the outstanding debt on the existing facilities (presented in Table 6-4 for the lowest and highest O&M cost alternatives). If the lowest O&M cost alternative were chosen, the Streator debt per capita ($292) would rank fifth among the 20 cities. The highest cost alternative would create a debt per capita that would rank second ($629).

6.7. Public Health Considerations

Each wastewater management alternative developed for the Streator FPA has a potential public health related risk. In general, the potential effects are related to pathogenic organisms present in municipal wastewater and their possible transmission to the public and to chemicals in the wastewater and the possible contamination of water supplies. All of the alternatives, however, have smaller potential risks than the possible risks associated with the present wastewater management practices. All alternatives would reduce significantly the discharge of untreated sewage from deteriorated sewer lines and combined sewer overflows to surface waters. Alternatives also would eliminate direct discharge of residential wasteflows to the mines in the presently sewered area.

Alternatives that include extension of sewer service would eliminate the use of septic tank systems and residential wastewater discharges to the mines in the presently unsewered areas. Use of septic tank systems frequently results in contamination of soil, groundwater, and surface waters and constitutes a public health hazard (Patterson and others 1971). Even if systems are designed, installed, and maintained properly, soil absorption fields eventually fail as the soils become clogged by chemical, physical, and biological processes. In the Streator FPA, many residences have septic tanks without absorption fields that discharge to the mines. These systems cannot be relied on to remove either fecal bacteria or significant amounts of dissolved organic material from the household sewage. In addition, only 15% to 30% of the BOD_5 is removed by these septic tanks (Patterson and others 1971).

All of the treatment options included in the alternatives involve a greater level of treatment than the present level and, therefore, reduce public health related risks. All options include either chlorination of

Table 6-4. Debt ratios for Alternatives 2h and 1a.

	City of Streator	Existing Service Area	Expanded Service Area
Alternative 2h			
Debt Per Capita	$292	$359	NA
Debt to Property Value	2.7%	NC	NA
Debt Service to Revenue	13%	NA	NA
Debt to Personal Income	5.3%	6.5%	NA
Alternative 1a			
Debt Per Capita	$629	NA	$462
Debt to Property Value	5.9%	NA	NC
Debt Service to Revenue	29%	NA	NA
Debt to Personal Income	11%	NA	8.0%

NA - not applicable
NC - not calculated due to insufficient information

Table 6-5. Criteria for local government full-faith and credit debt analysis. (Adapted from Moak and Hillhouse 1975, and Aronson and Schwartz 1975).

Debt Ratio	Standard Upper Limit for Debt
Debt Per Capita	
Low Income	$ 500
Middle Income	1,500
High Income	5,000
Debt to Market Value of Property	10% of current market value
Debt Service to Revenue (or Budget)	25% of the local government's total budget
Debt to Personal Income	7%[a]

[a]Not an upper limit, but the national average in 1970.

Table 6-6. Total outstanding debt per capita[a] in 1975 for 20 cities in the North Central Illinois Region (Illinois Department of Business and Economic Development 1976).

City	Outstanding Debt per Capita ($)
Princeton	$1,134.50
Granville	448.90
Peru	380.20
East Peoria	339.30
Normal	238.00
Bloomington	196.70
Havana	166.80
Ottawa	164.00
La Salle	155.20
Morton	154.60
Eureka	135.70
Morris	129.50
Clinton	89.40
Pontiac	83.80
Plano	75.00
Peoria	54.60
Henry	46.00
Wyoming	33.60
Streator	25.00
Pekin	22.30

[a]Equals the sum of general obligation bonds, revenue bonds, and other forms of debt, divided by the 1970 municipal population.

treated wastewater before discharge to the Vermilion River or disposal of treated wastewater into the mines without chlorination. Neither of these practices are employed presently. Disinfection removes a significant number of bacteria, although it does not remove all pathogenic organisms from the effluent. Furthermore, chlorination of wastewater can result in the formation of halogenated organic compounds that are suspected of being toxic to man (USEPA 1976b). Rapid mixing of the chlorine and design of contact chambers to provide long contact times, however, can achieve the desired disinfection and the minimum chlorine residual discharge (USEPA 1977a).

Treated wastewater and excess combined sewer flows would not be disinfected prior to mine recharge. Processes that occur in the mines provide significant treatment, including removal of large amounts of bacteria (Appendix C). Mine leachates that would result from alternatives using the existing secondary treatment and continuous effluent recharge may contain slightly higher fecal bacteria concentrations than leachates that would result from alternatives using upgraded treatment and effluent recharge only during dry-weather periods.

A potential risk of all alternatives is the generation of pathogenic aerosols at the wastewater treatment plant and their transmission to the public (Section 6.1.1.2.). Alternatives that include a larger (2.6 mgd) plant capacity and/or additional treatment processes may result in higher rates of aerosolization than those alternatives with the 2.0 mgd plant capacity and the existing secondary treatment. Alternatives that include the option to store and then treat excess combined sewer flows also may have higher rates of aerosolization than those alternatives that include the option to only treat those flows. The concentrations of viable aerosols generated by any of the alternatives and the possibility of disease transmission, however, are considered insignificant (Hickey and Reist 1975).

6.8. Aesthetic Impacts

Aesthetic considerations are related primarily to the location of the collection, treatment, and disposal facilities and to the treatment processes. Some aesthetic aspects such as odor, noise, and disruption are discussed in other sections. This section considers the visual impacts of the wastewater management alternatives.

All alternatives would involve construction activities that would create short-term visual impacts. Construction at the plant site would be required for upgrading and/or expansion of existing facilities and for additional facilities to store and/or treat excess combined sewer flows. Impacts, however, would be minimal, because most of the site is visually isolated from other land uses. Sewer separation and rehabilitation of the combined sewer system would have impacts, but the present aesthetic conditions would be restored after construction.

The locations of most above-ground facilities are identical for all alternatives. Visual impacts, therefore, would be similar. Slightly larger treatment facilities and adjacent facilities to store and/or treat excess combined sewer flows would have no significant impact. Stations to monitor water levels in the mines would be located throughout the service area for all alternatives. These stations, however, would be small and their visual impact would be minimal.

The water quality of mine leachates would improve over time, but iron deposits and the hydrogen sulfide odors may remain essentially the same. Aesthetically, the leachate discharges may continue to be unsightly and malodorous.

6.9. Secondary Impacts

The population of the Streator FPA is stable and is not limited by the availability of wastewater collection and treatment facilities (Section 3.5.3.). Wastewater management alternatives would not determine the extent and location of future residential, commercial, or industrial development. None of the alternatives, therefore, would have any significant secondary environmental or socioeconomic impacts. Air quality and water quality would not be degraded by alternative program-related growth. Alternatives would not affect the local economy. Any secondary impacts would be construction-related and, thus, minimal and short-term.

Some development may be directed away from the central business district to presently unsewered areas if sewers were extended, but it would not be significant. If sewers were extended, property values in presently unsewered areas would tend to increase, and residents might spend some income on home improvements. The spending, however, would not stimulate the local economy significantly.

7.0. THE PROPOSED ACTION

The alternative that was selected as the most cost-effective wastewater management plan for the Streator FPA is Alternative 2e (Table 5-2). This alternative would achieve the environmental objectives and would be financially feasible. The collection system consists of a rehabilitated combined sewer system. Wastewater treatment includes upgraded secondary treatment at the existing 2.0 mgd treatment plant. Excess combined sewer flows (flows not discharged to the mines or treated at the plant) would receive primary treatment and chlorination prior to discharge to the Vermilion River at the existing outfall. The mines beneath Streator would be recharged with effluent from the treatment plant during dry-weather periods. During wet-weather periods, the mines would be recharged with overflows from the combined sewer system and with stormwater from new storm sewers in the presently sewered area. The estimated total capital cost for Alternative 2e is $22,515,900. The annual operation and maintenance (O&M) cost is approximately $316,300.

7.1. The Selection of Component Options

The selection of component options that comprise the most cost-effective alternative involved the consideration of effectiveness in eliminating environmental problems and in complying with discharge requirements; costs, including the local share of the capital cost and the O&M cost; land requirements and extent of construction disruption; and public acceptability. The selection process also involved coordination between USEPA and State agencies, such as IEPA, the Illinois Department of Public Health, and the Illinois Department of Mines and Minerals (Section 5.2.).

The discussion below will present in summary form the rationale used to select the component options that appear most cost-effective at this point in the planning process. A matrix comparing the major impacts of system alternatives on the different environmental components was not developed. A matrix for thirty-six alternatives could not provide practically a summary of impacts for comparison and selection of the most cost-effective alternative. In addition, impacts of alternatives on some environmental components can not be quantified until additional studies are conducted (see Chapter 8), and differences between some impacts are insignificant. Often the only major differences are construction and/or O&M costs.

7.1.1. Collection System

The proposed action includes the continued use of the existing collection system as a combined sewer system. The three major interceptors (Prairie Creek, Kent Street, and Coal Run) would be replaced and other segments of the system would be rehabilitated (Section 5.2.2.2.). The extent of rehabilitation would depend on the findings of a recommended sewer system evaluation survey. The total capital cost of this component option would be $14,473,428 and the annual O&M cost would be $10,300.

This option would meet several objectives. The new interceptors and the rehabilitation would reduce significantly I/I at the treatment plant and discharges of raw sewage to surface waters from cracked and broken sewers (Section 4.1.). In addition, the interceptors would be sized to convey large storm flows to the treatment facilities, thereby reducing combined sewer overflows to surface waters. Some combined sewer flows would continue to discharge to the mines (Section 5.2.2.2.). These discharges would help maintain water levels in the mines during wet-weather periods and would decrease the needed capacity (size) of the new interceptors. It is expected that the State will allow the discharge of combined sewer flows to the mines (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978).

Sewer separation is considerably more expensive than the preferred option and would cause significant construction-related impacts (Section 6.0.). The installation of sanitary sewers in the presently sewered area would be $4,280,800 more costly than the rehabilitation of the existing system. The annual O&M cost would be $21,000 higher. The alternatives in the first group, therefore, were discarded.

Sewer extensions were not included in this component option. Additional facilities planning will be required to determine how to cost-effectively dispose of domestic sewage in the presently unsewered areas (Section 5.2.2.3.). Extension of sewers would cost approximately $10,391,600, and the annual O&M cost would be about $9,600 (see Alternative 2f, Table 5-3 and Appendix D).

7.1.2. Wastewater Treatment

7.1.2.1. Treatment Plant Design Capacity

The proposed action includes use of the 2.0 mgd design capacity at the existing plant for average daily dry-weather flows. This capacity would accommodate present domestic and industrial flows (1.121 mgd), additional flows from presently unsewered areas (0.53 mgd), and industrial sanitary wastes presently discharged to the mines (0.029 mgd; Section 5.2.3.1.). It is assumed that the State will not allow untreated sanitary wastes to be discharged to the mines (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978).

The use of the 2.0 mgd capacity plant assumes that the present discharge of industrial cooling and process waters to the mines will be allowed to continue by State agencies once NPDES permits are issued (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978). The existing plant capacity, however, would have to be expanded to 2.6 mgd if sewer extensions were determined to be cost-effective, and if much of the process water were considered unsuitable for mine discharge and if industries did not choose to treat their process water prior to discharge to the mines. If all industrial process water presently discharged to the mines (0.739 mgd) were conveyed to the treatment plant and if sewer service were not extended, the existing plant capacity (2.0 mgd) would be sufficient.

The expansion of the capacity of the treatment plant would cause minimal construction-related impacts but would increase costs significantly. Expansion of the treatment plant, which would provide upgraded secondary treatment, would increase the total capital cost of the proposed alternative by $455,800 and the annual O&M cost by $11,600. The extension of sewers would increase the total capital cost and the annual O&M cost by $11,159,100 and $12,700, respectively (these costs are for sewers only; see Alternative 2d, Table 5-3 and Appendix D).

7.1.2.2. Level of Treatment

Alternative 2e (the preferred alternative) includes upgraded secondary treatment, which consists of the existing secondary treatment plus nitrification and disinfection (Section 5.2.3.2.). For this study it is assumed that this level of treatment should produce an effluent that meets the less stringent effluent requirements for stream discharge (10 mg/l BOD_5, 12 mg/l suspended solids, 1.5 mg/l ammonia-nitrogen, and fecal coliform counts not larger than 200 per 100 milliliters; Section 4.4.).

It is assumed in Alternative 2e that the less stringent effluent limitations will be acceptable (By letter, Mr. Roger A. Kanverva, IEPA, to Charles Sutfin, USEPA, Region V, 18 July 1978). There are generally no BOD/SS-related water quality problems in the Vermilion River (Section 3.3.1.3.) and discharges of effluent containing 10 mg/l BOD_5 and 12 mg/l SS are not expected to cause a violation of any applicable water quality standard. A higher level of treatment, therefore, is not necessary if upgraded secondary treatment results in an effluent that can meet the 10 mg/l BOD_5 and 12 mg/l SS requirements.

The quality of the treated effluent, however, depends not only on the level of treatment but also is contingent on the quality of the influent to some extent. Because the existing combined sewer system will be used, there still will be I/I in the system following rehabilitation. The necessary level of treatment should be determined by analyzing the influent after sewer system rehabilitation (Section 5.2.3.2.). Treatment must be sufficient to meet effluent limitations during worst conditions.

If the amount of I/I were small, the concentrations of BOD_5 and SS in the influent may be sufficiently high so that upgraded secondary treatment would not remove sufficient oxygen demanding substances (BOD) and SS to meet the effluent limitations (10 mg/l BOD_5 and 12 mg/l SS). If this were the case, a higher degree of treatment would be necessary. Tertiary treatment without chemical coagulation could produce the necessary quality effluent. This level of treatment would increase the total capital cost of the recommended alternative by $747,000 and the annual O&M cost by $37,400 (see Alternative 2b, Table 5-3 and Appendix D). Full tertiary treatment would not be necessary if a combined sewer system were used.

Existing secondary treatment and continuous effluent recharge to the mines for additional treatment would not be permitted by IEPA if the effluent did not meet requirements for stream discharge (By letter, Mr. Roger A.

Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978). IEPA believes that discharges to the mines should be provided a level of treatment comparable to that required for discharge to surface waters. In the agency's opinion, the waters in the abandoned mines are "waters of the State," and the point-source discharges to them should be treated accordingly. Based on this reason, the alternatives in the fourth group and all other alternatives that include only secondary treatment were eliminated.

7.1.2.3. Treatment of Excess Combined Sewer Flows

Alternative 2e includes primary treatment and chlorination of excess combined sewer flows. This option to control excess combined sewer flows is acceptable to the State, as it provides for significant reduction in combined sewer overflows to surface waters and provides for compliance with current regulations of the Illinois Pollution Control Board (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978). The option to store excess combined sewer flows and then recharge the mines with these flows would not be acceptable to the State. Discharges to the mines would have to meet the same requirements as for stream discharge.

Storage of excess flows, followed by primary treatment and chlorination at a slower rate also would be acceptable to the State (By letter, Mr. Roger A. Kanverva, IEPA, to Mr. Charles Sutfin, USEPA, Region V, 18 July 1978). This option would decrease the total capital cost of the recommended alternative by $349,900. This option, however, would increase the annual O&M cost by $72,100. It also would require additional land for a storage basin. A basin designed to accommodate 12.3 mgd would require 2.5 acres if the basin were 15 feet deep. An acceptable site for such a basin is not readily available, especially a site that does not have a high potential for subsidence. Based on this reason, the alternatives in the third group were dropped.

7.1.3. Mine Recharge

The proposed action would provide for mine recharge via the combined sewer system, storm sewers, and an effluent recharge system (Section 5.2.4.). The recharge should be sufficient to maintain water levels in the mines and, thus, minimize the potential for subsidence (Section 5.2.4.). During wet-weather periods, combined flows would be discharged to the mines from drop shafts located throughout the existing collection system. Additional stormwater would be directed to the mines by storm sewers and drop shafts that would be installed in the presently sewered area. During dry-weather periods, treatment plant effluent would be pumped to the mines via a recharge system that would extend to both presently sewered and unsewered areas. Stations recording water levels in the mines would be installed throughout the recharge area and would be monitored continuously. Changing water levels would indicate when the recharge system should be used or when recharge has been sufficient.

7.2. Total and Local Costs

Alternative 2e has a total capital cost of $22,515,900 and an annual O&M cost of $316,300 (based on January 1978 price levels; see Appendix D).

The average annual equivalent cost over a 20-year period (with a 6.625% interest rate) is $2,189,300.

The local costs of this alternative include 25% of the total capital cost eligible for funding under the Construction Grants Program and 100% of the annual O&M cost, plus the remaining debt on the existing facilities (Table 7-1). The mine recharge costs will be eligible for Federal and/or State funding. The present debt is $300,000, which would increase the annual local cost of the alternative by $15,000 over a 20-year period. Local costs would be funded by an undetermined combination of municipal bonds, new sewer connection fees, and/or user charges.

The financial feasibility of the proposed action was evaluated by determining debt ratios on the debt that would be incurred to finance the local share of the total capital cost (Table 7-2; see Section 6.6.3. for methodology and debt criteria). Alternative 2e would be financially feasible. The debt to personal income ratio in the presently sewered area (8.5%) would exceed the 1970 national average (7.0%), but no standard upper limit for debt would be exceeded (Table 6-5). The debt per capita for the City of Streator would rank fourth among the 20 cities in the North Central Ilinois Region (Table 6-6).

7.3. Minimization of Adverse Impacts

Some adverse impacts would be associated with the proposed action. There are, however, a variety of legal requirements and other measures that are intended to minimize adverse impacts. To the extent that these measures are applied, many adverse impacts could be reduced significantly or eliminated. Potential measures to minimize impacts related to the construction and operation of the proposed wastewater facilities are discussed below.

7.3.1. Minimization of Construction Impacts

Construction activities could cause significant impacts. Impacts would be associated primarily with the rehabilitation of the collection system, including the replacement of the three major interceptors, the installation of the effluent recharge system and the storm sewers, and the construction of facilities to treat excess combined sewer flows. Adverse impacts, however, can be controlled, and most should be of short duration. Plans and specifications must include mitigative measures as discussed in the following paragraphs.

Fugitive dust at the various construction sites can be reduced through various techniques. Construction sites, spoil piles, and unpaved access roads can be wetted periodically to minimize dust. Large spoil piles also can be covered with matting, mulch, and other materials to reduce exposure to wind erosion. Street sweeping can control traffic dust where excavated material is tracked or dumped on paved surfaces.

Proper maintenance of construction equipment would minimize emissions of hydrocarbons and other fumes. Air pollution control devices also could be used on stationary internal combustion engines. The resident engineer should be given the authority to refuse usage of poorly maintained equipment.

Table 7-1. Local costs ($) of Alternative 2e for wastewater facilities at Streator, Illinois. A 20-year analysis period was used.

Costs	
Present Worth	
Capital Cost (25% of Total Capital Cost)	5,628,975
O&M Cost	3,450,835
Total	9,079,810
Average Annual Equivalent	
Capital Cost	516,177
O&M Cost	316,300
Subtotal	832,477
Existing Annual Debt	15,000
Total	847,477

Note: See Table 6-3 for methodology used to calculate local costs.

Table 7-2. Debt ratios of Alternative 2e for wastewater facilities at Streator, Illinois.

Debt Ratios	City of Streator	Existing Service Area
Debt Per Capita	$380	$467
Debt to Property Value	3.6%	NC
Debt Service to Revenue	18%	NA
Debt to Personal Income	6.9%	8.5%

NA - not applicable
NC - not calculated due to insufficient information
Note: See Section 6.6.3. for methodology used to determine debt ratios and for debt criteria.

Burning of construction-related wastes would be controlled by regulations of the Illinois Pollution Control Board (1977). The rules allow burning of landscape waste only at the place where the waste is generated; when atmospheric dispersion conditions are favorable; if no visibility hazard is created; and in sparsely populated areas.

A careful analysis will have to be conducted to select a site for facilities to treat excess combined sewer flows. Such facilities should not be located above an abandoned mine and/or in an area where there is a potential for subsidence (Appendix B). These areas could not support such facilities. There are areas near the treatment plant that are not undermined and, thus, would be appropriate for excess flow treatment facilities.

Measures also should be taken to minimize the potential for damage to new interceptors, storm sewers, and the recharge system from possible future subsidence. Where possible, routes should be changed to avoid areas that have a high subsidence potential. Light weight pipes, flexible joints, and timber or concrete supports could be provided where necessary. The facilities planners will determine what would be necessary and appropriate during detailed planning.

Where land is disturbed and soils are exposed, measures must be taken to minimize erosion. USEPA's Program Requirements Memorandum 78-1 (1977b) established requirements for the control of erosion and runoff from construction sites. Adherence to these requirements would minimize the potential for problems to a large extent. The requirements include:

- Construction site selection should consider potential occurrence of erosion and sediment losses
- The project plan and layout should be designed to fit the local topography and soil conditions
- When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems that require extensive control measures
- Whenever possible, topsoil should be removed and stockpiled before grading begins
- Land exposure should be minimized in terms of area and time
- Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation
- Natural vegetation should be retained whenever feasible
- Appropriate structural or agronomic practices to control runoff and sedimentation should be provided during and after construction

- Early completion of a stabilized drainage systems (temporary and permanent systems) will reduce substantially erosion potential

- Access roadways should be paved or otherwise stabilized as soon as feasible

- Clearing and grading should not be started until a firm construction schedule is known and can be coordinated effectively with the grading and clearing activities.

The number of pipes crossing streams should be minimized to protect water quality and aquatic biota. Where crossings are necessary, careful planning could minimize adverse effects. Installation of pipes across streams should be scheduled during low-flow conditions, usually during the late summer. Low flows would transport smaller sediment loads downstream. Some project area waterways also are dry at that time of year. Potentially erodible bank-cuts must be stabilized so that a storm event would not cause significant erosion. Where significant stream flow would be encountered, temporary diversion channels with artificially stabilized banks or culverts should be used to minimize the potential for erosion. Regardless, Section 10 (Rivers and Harbors Act of 1899) and/or Section 404 (PL92-500) permits would be required for all stream crossings.

Disturbed land should be regraded, compacted, and revegetated immediately after construction. Construction sites should be restored to their original condition as closely as possible. Native vegetation should be used. Such efforts would facilitate re-establishment of wildlife habitats.

The National Historic Preservation Act of 1966, Executive Order 11593, the Archaeological and Historic Preservation Act of 1974, and the 1973 Procedures of the Advisory Council on Historic Preservation require that care must be taken early in the planning process to identify cultural resources and to minimize adverse effects on them. US-EPA's final regulations for the preparation of EISs (40FR16818) also specify that compliance with these regulations is required when a Federally funded, licensed, or permitted project is undertaken. Due to the lack of adequate information on existing archaeological resources at some potential construction sites (along proposed routes for storm sewers and the recharge system), a survey by professional archaeologists would be necessary to identify potentially significant areas. In addition, it may be necessary to provide archaeological expertise during construction in critical areas to avoid destruction of archaeological resources. If not already identified, project delays due to involvement with discovered archaeological sites would be costly. For this reason, adequate ground coverage surveys during the planning period are advisable. Consultation with the State Historic Preservation Officer (SHPO) should be undertaken by the City and its facilities planners concerning cultural resources before the commitment of capital for project construction.

Appropriate planning can control construction-related disruption in the community. Announcements should be published in newspapers and broadcast through other news media to alert drivers of temporary closings of primary traffic routes during sewer rehabilitation and installation of storm sewers and the recharge system. Traffic control may be needed at points where certain construction equipment would enter onto public streets from access areas. Special care should be taken to minimize disruption of access to commercial establishments and to frequently visited areas. Planning of routes for heavy construction equipment should include consideration of surface load restrictions to prevent damage to streets and roadways.

7.3.2. Minimization of Operation Impacts

Impacts related to the operation of the proposed wastewater facilities would be minimal if the facilities were designed, operated, and maintained properly. Aerosols, gaseous emissions, odors, and noise from the various treatment processes can be controlled to a large extent. Above-ground pumps would be enclosed and installed to minimize sound impacts. The effluent discharged from the treatment plant will be regulated by the conditions of the NPDES permit. The permit will specify the discharge quality (Section 5.3.) and will require regular monitoring of the effluent. Periodic plant inspection will be conducted by IEPA. If the conditions of the permit are violated, enforcement actions will be taken against the City of Streator to ensure compliance. Special care will have to be taken to control chlorination and effluent concentrations of chlorine residuals (Section 6.3.1.4.).

Federal Guidelines for Design, Operation, and Maintenance of Wastewater Treatment Facilities (Federal Water Quality Administration 1970) require that:

All water pollution control facilities should be planned and designed so as to provide for maximum reliability at all times. The facilities should be capable of operating satisfactorily during power failures, flooding, peak loads, equipment failure, and maintenance shutdowns.

The facilities planners for the City of Streator should consider the following types of measures (if not implemented previously) to ensure system reliability:

- Duplicate sources of electric power
- Standby power for essential plant elements
- Multiple units and equipment to provide maximum flexibility in operation
- Replacement parts readily available
- Holding tanks or basins to provide for emergency storage of overflow and adequate pump-back facilities
- Flexibility of piping and pumping facilities to permit rerouting of flows under emergency conditions
- Provision for emergency storage or disposal of sludge
- Dual chlorination units
- Automatic alarm systems to warn of high water, power failure, or equipment malfunction
- No treatment plant bypasses or upstream bypasses

- Design of interceptor to permit emergency storage without causing back-ups
- Enforcement of pretreatment regulations to avoid industrial waste-induced treatment upsets
- Flood-proofing of treatment plant
- Plant Operations and Maintenance Manual to have section on emergency operation procedures
- Use of qualified plant operators.

Through the incorporation of these types of measures, the facilities would be virtually "fail-safe," ensuring that effluent limitations would be met during the system's entire design life.

Proper and regular maintenance of collection, treatment, and recharge components is essential to maximize efficiency and to prevent adverse impacts. Federal and State O&M guidelines and regulations should be followed. Special care should be taken to maintain the combined sewers, the storm sewers, and the recharge system to ensure maximum mine recharge and, thus, to minimize the potential for subsidence. Drop shafts, where possible, should be inspected regularly so that they do not become blocked. If records from the mine recharge monitoring stations indicate that the amount of flow recharged to the mines is decreasing, drop shafts may be becoming blocked, and additional drop shafts may be necessary if the existing ones can not be kept open.

The provision for stations to record water levels in the mines and for continuous monitoring is critical. When water levels begin to decline, the effluent recharge system can be activated to minimize the potential for subsidence. When water levels begin to increase above present levels, the system can be deactivated to prevent overcharging and above-ground flooding. An automatic alarm system can be installed to warn the treatment plant operator when water levels are changing.

Industries discharging process and cooling waters to the mines would require appropriate permits from State agencies (Section 5.2.3.1.). Treatment prior to mine discharge may be considered necessary to minimize the potential impact of leachates on the water quality of surface waters.

Domestic discharges to the mines would have to be eliminated in compliance with the Private Sewage Disposal Licensing Act and Code of 1974 and other State regulations. If extensions of sewers to presently unsewered areas were not considered cost-effective, alternative on-site disposal systems would be developed to sewer these areas.

7.4. Unavoidable Adverse Impacts

There is a general amount of disruption associated with the implementation of the proposed action that cannot be avoided. Construction activities would create dusty and noisy conditions that would degrade the aesthetic quality of affected areas. Traffic congestion may be created when sewers are rehabilitated and when storm sewers and the effluent recharge system are installed. Some loss of vegetation and wildlife habitat and some erosion and siltation/sedimentation are inevitable. Impacts, however, should be minimal and/or of short duration.

Discharges from the proposed treatment facilities would have some effect in the mixing zone and some lesser effect downstream. The effects traditionally have been considered acceptable when the economics of wastewater treatment are considered. Impacts would be less if discharges met the conditions of the final NPDES permit (specifying 4 mg/l BOD_5 and 5 mg/l SS as opposed to 10 mg/l BOD_5 and 12 mg/l SS), but the costs would be considerably larger. Discharges, however, would not cause the violation of any in-stream water quality standard. Current uses of the Vermilion River and the aquatic biota would not be affected adversely.

The proposed action would not eliminate mine leachate flows to surface waters. Thus leachates would continue to contribute pollutant loads to surface waters in the Streator FPA. Leachates would have some effect on water quality, but the impacts should be reduced as pollutant loads discharged to the mines are controlled (Appendix C). Leachates still would contain significant concentrations of coliform bacteria and iron and would create malodorous and unsightly conditions near leachate discharge points.

7.5. Irretrievable and Irreversible Resource Commitments

The construction and operation of rehabilitated and upgraded wastewater facilities at Streator would cost a considerable amount of money and would consume a large amount of resources (Section 7.2.). The types of resources that would be committed through the implementation of the proposed action include public capital, labor, energy, and unsalvageable materials. Non-recoverable resources would be foregone for the provision of improved water pollution control.

The proposed action proposes the use of most of the existing facilities. These facilities represent a significant commitment of resources previously made by the City of Streator. Commitment of additional resources to rehabilitate deteriorated components and to comply with current regulations, therefore, would not only achieve present environmental objectives but also would extend the longevity of past investments.

Capital expenditures and resource requirements for the construction of facilities would be significant. A large construction labor force (approximately 550 workers for one year; Draft EIS, Section 5.5.2.1.) and considerable construction equipment would be needed for the different component systems. A large amount of materials also would be consumed, especially pipes for new interceptors, storm sewers, and the effluent recharge system. In addition, a substantial amount of energy resources would be consumed, primarily through combustion of fossil fuels by construction equipment.

Annual O&M expenditures, including labor, would be considerably higher than present expenditures, but other resource commitments would not increase substantially. The annual O&M cost would increase from $111,338 (disbursements during fiscal year 1977; Draft EIS, Table E-12) to approximately $316,300 (184% increase). Six plant operators would be necessary

(Draft EIS, Section 5.5.2.2.). Additional energy would be required for an extra blower to provide sufficient nitrification and for pumping treated effluent to the mines during dry-weather periods. New disinfection facilities also would consume energy, as well as chlorine. Other additional chemicals would not be utilized.

7.6. Relationship Between Short-term Uses of Man's Environment and Maintenance and Enhancement of Long-term Productivity

The short-term disruption and commitment of resources associated with construction and operation of rehabilitated and upgraded wastewater facilities would be necessary to improve water pollution control and to minimize the potential for subsidence. Environmental impacts and resource requirements, however, would be offset by water quality improvements and stabilized mine conditions. Long-term, significant environmental benefits would be derived from short-term, minimal environmental costs.

8.0. RECOMMENDATIONS

Alternative 2e was developed as a conceptual scheme to control water pollution in the Streator FPA and to minimize the potential for subsidence. More facilities planning, however, is necessary before any alternative can be finalized. Additional studies that are necessary were presented in previous sections of this EIS and are discussed together below. These studies will enable all alternative components to be designed and implemented. The sequence of interdependent recommendations is presented in Figure 8-1.

Before any additional planning is done to refine the proposed action, it is critical to confirm the feasibility of certain assumptions that were incorporated in the alternative. The assumptions include: 1) approval of less stringent effluent limitations (specifically 10 mg/l BOD_5 and 12 mg/l SS) and 2) approval of that the discharge of treated combined sewer flows (wet-weather flows) from the collection system, stormwater, and treatment plant effluent to the mines. The City of Streator should request a change in the current, final NPDES permit and should start the process of obtaining permits to discharge to the mines. This will require consultation and coordination with the IEPA, the Illinois Pollution Control Board, the Illinois Department of Mines and Minerals, and the Illinois Mining Board.

8.1. Collection System

A thorough sewer system evaluation survey (SSES) is necessary before the existing collection system can be rehabilitated. Such a survey would detect significant sources of I/I and would indicate the extent of rehabilitation required. Drop shafts to the mines also would be located, and those found to be level with the bottom of sewers or manholes would be raised during rehabilitation, if possible, to prevent dry-weather flows from discharging to the mines. The SSES should include determination of the amount of I/I remaining after cost-effective rehabilitation of the sewer system. Treatment capacity should be provided for the amount of I/I reaching the treatment facilities.

The facilities planners should evaluate the cost-effectiveness of sewer extensions. As part of the analysis, they should conduct a survey in presently unsewered areas (areas considered for sewer extensions; Figure 5-1) to determine if septic tank systems are suitable for these areas, and to identify which systems are malfunctioning and which residential lots have septic tanks without absorption fields that discharge effluents to the mines. All requirements of PRM 78-9 should be met (Section 5.2.2.3.). Detailed plans for sewers and for alternative on-site disposal systems should be developed to evaluate which course of action would be most cost-effective.

8.2. Wastewater Treatment

8.2.1. Treatment Plant Design Capacity

Before the wastewater treatment plant is upgraded, industries should obtain permits from the appropriate State agencies to continue discharging

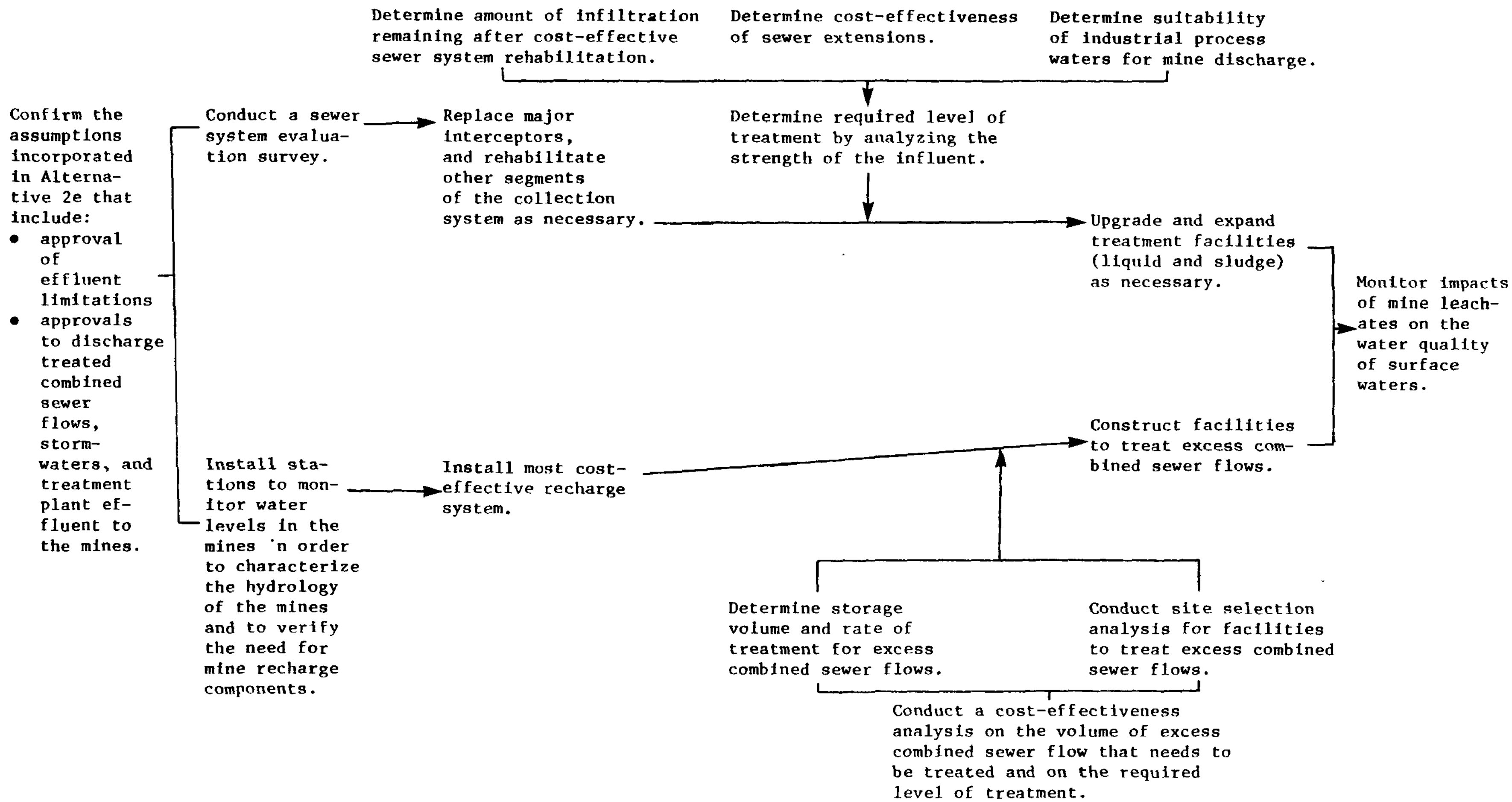

Figure 8-1. The sequence of interdependent recommendations.

process and cooling waters to the mines. The plant capacity assumed in the proposed action would have to be expanded if 1) sewer extensions were determined cost-effective; 2) if much of the process water were considered unsuitable for mine discharge and if industries were to choose not to treat their process water prior to discharge to the mines; and 3) if the amount of infiltration remaining after cost-effective sewer system rehabilitation were significant (Section 7.1.2.1.).

8.2.2. Level of Treatment

After the three major interceptors are replaced and the other segments of the collection system are rehabilitated, the strength of the wastewater entering the treatment plant (the influent) should be analyzed to determine the level of treatment required to meet acceptable effluent limitations. It presently is assumed that upgraded secondary treatment would provide the necessary removal of oxygen demanding wastes, suspended solids, and ammonia. A higher level of treatment, however, might be required to meet effluent limitations based upon the influent wastewater strength. The influent should be analyzed after the combined sewer system is rehabilitated to determine the required level of treatment. The influent should be sampled during dry-weather and wet-weather periods. Treatment provided must be sufficient to meet effluent limitations during worst conditions. The facilities planners should evaluate the need of the tertiary treatment to meet effluent limitations during additional facilities planning work.

8.2.3. Treatment of Excess Combined Sewer Flows

The facilities planners should conduct a cost-effectiveness analysis on the volume of excess combined sewer flow that needs to be treated and on the required level of treatment. For this alternative component to be eligible for Federal/State funding, the specific requirements of PRM 75-34 (USEPA 1975b) must be met. After the collection system is rehabilitated, analyses should be conducted to determine I/I, its quality, and peak pollutant loads. Treatment options then should be developed, specifying the ultimate storage volume and rate(s) of treatment, and should be assessed in terms of their environmental impacts and costs. Special attention should be given to the selection of sites for the facilities to avoid areas with subsidence potential.

8.2.4. Sludge Management

Once the required level of wastewater treatment has been determined, the facilities planners should develop sludge management strategies and should evaluate their cost-effectiveness. Existing facilities should be inspected closely, as damages have been observed (Draft EIS, Appendix F).

8.3. Mine Recharge

Stations recording water levels in the mines should be installed as soon as possible. These stations are necessary to characterize the hydrology of the mines and to verify the need for mine recharge components. Water levels were measured as part of previous investigations (Appendix B), but long-term data are necessary to determine the effects of storm events and seasonal trends. It also will be critical to see how water levels differ in the future from present conditions and how they fluctuate after the collection system is rehabilitated. It may not be necessary to install additional storm sewers and drop shafts[1] or to construct an effluent recharge system. Recharge of effluent (after upgraded treatment) during wet-weather (on an as-needed basis) also should be considered. This recharge option would eliminate the need for additional storm sewers and drop shafts, and thus would result in considerable cost savings. The costs of the proposed alternative using continuous effluent recharge (instead of additional storm sewers and drop shafts) are presented below (compare them with the costs of the other alternatives; Table 5-3, Section 5.4).

Total Capital Cost	Total O&M Cost	Total Present Worth	Average Annual Equivalent Cost
$18,150,700	$204,600	$18,767,800	$1,721,000

A determination will be made by the City's facilities planners regarding what is essential to cost-effectively maintain water levels in the mines.

If storm sewers and/or an effluent recharge system were determined to be necessary, an archaeological survey might be required. After the detailed plans for recharge components are developed, the State Historic Preservation Officer should be consulted to ensure that construction would not affect significant archaeological resources.

Once the proposed action is implemented, including a mine recharge scheme, the water quality of surface waters and the impacts of leachates on water quality should be investigated. The quantity and quality of leachate flows should be monitored over a sufficient period of time to characterize dry-weather and wet-weather conditions and to assess weather-related impacts. Other sources of pollution in the Streator FPA (i.e., treatment plant effluent, combined sewer overflows, and discharges from cracked and broken sewer lines) would be controlled, and it might be possible to determine if leachates were having an adverse impact on water quality. The quality of mine leachates, however, should improve over time as pollutant loads currently discharged to the mines are eliminated.

8.4. Financing

After additional facilities planning, when the specifics of the proposed action have been refined, the best manner of financing the local costs and of phasing the project should be determined. The share of construction and operation costs to be borne by industrial users should be determined (as required by Federal regulations--39FR5261). This would permit a more realistic estimation of the costs to local residents.

[1]Storm sewers and additional drops shafts, however, would help minimize the required capacity of new interceptors and facilities to treat excess combined sewer flows (Section 5.2.4.).

9.0. GLOSSARY OF TECHNICAL TERMS

Alluvium. Detrital material, such as silt, clay, sand, or gravel, deposited by moving water.

Ammonia-nitrogen. Nitrogen in the form of ammonia (NH_3) that is produced in nature when nitrogen-containing organic material is biologically decomposed.

Anticline. A fold in which layered strata are inclined down and away from the axes.

Argillaceous. Of rocks or sediments made of or largely composed of clay-size particles or clay minerals.

Biochemical oxygen demand (BOD). A bioassay-type procedure in which the weight of oxygen utilized by microorganisms to oxidize and assimilate the organic matter present per liter of water is determined. It is common to note the number of days during which a test was conducted as a subscript to the abbreviated name. For example, BOD_5 indicates the results are based on a five-day long (120 hours) test. The BOD value is a relative measure of the amount (load) of living and dead oxidizable organic matter in water. A high demand may deplete the supply of oxygen in the water, temporarily or for a prolonged time, to the degree that many or all kinds of aquatic organisms are killed. Determinations of BOD are useful in evaluating the impact of wastewater on receiving waters.

Carbon monoxide (CO). A colorless, odorless, and very toxic gas that is formed by the incomplete oxidation of carbon. It is released from motor vehicles, furnaces, and other machines that burn fossil fuels.

Coliform bacteria. Members of a large group of bacteria that flourish in the feces and/or intestines of warm-blooded animals, including man. Fecal coliform bacteria, particularly *Escherichia coli* (*E. coli*), enter water mostly in fecal matter, such as sewage or feedlot runoff. Coliforms apparently do not cause serious human diseases, but these organisms are abundant in polluted waters and they are fairly easy to detect. The abundance of coliforms in water, therefore, is used as an index to the probability of the occurrence of such diseaseproducing organisms (pathogens) as *Salmonella*, *Shigella*, and enteric viruses. The pathogens are relatively difficult to detect.

Combined sewer. A sewer, or system of sewers, that is used to collect and convey both sanitary sewage and stormwater runoff. During dry-weather periods, most or all of the flow in a combined sewer is composed of sanitary sewage. During a storm, runoff increases the rate of flow and may overload the sewage treatment plant to which the sewer connects. At such times, it is common to divert most or all of the flow, without treatment, into the receiving water.

Decibel (dB). A unit of measurement used to express the relative intensity of sound. For environmental assessment, it is common to use a frequency-rated scale (A scale) on which the units (dBA) are correlated with responses of the human ear. On the A scale, 0 dBA represents the average least perceptible sound (rustling leaves, gentle breathing), and 140 dBA represents the intensity at which the eardrum may rupture (jet engine at open throttle). Intermediate values generally are: 20 dBA, faint (whisper at 5 feet, classroom, private office); 60 dBA, loud (average restaurant or living room, playground); 80 dBA, very loud (impossible to use a telephone, noise made by food blender or portable sanding machine; hearing impairment may result from prolonged exposure); 100 dBA, deafening noise (thunder, car horn at 3 feet, loud motorcycle, loud power lawn mower).

Dissolved oxygen (DO). Oxygen gas (O_2) in water. It is utilized in respiration by fish and other aquatic organisms, and those organisms may be injured or killed when the concentration is low. Because much oxygen diffuses into water from the air, the concentration of DO is greater, other conditions being equal, at sea level than at high elevations, during periods of high atmospheric pressure than periods of low pressure, and when the water is turbulent (during rainfall, in rapids, and waterfalls) rather than when it is placid. Because cool water can absorb more oxygen than warm water, the concentration tends to be greater at low temperatures than at high temperatures. DO is depleted by the oxidation of organic matter and of various inorganic chemicals. Should depletion be extreme, the water may become anaerobic and could stagnate and stink.

Drift. Rock material picked up and transported by a glacier and deposited elsewhere.

Fissle. Capable of being split along the line of the grain or cleavage plane.

Interceptor sewer. A sewer designed and installed to collect sewage from a series of trunk sewers and to convey it to a sewage treatment plant.

Inversion. A condition of the atmosphere in which an air mass is trapped by an overlying layer of warmer air and cannot rise. During an inversion, polluted air spreads horizontally, rather than vertically, so that contaminants are not dispersed widely. Air pollution episodes commonly are associated with prolonged inversions.

Lateral sewer. A sewer designed and installed to collect sewage from a limited number of individual properties and to convey it to a trunk sewer. Also known as a street sewer or collecting sewer.

Leachate. A solution formed when water percolates through solid waste, soil, or other materials and extracts soluble or suspendable substances from the material.

Lithology. The description of the physical character of a rock as determined by the eye or with a low-power magnifier, and based on color, structure, mineralogic components, and grain size.

Loam. Soil mixture of sand, silt, clay, and humus.

Loess. An unsorted, wind-flown deposit of fine-grained soil material, predominately silt or very fine sand.

Macroinvertebrates. Invertebrates that are visible to the unaided eye (retained by a standard No. 30 sieve, which has 28 meshes per inch or 0.595 mm openings); generally connotates bottom-dwelling aquatic animals (benthos).

Mesic. Characterized by intermediate and generally optimal conditions of moisture.

Moraine. A mound, ridge, or other distinctive accumulation of sediment deposited by a glacier.

Nitrate-nitrogen. Nitrogen in the form of nitrate (NO_3). It is the most oxidized phase in the nitrogen cycle in nature and occurs in high concentrations in the final stages of biological oxidation. It can serve as a nutrient for the growth of algae and other aquatic plants.

Nitrite-nitrogen. Nitrogen in the form of nitrite (NO_2). It is an intermediate stage in the nitrogen cycle in nature. Nitrite normally is found in low concentrations and represents a transient stage in the biological oxidation of organic materials.

Nitrogen dioxide (NO_2). A reddish-brown gas that is toxic in high concentrations. It is a precursor of photochemical smog. The odor is strong and irritating. It is produced by the oxidation of nitric oxide in the atmosphere.

Outwash. Sand and gravel transported away from a glacier by streams of meltwater and either deposited as a floodplain along a preexisting valley bottom or broadcast over a preexisting plain in a form similar to an alluvial fan.

Photochemical oxidants. Secondary pollutants formed by the action of sunlight on nitric oxides and hydrocarbons in the air; they are the primary components of photochemical smog.

Piezometric level. An imaginary point that represents the static head of groundwater and is defined by the level to which water will rise.

Plagioclase feldspar. A common rock-forming mineral having the general formula $(Na,Ca)AL(Si,Al)Si_2O_8$, also known as sodium-calcium feldspar.

Primary treatment. The first stage in the treatment of wastewater in which floating wastes and settleable solids are removed mechanically by screening and sedimentation.

Sanitary sewer. A sewer that conveys only domestic, industrial, and commercial wastewaters. Stormwater runoff is conveyed in a separate system.

Secondary treatment. The second stage in the treatment of wastewater in which bacteria are utilized to decompose the organic matter in sewage. This step is accomplished by introducing the sewage into a trickling filter or an activated sludge process. Effective secondary treatment processes remove virtually all floating solids and settleable solids, as well as 90% of the BOD and suspended solids.

Storm sewer. A conduit that collects and transports stormwater runoff. In most sewerage systems, storm sewers are separate from those carrying sanitary or industrial wastewater.

Study Area. The Streator Facilities Planning Area as shown in Figure 12.

Syncline. A fold having a stratigraphically younger rock material in its core; it is concave upward.

Tertiary treatment. Wastewater treatment beyond the secondary, or biological, stage that includes removal of nutrients, such as phosphorus and nitrogen, as well as a large percentage of suspended solids. It produces an effluent with high water quality. Tertiary treatment also is known as advanced waste treatment.

Till. Unsorted and unstratified drift consisting of a heterogeneous mixture of clay, sand, gravel, and boulders that is deposited by and underneath a glacier.

Trunk sewer. A sewer designed and installed to collect sewage from a number of lateral sewers and to conduct it to an interceptor sewer or, in some cases, to a sewage treatment plant.

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11.0. INDEX

APPENDIX A. COMMENT LETTERS ON DRAFT EIS

United States Department of Agriculture
Soil Conservation Service
P. O. Box 678
Champaign, IL
61820

September 25, 1979

Mr. Gene Wojcik, Chief
EIS Section
U.S. Environmental Protection Agency
Region V
230 South Dearborn St.
Chicago, IL 60604

Dear Mr. Wojcik:

We have reviewed the Environmental Impact Statement regarding Rehabilitation of Wastewater Facilities, Streator, Illinois.

There is an insignificant area of prime farmland involved.

Sincerely,

Robert Eddleman, Acting

Warren J. Fitzgerald
State Conservationist

cc: Director, Office of Federal Activities (5)
Berg, Administrator
Lett, w/copy of draft
Smith, AC, A-2
Madison, DC, A-2

RECEIVED
'79 SEP 27 AM 11:36
WATER DIVISION

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

October 22, 1979

Mr. Gene Wojcik
Chief, EIS Section
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Wojcik:

We have reviewed the Draft Environmental Impact Statement (EIS) for Rehabilitation of Wastewater Facilities in Streator, Illinois. We are responding on behalf of the Public Health Service and are offering the following comments for your use in preparing the final EIS.

We understand that the proposed rehabilitation of wastewater facilities includes replacement of three major combined interceptor sewers and upgrading of the existing treatment plant to include nitrification and chlorination.

Subsidence

We have some concerns about the potential for continued local subsidence and its effects upon the life of the project works and future human health and welfare. These potential effects should be further addressed. The subsidence effects caused from periodic inundation of mine shafts from sewage, stormwater, and excess combined flows are unknown. The extent to which past subsidence control efforts may have aggravated subsidence because of not maintaining stable water levels in the mines should be disclosed. According to Appendix B, Evaluation of the Potential for Ground Surface Subsidence, "fluctuation in mine water levels must be minimized. . ." because mine inundation ". . .would cause drying and subsequent deterioration of the pillars and wooden roof support system." Past subsidence has been documented on pages B-31 to B-33 of the EIS and reveals the very unstable subsurface conditions in Streator.

The long-term viability of this project appears to be dependent upon both the availability of sufficient recharge water during summer drought periods and satisfactory maintenance of stable and flooded water levels in the mines. Even with these subsidence control measures, there is no guarantee that subsidence will be abated. According to the EIS, there is no "safe" level at which mine water should be maintained. If permanent subsidence control measures (such as providing grout columns) are not implemented by the city, how viable will this project be in view of the past cases of sheared sewer and water lines, collapsed streets, etc. from subsidence?

The secondary effects of encouraging development in local areas that are particularly susceptible to future subsidence, such as the northwest part of Streator, should be addressed.

Mine Leachate and Water Supply

We agree that more detailed investigations are required to characterize mine leachate quality and flow during dry-weather and wet-weather periods. Since industry is contributing to the existing wasteload conveyed to the treatment plant and/or mines, the quality of the industrial wastewater should be better described in the EIS. We trust project plans will include measures to eliminate all direct dry-weather discharges of wastewater to the mines.

In view of the industrial and municipal wastewater discharged into the mines, the incompetency and local failure of the roof rock above the mine chambers, and the potential for vertical downflow via leaky well casings, any past or potential problems associated with the contamination of local public and private wells should be disclosed in the EIS.

We appreciate the opportunity to review this draft EIS. Please send us one copy of the final EIS when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-79/897

OCT 22 1979

Mr. Gene Wojcik
Chief, EIS Section
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Wojcik:

We have reviewed the draft environmental statement on rehabilitation of wastewater facilities for Streator, Illinois. We are principally concerned about potential impacts on wildlife habitat and on archeological and recreational resources, and about the potential hazard of coal mine subsidence.

We note that mention is made that Section 10 (Rivers and Harbors Act of 1899) and/or Section 404 (Public Law 92-500) permits would be required for all stream crossings (p. 6-8) and we wish to point out that our comments on this statement do not in any way preclude additional and separate evaluation and comments by the U.S. Fish and Wildlife Service pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.). In review of any permit application, the U.S. Fish and Wildlife Service as a minimum: (1) will recommend that the Corps of Engineers require features to reduce turbidity and minimize pollution during construction and measures to protect disturbed areas from erosion; and (2) may recommend such other measures as would be apparent and appropriate from the information available at the time.

Wildlife Habitat

It appears that water quality would be improved significantly as a result of the proposed action but at the expense of adverse impacts on floodplain and wetland habitats (p. 5-5). The final statement should include a discussion of how the selected alternative complies with Executive Order 11988, Floodplain Management, and Executive Order 11990, Protection of Wetlands. The "Pfeffer exemption," to which several references are made throughout the document, should be explained.

The discussion of unavoidable adverse impacts (p. 6-10, par. 5) should be expanded to include the quantity (acres) and quality of the wildlife habitat that would be directly and indirectly impacted by the selected alternative. This information would better assist the reviewer in determining whether or not project impacts would be "minimal and/or short duration" as stated in the last sentence of the paragraph.

Archeological Resources

The State Historic Preservation Officer should be consulted immediately to develop an archeological survey and to discuss determinations of eligibility for those districts in which brick streets may be affected.

Recreational Resources

The draft statement appears to give no consideration to recreation although P.L. 95-217 requires such consideration in the planning of wastewater facilities. The final statement should address the recreation potential of the proposal and the actions to be taken in that regard.

The map on page xii shows a major interceptor to be replaced and an effluent-distribution force main crossing the James Street Recreation Area in the City of Streator. Construction activities which disrupt the soils, vegetation, and physical facilities could have long-lasting and adverse effects on the park or other recreation areas not identified within the project boundaries. The final statement should identify all park and recreational resources which may be affected, and impacts and appropriate mitigation measures should be discussed.

Mine Subsidence

An objective of the proposed action is to develop alternatives that would not increase the potential for subsidence (p. 4-1, item 4.1). Because numerous accounts of subsidence associated with coal mining in the Streator area have been reported since mining was begun, the propagation of mine-subsidence fissures from passive subsidence areas into potential subsidence areas should be considered. Such an expanded fissure system could permit increased migration of mine water leachate from the flooded mines to water-bearing units locally tapped by wells and also result in greater pollution in Prairie Creek and the Vermillion River. Further, mine water levels could be significantly lowered and might not provide the hydrostatic head necessary to minimize the mine subsidence potential.

We appreciate the opportunity to review this draft.

Sincerely,

for LARRY E. MEIEROTTO
Assistant SECRETARY

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
REGION 5
18209 DIXIE HIGHWAY
HOMEWOOD, ILLINOIS 60430

October 31, 1979

IN REPLY REFER TO

HED-05

'79 NOV 1 PM 12:07
WATER DIVISION
RECEIVED

Mr. Gene Wojcik
Chief, EIS Section
Environmental Engineering Branch
Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Wojcik:

The draft environmental statement for the rehabilitation of wastewater facilities at Streator, Illinois has been reviewed. The proposed action has no impact on facilities within our functional area of responsibility. Therefore, we have no comments to offer on the statement.

Sincerely yours,

Donald E. Trull
Regional Administrator

By: Jerry L. Paston
W. G. Emrich, Director
FOR Office of Environment and Design

Illinois Department of Conservation
life and land together
605 WM. G. STRATTON BUILDING • 400 SOUTH SPRING STREET • SPRINGFIELD 6270(
CHICAGO OFFICE – ROOM 100, 160 NO. LASALLE 60601
David Kenney, Director • James C. Helfrich, Assistant Director

September 14, 1979

Mr. John McGuire
Regional Administrator
U. S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. McGuire:

We have reviewed the draft environmental impact statement for Rehabilitation of Wastewater Facilities in Streator, Illinois.

In our opinion, the document adequately addresses the concerns of this department pertaining to cultural resources.

Sincerely,

David Kenney
State Historic Preservation Officer

DK/AEM/js

Illinois Department of Conservation
life and land together

605 WM. G. STRATTON BUILDING • 400 SOUTH SPRING STREET • SPRINGFIELD 62706
CHICAGO OFFICE – ROOM 100, 160 NO. LASALLE 60601
David Kenney, Director • James C. Helfrich, Assistant Director

RECEIVED
'79 OCT 1 PM 1:23
WATER DIVISION

September 27, 1979

Mr. Gene Wojcik
Chief EIS Section
US EPA, Region 5
230 South Dearborn
Chicago, IL 60604

RE: Rehabilitation of Streator Wastewater Facilities
SAI# 79091360
LaSalle & Livingston County

Dear Mr. Wojcik:

We have noted your proposal for planning for the above proposed project. Within your planning area we have record of several sites. The area of the sites is indicated on the enclosed map. Please be aware that to prevent damage to the archaeological resources, this locational information should remain confidential and is provided for planning purposes only.

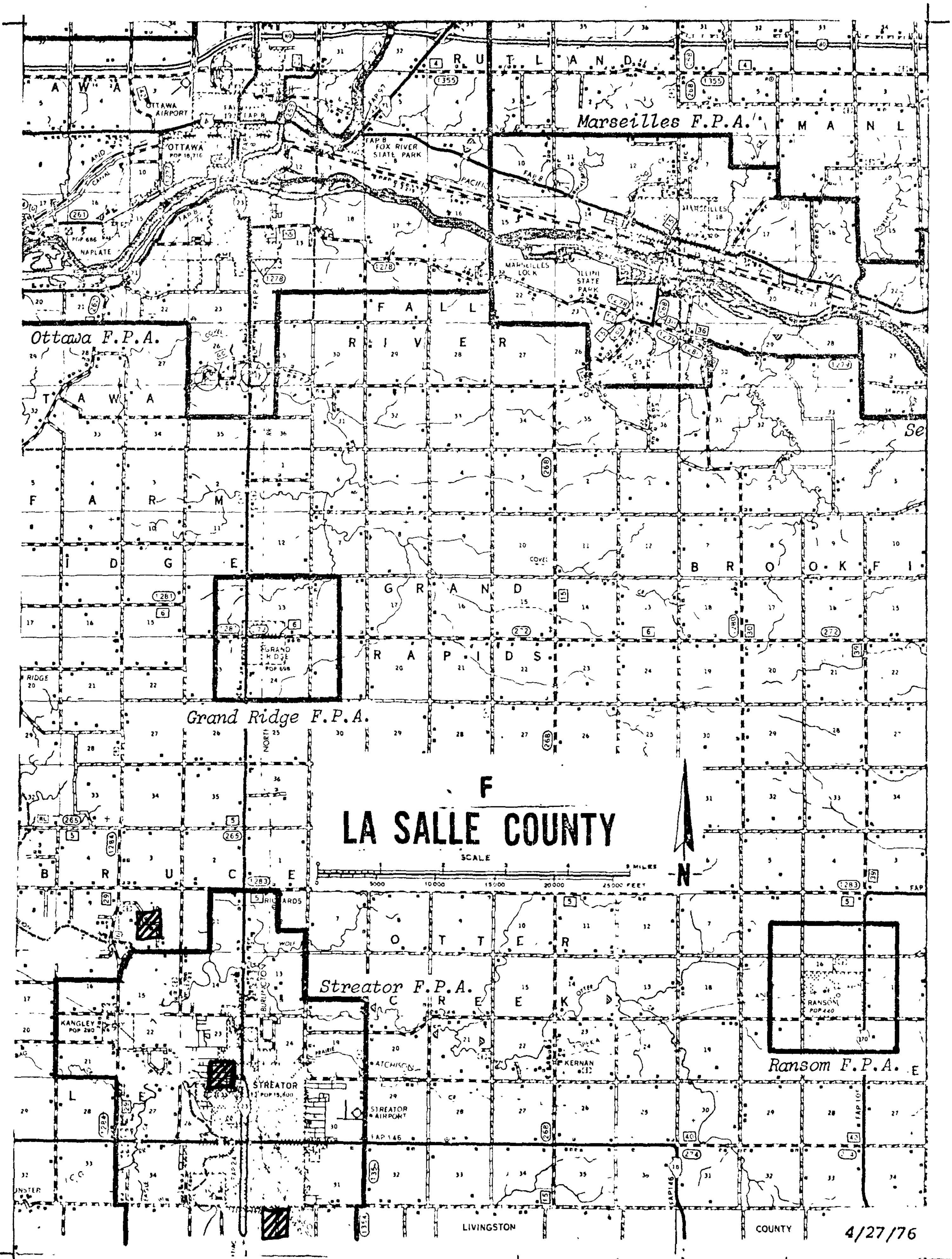
It is possible that there may be other sites within this area and that some may qualify for the National Register. When you have locations for construction, we would need to review the plans. This letter does not constitute "sign-off" for construction purposes.

Sincerely,

Margaret K. Brown (LSA)

Margaret Kimball Brown
Staff Archaeologist

MKB/LSA
cc: T.E. Hornbacker



LA SALLE COUNTY
SCALE
MILES
FEET
Marseilles F.P.A.
Ottawa F.P.A.
Grand Ridge F.P.A.
Streator F.P.A.
Ransom F.P.A.
R U T L A N D
F A L L R I V E R
G R A N D R A P I D S
B R U C E
O T T E R C R E E K
OTTAWA AIRPORT
FOX RIVER STATE PARK
MARSEILLES LOCK
NAPLATE
GRAND RIDGE
STREATOR
STREATOR AIRPORT
KANGLEY
RANSOM
KERNAN
LIVINGSTON COUNTY
4/27/76

▨ - 1 site

Oct. 30, 1979

Dear Sir,

I hope you will carry on with the work of cleaning up the sewers in Streator, Ill. which should improve the water in the Vermillion River, but I think you should also check some problems up river from Streator. The Smith-Douglas Fertilizer Plant in Livingston County, just a half mile out of the city limits, has a huge ~~[illegible]~~ pile of residue from their plant production which sits on the bank of a creek which feeds the Vermillion just below the Northern Illinois Water Corporations Dam. This pollutant turns the water in this area a sickly looking white at low water and to be able to stand there and see small fish dying in this garbage water is sickening. Also the gates on the dam have not worked in at least 40 years. So the stuff can't even be flushed out. Something about this should be done also.

Sincerely yours,
Lawrence J. Benner
RR4
Streator, Ill.
61364

Gene Wojcik
Chief E.I.S Section
Environmental Engineering Branch
US EPA Region V
230 S. Dearborn St
Chicago Ill 60604

RECEIVED

'79 NOV 6 AM 10:39

WATER DIVISION

Dear Sir: -

Streators existing sewage system was put in service about 20 years ago, due to a mandation that it was a must. This was done and approved by existing regulatory authorities as adequate. Since then Streator's population is now less than it was then, as matter of fact one of our largest industries is now down to about half of what it was then; so how do you people figure that it is now inadequate, How do we know that in another twenty years, others will come along and tell us again that it needs rebuilding. Streator's chances for a growing population are just about nil, with manufacturing plants closing or decreasing their operations.

Also how can Streatorites pay for such an extremely large amount as you propose the payments. Other towns have had their projects fully subsidized by the government, then why not Streator.

If what you are really getting at, is not the environments within the city limits of Streator but the adjacent areas not within the city limits, These people have refused to join us within the city limits. Why not badger them into obtaining proper sewerage systems. They seem not to want to pay for any services. Let them pay to clean up their own mess. Why us?

A very irate citizen of the
City of Streator

1 Oct 3 '79

Dear Sir

I'm writing to protest the expensive work you are foisting on the elderly of [illegible] & [illegible] for that is all that will be living in [illegible]. The factories are closing. [illegible] - Anthony or [illegible] [illegible] builders [illegible]. Do you think? you don't think - the people living on [illegible] who have struggled to own their homes & many of us to [illegible] bills are now asked to [illegible] this last more bill - not fair.

It means making another cut in food - doctor care - med for there are those of us who simply cannot [illegible] bills [illegible] means [illegible] [illegible] it means don't eat [illegible] to Dr. don't buy this medicine need.

We are people who worked but we worked when wages were low so our pensions low & now you come along with this - not fair.

If you must [illegible] find another way to get paid for we cannot afford it. [illegible]

A-14

2

upon people. bring all of this are probably young, get on government pay + you don't know the first [illegible] about getting along on what you have as money.

Also those projects you put out [illegible] it seems to me all this [illegible] sewer work is unnecessary. A make-work thing for the E.P.A. people. Lets wait for W.P.A. + let them put it in [illegible] [illegible]. There are at least 500 [illegible] in Streator now + there will be more + no [illegible] is no work or [illegible] work + the sewer upgrade won't make a [illegible]. Who do you think you are kidding?

RECEIVED
'79 NOV 2 AM 11:51
WATER DIVISION

WARREN & VAN PRAAG, INC.
CONSULTING ENGINEERS · ARCHITECTS
8303 Higgins Road • Chicago, Illinois 60631 • (312) 693-5016
SINCE 1918

October 11, 1979

United States Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Attention: Gene Wojik, Chief, EIS Section

Subject: Comments on Draft Environmental Impact
Statement for Streator, Illinois

Gentlemen:

Warren & Van Praag has conducted a preliminary review of the Draft of the Environmental Impact Statement (EIS) for Streator, Illinois prepared by the United States Environmental Protection Agency and Wapora, Inc. The findings of this study were compared with the findings presented in the City of Streator, Illinois "Comprehensive Sewerage and Drainage Report (CSDR) February, 1975", prepared by Warren & Van Praag. The purpose of this comparison was to ascertain what differences, if any, exist between the recommendations developed from these two studies, to discover the reasons for any differences, and to determine what effect these differences would have on improvements proposed.

Following is a listing of major "points of difference" between the EIS and Warren & Van Praag's study which have been identified thusfar:

1) Planning Area

2) Population Projections

3) Plant Design Criteria

   a) Dry Weather Flow

   b) Wet Weather Flow

Executive Offices, 1270 N. Warson Road • St. Louis, Missouri 63132 • (314) 694-2050
Decatur, Illinois • St. Louis, Missouri • Chicago, Illinois • Davenport, Iowa • Rhinelander, Wisconsin

4) Alternative Treatment Processes

5) Treatment Plant Design Flows

6) Storm Drainage

7) Cost Estimates

8) Cost-Effectiveness

Generally, Warren & Van Praag supports the overall findings of the EIS regarding the potential subsidence hazard in Streator and the need for providing positive control measures. As both the EIS and Warren & Van Praag's study point out, the only control measure which appears to be cost-effective at this time, is the continued flooding of the mine system using municipal, private and storm wastewater to retard further deterioration of the supporting structures. As was also pointed out in both studies, this flooding will not stop subsidence, but will only reduce the number and severity of incidents. Some subsidence will continue to occur in and around Streator. While Warren & Van Praag agrees with the overall conclusions, we cannot agree, however, with the plan for providing the necessary mine flooding as recommended in the EIS. We do not believe it is truly the cost-effective solution because of the "points of difference" listed previously. Following are discussions of each of these "points" and their effect on the recommendations:

1) PLANNING AREA

The difference of planning area boundaries between the EIS and Warren & Van Praag studies are shown in Figure 1-2 (page 1-5) of the EIS. The area shown enclosed by a dotted line in Figure 1-2 identified as the Warren & Van Praag Planning Area is, in fact, the projected year 2000 service area of the Streator sewer system. The ultimate sewer service area (and planning area) is shown in Figure 1 of the Comprehensive Sewerage & Drainage Report (CSDR). The boundary of this ultimate service area agrees more closely with the

Planning area boundary of the EIS. The major difference being the exclusion of Kangley from the CSDR area. However, as pointed out in the EIS (Paragraph 4.2.2.3, page 4-4), inclusion of Kangley in the Streator wastewater collection/treatment system is not cost-effective at this time.

2) POPULATION PROJECTIONS

The analyses and recommendations presented in the Environmental Impact Statement are based on a projected zero population growth for the EIS planning area. That is, population is expected to remain at its current (1970 & 1977) 21,750 level for the EIS planning period which extends to the year 2000. The bases of this projection are discussed in detail in the EIS in Paragraphs 2.5.1 thru 2.5.3 (pg. 2-30 thru 39). This projection differs substantially from the population forecasts used to develop the Comprehensive Sewerage and Drainage Report (CSDR) recommendations. Those forecasts were prepared from data presented in the Comprehensive Plan for Streator, January, 1969, prepared by Harland Bartholomew and Associates. These forecasts call for a population of 34,000 within the year 2000 sewer service area (CSDR Figure 1), which is substantially smaller than the EIS planning area.

The Illinois Environmental Protection Agency also assists in population growth forecasting in that it provides disaggregations, by township and/or planning area, of Bureau of the Budget (state and county) population projections. The IEPA was contacted as part of our review of the EIS to provide an additional source of information regarding population growth estimates for Streator. Data from this agency seems to be somewhat of a median between projections used in the EIS and CSDR. IEPA forecasts indicate a slow but steady growth for the townships surrounding Streator which also is expected to affect Streator itself. Streator's sewer service area population is expected to be approximately 21,000 by the year 2000, while the EIS planning area population is projected to exceed 29,000. The IEPA also advised that if Streator were to pursue an aggressive annexation program, the 2000 sewer service area population could be substantially greater than the 21,000 now forecast.

The differences in the EIS, CSDR and IEPA projections demonstrate the inconclusiveness of population forecasting. It appears that, based on current trends, the projections included in the February, 1975 CSDR are probably somewhat high, and that projections included in the EIS may be low. It is extremely unwise, however, to base the sizing of major sewers on low projections such as those included in the EIS (particularly in the face of the conflicting data provided by Warren & Van Praag and IEPA projections) due to the extremely long (40 to 50 year) service lives of such sewers. This is particularly true because of the low cost of providing additional capacity at the time of construction by means of pipe size increases versus the high cost of adding capacity at later times by construction of parallel sewers. Warren & Van Praag recommends that, at the very least, major sewers be sized on the basis of current IEPA population growth projections and that consideration be given to providing further additional capacity based on the ultimate needs of the Streator planning area. The increase in sewer sizes will, of course, increase the capital costs of all the alternatives presented in the EIS. However, it is expected that this cost increase will affect all alternatives analyzed relatively equally. The greatest effect will probably be felt in the plans calling for rehabilitation and reuse of the existing sewers as the sanitary system, since the providing of additional capacity to meet ultimate needs may require construction of additional parallel sewers which would not be needed with other plans.

3) PLANT DESIGN CRITERIA - DRY WEATHER FLOWS

The Environmental Impact Statement analyses and recommendations are based on the cost of providing dry weather flow treatment to meet current State effluent regulations which are (based on the dilution ratio of the Vermilion River at Streator): biochemical oxygen demand (BOD) not greater than 4 mg/l and Suspended Solids (SS) not greater than 5 mg/l. The Illinois Pollution Control Board and the Illinois Environmental Protection Agency have recognized that this standard is not consistently achievable using today's best practicable treatment technology and have generally granted a variance from this standard to: BOD not greater than 10 mg/l, an SS not greater than 12 mg/l. It can be expected that such a variance would also be granted to Streator. The probability of obtaining this type of variance was assumed in the EIS, although it was incorrectly described as a "Pfeffer exemption" (Paragraph 4.2.3.2, pages 4-8 & 9, Paragraph 3.5, pages 3-8 & 9) which are generally no longer granted.

The EIS also assumes that if all treatment plant discharges were directed to the underground mines a further reduction in required effluent quality could be obtained wherein BOD not greater than 20 mg/l and SS not greater than 25 mg/l could be discharged (to the mines). This plan also assumes that additional treatment will be provided in the mines (Paragraph 4.2.3.2, page 4-9 and Table 4-2, page 4-15). These assumptions are in direct contradiction with current IPCB regulations and are diametrically opposed to actions taken thusfar by IEPA and other regulatory agencies. Recent contacts with IEPA have confirmed that the chances for obtaining permits for such discharges are extremely slim if not non-existent. All alternatives included in the EIS based on obtaining this permit variance should be eliminated from consideration. This includes alternatives 1g, 1h, 1i, 2g, 2h, 2i, 3g, 3h, 3i, 4g, 4h, and 4i. If these alternatives are to remain in consideration, appropriate capital and operating costs should be added to provide acceptable levels of treatment.

PLANT DESIGN CRITERIA - WET WEATHER FLOWS

The Environmental Impact Statement presents a listing of State regulations regarding combined sewer discharge treatment requirements (Paragraph 3.5 pages 3-8 & 9). The regulations listed do not represent current guidelines. Current regulations are contained in Illinois Pollution Control Board Rule 602 and interpretations, such as Technical Advisory TA-3 June 1, 1977 and the March 14, 1979 Memorandum on Combined Sewer Overflows by the IEPA. These updated regulations appear to cause an increase in treatment costs over those now included in the EIS. Latest IEPA procedures for determining compliance with Rule 602, are summarized as follows (from IEPA TA-3 June 1, 1977 page 6):

3. Levels of Treatment

Summarizing the above discussions, the following levels of treatment are required under the provisions of Rule 602(c).

a. Dry weather flow - Complete treatment

b. First flush - Complete treatment

c. All flows in excess of "A" plus "B" (Separate Sewers) - Primary clarification and disinfection* plus 30/30 mg/l BOD/TSS on a monthly average.

d. Flows in excess of "A" plus "B" (Combined Sewers) - Primary clarification and disinfection* for flows up to 1250 gal/P.E. x P.E. (organic).

e. No discharge may cause or contribute to water quality violations.

* - In addition, discharges must comply with all requirements of Part IV (Chapter 3) except Rule 404.

Based on the procedures outlined in TA-3, and the projected domestic and industrial loadings presented in the EIS, the year 2000 organic loading on Streator's combined sewer system is estimated to be approximately 40,000 P.E. (population equivalent). For such a loading, State regulations require dry weather flow and combined sewer overflow pollution control facilities to have a total peak capacity of at least 50 MGD (40,000 PE x 1250 GPD per PE). Additional capacity may also be required to prevent potential water quality violations. Assuming that the minimum required facilities (50 MGD peak) will be sufficient to prevent water quality violations and that the dry weather flow treatment system is sized to handle the peak theoretical wastewater loads of 2.4 MGD (Average Daily Flow - EIS Table 4-1, Scenario E, page 4-7) x 2.5 peaking factor = 6 MGD, the combined overflow storage and/or treatment facilities would be required to have a peak flow capacity of at least 44 MGD (50 MGD total peak capacity for all systems minus 6 MGD peak dry weather flow capacity).

The 44 MGD combined overflow facility would, of course, be substantially more costly than the 4.8 to 12.3 MGD facilities included in the various alternatives presented in the EIS. It is also highly unlikely that the existing combined sewer lateral system, even if rehabilitated, could transport the volume of flow required to meet State regulations without the addition of a substantial number of relief sewers. Therefore, the cost of increased treatment capacity as well as the cost of the additional sewers required should be added to those alternative plans presented in the EIS which include treatment of combined flows, which are plans 2a-2i and 3a-3i. Plans 4a thru 4i call for the discharge of virtually untreated combined overflow sewage to the mines. This is specifically prohibited by IPCB regulations, therefore, these alternatives should be excluded from further consideration.

4) ALTERNATIVE TREATMENT PROCESSES

The Environmental Impact Statement establishes the probable effluent limitations with which Streator will have to comply, which are: effluent containing no greater than 10 mg/l BOD, 12 mg/l SS, and 1.5 mg/l (April - October else 4 mg/l) NH_3-N. It is our opinion that some of the treatment processes considered by the EIS will not, in fact, consistently produce an effluent which will meet these standards.

In Paragraph 4.2.3.2 of the EIS it is stated, in part, that by discharging a dilute influent to a waste treatment plant (i.e. not eliminating I/I), less sophisticated treatment processes would be required to reach a particular effluent quality than would be required for a higher strength influent. While this is true over limited ranges, a certain practical limit is reached for each succeedingly sophisticated level of treatment. Increasing dilution beyond this limit can actually be counter-productive in that waste strength falls below the point necessary to maintain adequate biological and/or chemical activity. Recent contacts with IEPA have confirmed that to reach a 10/12 standard consistently, some form of tertiary treatment will be required. Therefore, all alternatives discussed in the EIS which do not include adequate tertiary treatment should be eliminated from comparison. These plans are: 1g, 1h, 1i, 2g, 2h, 2i, 3g, 3h, 3i, 4g, 4h, and 4i. If these plans are to be compared, additional capital and operating costs should be included to account for the more sophisticated treatment processes which are actually required to meet expected effluent limitations.

In Paragraph 4.2.3.2 (page 4-8), the EIS states, "Nitrification would be provided by the addition of one 150 horsepower blower in the activated sludge unit...". The ability to nitrify in an activated sludge system is not a function of air volume but rather of sludge age. A common method for increasing sludge age while maintaining proper mixed liquor solids concentration is the addition of aeration tank capacity thus increasing detention time. This may be done using a single aeration stage process or a two stage process, in which additional clarifiers would also be required. The existing aeration tankage at Streator is not sufficient to provide an adequate detention time for nitrification based on the year 2000 projected theoretical wastewater load of 2.4 MGD (discussed elsewhere in this report). Therefore, additional capital and operating costs should be included in the various EIS treatment alternatives to account for the additional aeration tank capacity required. Other methods of nitrification should also be considered to determine if any cost savings may be realized.

5) TREATMENT PLANT DESIGN FLOWS

Several of the wastewater collection plans considered in the Environmental Impact Statement (Paragraph 4.2.3.1 pages 4-6 thru 4-8) call for the continuing of the discharge of certain untreated wastewater to the abandoned mines. These discharges include portions of: combined sewer overflows, contaminated industrial process wastewaters, and/or sanitary wastewaters. Continuing the discharge of <u>any</u> untreated wastes to the mine system appears to be in direct contradiction with current regulations of the Illinois Pollution Control Board and other agencies, and contrary to the actions taken thusfar by these agencies. We recommend that no plan be considered which does not meet all applicable regulations. With regard to the various design flow alternatives presented in Table 4-1 (page 4-7) of the EIS, only the flow listed as Scenario E includes the treatment of all contaminated wastewaters (although some adjustment may be required if population projections are revised). Year 2000 average daily flow projected for Scenario E is 2.42 MGD. It is our opinion that all alternatives which do not provide treatment for at least 2.4 MGD be excluded from further consideration. Those plans which do not appear to provide sufficient capacity are: 1b, 1c, 1e, 1f, 1h, 1i, 2b, 2c, 2e (the EIS recommended plan), 2f, 2h, 2i, 3b, 3c, 3e, 3f, 3h, 3i, 4b, 4c, 4e, 4f, 4h and 4i.

In addition to the theoretical wastewater flow, the wastewater treatment system must also be sized to handle whatever infiltration and/or inflow enters the system. It is expected that for the alternatives which call for replacement of the sanitary sewers, Plans 1a thru 1i, inflow could be virtually eliminated thru careful construction and testing procedures. Infiltration could also be reduced to minimal levels through proper selection of sewer materials and through proper installation. Current standards (Ten State Standards) call for a maximum infiltration of 200 gallons per inch of sewer diameter per mile of sewer per day. For the average sewer diameter of 9 inches and length of 56 miles, as stated in Paragraph 4.2.1.1 (pages 4-2 & 3) of the EIS, infiltration should not exceed 100,800 gallons per day. This amount should be added to projected theoretical wastewater flow to determine wastewater treatment plant loadings.

For those alternatives plans 2a thru 2i, 3a thru 3i, and 4a thru 4i which call for rehabilitation of the existing sewers, infiltration and inflow loadings will be substantially higher. Since these plans call for the existing sewers to continue to function as a combined sewer system, it is assumed that no inflow sources will be eliminated by the rehabilitation proposed. Based on the ten year storm used as the basis for analyses presented in the EIS (Paragraph 4.2.3.3, page 4-10) and a duration of 3 hours, approximately 120 MG of water would enter the combined sewer system. Assuming a time of concentration of one hour for the sewer system, the instantaneous peak flow rate would be in the range of 2000 MGD. As discussed elsewhere in this report, current IPCB regulations would require a capture and/or treatment of approximately 50 MGD of this flow for a period of sufficient duration to prevent receiving water quality violations. A substantially lower capture rate is used for the various alternatives presented in the EIS calling for collection, storage and/or treatment of combined flows. Design criteria (and costs) for these plans should be adjusted to reflect the systems required to meet State and other regulations.

As discussed in the Comprehensive Sewerage and Drainage Report (CSDR), the existing sewer system is also subject to a substantial amount of infiltration. Estimates presented therein indicate that the peak infiltration may be as high as 5 MGD. In the 1975 study it was estimated that as much as 62% of this infiltration could be eliminated through cost-effective rehabilitation. It was estimated that rehabilitation, including an SSES, might cost approximately $1,500,000. These estimates were reused in the EIS for development of the alternates presented therein. Additional surveys in other communities performed by Warren & Van Praag and others have shown that the 62% infiltration elimination efficiency represents the near maximum obtainable for this type of work and this high efficiency is not normally achieved in typical systems. Further, it has been shown that the service lives of conventional types of rehabilitation is proving to be substantially shorter than originally estimated. For Streator, assuming that 25% of the sewer joints would require grouting and that this grout would last 10 years, the estimated cost could be $3,500,000 to $5,000,000 including the SSES. It is now estimated that such a program could reduce infiltration by 25 to 50 percent depending on the number and severity of defects which could not be grouted (such as cracked pipes). Assuming a 40% repair efficiency, some 3 MGD of infiltration would still enter the rehabilitated system. Treatment capacity over and above the theoretical wastewater must be provided for this flow.

The following wastewater loading rates should be used for the various alternatives presented in the EIS:

For alternatives which include the replacement of the existing sanitary sewers:

		Average Daily Flow-MGD	Peak Daily Flow-MGD
Theoretical Wastewater Flow		2.42 *	6.05
Infiltration		.10	.10
Inflow		(negligible)	(negligible)
Year 2000 plant design flow			
	dry weather system	2.52	6.15
	wet weather system	(none required)	

For alternatives which include rehabilitation of the existing sanitary sewers:

		Average Daily Flow-MGD	Peak Daily Flow-MGD
Theoretical Wastewater Flow		2.42 *	6.05
Infiltration		3.00	3.00
Inflow		(not applicable)	50.00
Year 2000 plant design flow			
	dry weather system	5.42	9.05
	excess flow	-	50.0

* (based on EIS population projections)

Comparing these estimated design flows with the alternatives presented in the EIS, the treatment facilities included in all alternatives <u>except</u> la and ld do not provide sufficient treatment capacity to meet projected needs and wastewater treatment criteria as described in IPCB and other regulations. Treatment costs for all alternatives except la and ld should, therefore, be revised to include the required treatment capacity.

6) STORM DRAINAGE

As discussed in the paragraphs of this report on Treatment Plant Design Flows, during the 10 year rainfall used as the basis for the analyses and recommendations presented in the EIS, 120 MG of storm runoff may enter the combined system at peak rates up to 2000 MG. It is unlikely the existing sewer system can transport this volume of flow. This is demonstrated by the substantial (possibly up to 600) number of drop pipes which have been installed in these sewers. The major purpose of these overflows was to relieve overloaded sewers. In order to transport the volumes of combined flow to the treatment facilities required by current regulations, parallel relief sewers will probably be required. The cost of these sewers should be added to all plans which involve rehabilitation and use of the existing sewers as a combined system.

If the existing sewer system is to be used as a storm drainage and supplemental mine recharge system (as suggested in the plans calling for construction of new sanitary sewers), it is likely that some additional storm sewers (primarily laterals) will be required to insure that flows are distributed evenly to the mine system. A complete survey of existing drop shafts to the mines is required to assure this even distribution. It is probable that additional drop shafts to the mines will also be required together with adjustment and/or rehabilitation of the existing shafts.

7) COST ESTIMATES

Detailed layouts of the various alternatives collection and treatment processes considered in the EIS have not been included. Therefore, it is not possible to evaluate fully the various capital and operating cost estimate and comparisons presented therein. It is suggested that this information be provided so as to more accurately define the scope of the various plans considered and to assess their suitability to meet current and future needs in Streator.

8) COST-EFFECTIVE ANALYSIS

Table 4-3 (page 4-20) of the Environmental Impact Statement presents a summary of total estimated capital, operating and present worth costs of the 36 alternatives analyzed. Table 5-2 (page 5-9) presents a summary of the estimated BOD loadings of the discharges resulting following implementation of the alternatives. In order to select the most cost-effective solution to the Streator problem, the EIS relies only on the cost data presented in Table 4-3. Warren & Van Praag suggests that the data of tables 4-3 and 5-2, and other data be combined in a form which indicates total present worth cost per pound of BOD eliminated. We believe that the values determined will provide an additional criterion from which to select the most cost-effective alternative. This procedure is suggested in Federal regulations, particularly those guidelines covering the cost/benefit of combined sewer overflow treatment.

A summary of the most significant of Warren & Van Praag's comments are included in the attached document, the basis of which is the EIS Summary Sheet (pages x-xiii). We hope that our comments will be of benefit in the developing and implementable, environmentally sound, and cost-effective plan for wastewater management in Streator, which will serve that City's present and future needs. We would be very happy to present any additional information regarding our comments presented herein, or any other services which the agency may require to aid in the timely completion of the Environmental Impact Statement for Streator.

Very truly yours,

WARREN & VAN PRAAG, INC.

David P. Tulp, P.E.
Manager - Chicago Office

J. Thomas Rowlett, P.E.
Project Manager

JTR/DPT/lw

cc: T. Bakalar, Mayor, City of Streator
Michael Mauzy, IEPA
Al Keller, IEPA
Ron Drainer, IEPA

ATTACHMENT TO

COMMENTS ON DRAFT OF

STREATOR ENVIRONMENTAL IMPACT STATEMENT

Following is a reiteration of pertinent portions of the Summary of the Environmental Impact Statement annotated to reflect Warren & Van Praag's major comments and concerns. The EIS summary is presented in upper case letters and the Warren & Van Praag comments in lower case letters enclosed by brackets:

SUMMARY SHEET

ENVIRONMENTAL IMPACT STATEMENT

REHABILITATION OF WASTEWATER FACILITIES

STREATOR, ILLINOIS

DRAFT (X)
FINAL ( )

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V

CHICAGO, ILLINOIS

1. <u>TYPE OF ACTION</u>: ADMINISTRATIVE (X)
LEGISLATIVE ( )

2. <u>DESCRIPTION OF ACTION PROPOSED IN THE FACILITIES PLAN</u>

THE ACTION PROPOSED IN THE DRAFT FACILITIES PLAN FOR THE CITY OF STREATOR, ILLINOIS, INCLUDES SEWER SEPARATION, AND UPGRADING AND EXPANSION OF THE EXISTING TREATMENT PLANT. NEW SANITARY SEWERS WOULD BE INSTALLED IN THE PRESENT SERVICE AREA AND IN ADJACENT AREAS. [Projected service population 34,000 plus industrial and commercial - appears to be high based on current IEPA forecasts]. THE EXISTING COMBINED SEWER SYSTEM WOULD BE REHABILITATED FOR USE AS A STORM SEWER. THE TREATMENT PLANT WOULD BE EXPANDED TO ACCOMMODATE A DESIGN AVERAGE FLOW OF 5.59 MGD AND WOULD BE UPGRADED WITH THE ADDITION OF TERTIARY TREATMENT AND CHLORINATION. THE EFFLUENT DISCHARGED TO THE VERMILION RIVER WOULD MEET THE REQUIREMENTS OF THE FINAL NPDES PERMIT (4 mg/l BOD_5 and 5 mg/l SS).

THE PORPOSED ACTION IN THE DRAFT FACILITIES PLAN INCLUDES MINE RECHARGE OF WASTEWATER AND STORMWATER TO MAINTAIN PRESENT WATER LEVELS IN THE MINES. RECHARGE IS CRITICAL TO MINIMIZE THE POTENTIAL FOR GROUND SUBSIDENCE. DURING DRY-WEATHER PERIODS, THE MINES WOULD BE RECHARGED WITH EFFLUENT FROM THE TREATMENT PLANT. DURING WET-WEATHER PERIODS, THE MINES WOULD BE RECHARGED WITH STORMWATER VIA DROPS SHAFTS IN THE EXISTING COLLECTION SYSTEM AND VIA STORM SEWERS INSTALLED IN THE PRESENTLY SEWERED AND UNSEWERED AREAS.

FEDERAL FINANCING HAS BEEN REQUESTED BY THE CITY OF STREATOR UNDER THE STATUTORY AUTHORITY OF THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 (PUBLIC LAW 92-500) AND THE CLEAN WATER ACT AMENDMENTS OF 1977 (PUBLIC LAW 95-217). STREATOR'S CONSULTING ENGINEERS ESTIMATED THE TOTAL PROJECT COST TO BE $52,334,840 AT JANUARY 1975 PRICE LEVELS (WARREN & VAN PRAAG, INC. 1975). THE TOTAL CAPITAL COST WAS RECALCULATED BY WAPORA, INC., AND WAS ESTIMATED TO BE $56,237,300 AT JANUARY 1978 PRICE LEVELS.

3. DESCRIPTION OF THE EIS PROPOSED ACTION

THE PROPOSED ACTION INCLUDES REHABILITATION OF THE EXISTING WASTEWATER FACILITIES AT STREATOR, ILLINOIS. [Treatment capacity selected appears to be inadequate to serve developed but currently unsewered areas adjacent to Streator, to eliminate all existing discharges of contaminated industrial flows to mines, or to allow for a reasonable growth of Streator as shown by IEPA population projections]. THE THREE MAJOR INTERCEPTOR SEWERS IN THE COMBINED SEWER SYSTEM WOULD BE REPLACED (FIGURE S-1). [Proposed sewer sizes appear to be too small to capture sufficient combined sewer flow to meet IPCB regulations. The lateral sewers of the existing combined system may also be too small to transport required flow. It may not be possible to obtain permits to discharge combined sewer overflows to mines]. A SEWER SYSTEM EVALUATION SURVEY WILL BE CONDUCTED TO DETERMINE THE EXTENT OF COST-EFFECTIVE REHABILITATION OF OTHER SEGMENTS OF THE COLLECTION SYSTEM, INCLUDING THE LEVEL OF INFILTRATION/INFLOW REMOVAL. [Costs estimated to perform survey and rehabilitation appear to be too low, and projected repair efficiency too high. No treatment capital or operating costs have been included for treatment of the infiltration remaining after rehabilitation which is estimated to be approximately 3 MGD peak]. THE TREATMENT PLANT WOULD BE UPGRADED TO INCLUDE NITRIFICATION AND CHLORINATION. [As proposed, the treatment process will not be able to achieve a 10/12 effluent consistently nor will it be able to nitrify. As stated elsewhere, design capacity proposed will not meet needs or regulations]. THE EFFLUENT DISCHARGED TO THE VERMILION RIVER WOULD MEET THE REQUIREMENTS OF A "PFEFFER EXEMPTION" (10 mg/l BOD_5 and 12 mg/l SS). ["Pfeffer exemptions" as such are no longer granted; 10/12 variances are now based on best practicable treatment technology which is economically achievable]. COMBINED SEWER FLOWS IN EXCESS OF THE PLANT'S CAPACITY WOULD RECEIVE PRIMARY TREATMENT AND CHLORINATION PRIOR TO DISCHARGE TO THE RIVER. [Size of the proposed combined sewers and treatment system are not sufficient to meet IPCB regulations. Most of the combined flows would have to overflow to mines thru drop shafts in the sewer system due to the inadequate capacity of that system. Possibility of obtaining a permit for such discharges to mines is highly doubtful].

ADDITIONAL "STEP I" FACILITIES PLANNING WILL BE REQUIRED TO CONFIRM THE COST-EFFECTIVENESS OF THE EIS PROPOSED ACTION. PLANNING, FOR EXAMPLE, WILL BE NECESSARY TO DETERMINE HOW TO COST-EFFECTIVELY DISPOSE OF WASTEWATER FROM AREAS ADJACENT TO THE EXISTING SEWER SERVICE AREA. THE TREATMENT PLANT'S CAPACITY WOULD HAVE TO BE EXPANDED IF SEWERS WERE EXTENDED AND IF PRESENT INDUSTRIAL DISCHARGES OF PROCESS AND COOLING WATERS TO THE MINES WERE NOT PERMITTED TO CONTINUE.

THE MINES BENEATH STREATOR WOULD BE RECHARGED WITH WASTEWATER AND STORMWATER TO MAINTAIN PRESENT WATER LEVELS IN THE MINES. DURING DRY-WEATHER PERIODS, THE MINES WOULD BE RECHARGED WITH EFFLUENT FROM THE TREATMENT PLANT (FIGURE S-1). DURING WET-WEATHER PERIODS, THE MINES WOULD BE RECHARGED WITH OVERFLOWS FROM THE COMBINED SEWER SYSTEM AND WITH STORMWATER FROM NEW STORM SEWERS IN THE PRESENTLY SEWERED AREA.

THE TOTAL CAPITAL COST OF THE EIS PROPOSED ACTION HAS BEEN ESTIMATED TO BE $21,932,800 (AT JANUARY 1978 PRICE LEVELS). AVERAGE ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS HAVE BEEN ESTIMATED TO BE $266,500. [The estimated capital and operating costs are inappropriate since they are based on a proposed plan which does not meet current or projected needs in Streator or comply with all environmental regulations, as discussed elsewhere]. SEVENTY-FIVE PERCENT OF THE TOTAL CAPITAL COST WILL BE ELIGIBLE FOR FEDERAL CONSTRUCTION GRANT FUNDS. THE LOCAL COSTS WILL INCLUDE 25% OF THE TOTAL CAPITAL COST AND 100% OF THE O&M COST. THE AVERAGE ANNUAL LOCAL COST OVER A 20-YEAR PERIOD HAS BEEN ESTIMATED TO BE $769,309. ASSUMING A POPULATION OF 12,700 IN THE SEWER SERVICE AREA, THE PER CAPITA COST WILL BE APPROXIMATELY $61 PER YEAR.

4. MAJOR ENVIRONMENTAL IMPACTS OF THE EIS PROPOSED ACTION

THE EIS PROPOSED ACTION WOULD REDUCE SUBSTANTIALLY POLLUTANT LOADS DISCHARGED TO THE VERMILION RIVER FROM THE STREATOR FACILITIES PLANNING AREA. WATER QUALITY IN THE AREA AND DOWNSTREAM, THEREFORE, SHOULD IMPROVE SIGNIFICANTLY, ESPECIALLY DURING PERIODS OF LOW RIVER FLOWS. DISCHARGES OF UNTREATED COMBINED SEWER OVERFLOWS AND DISCHARGES FROM CRACKED AND BROKEN SEWER LINES WOULD BE ELIMINATED. IN ADDITION, POLLUTANT LOADS TO THE MINE WOULD BE REDUCED, AND THUS, THE QUALITY OF MINE LEACHATES WOULD IMPROVE OVER TIME. ALL SANITARY WASTEWATER DISCHARGES TO THE MINES WOULD BE ELIMINATED. [The major portion of combined flow would be discharged to the mines thru a system of drop shaft-type overflows which are required due to the inadequate size of the existing combined sewer lateral system. Combined flows carry pollutant loads several times higher than sanitary flows during certain portions of the overflow event. It is likely that a large portion of these pollutants would be discharged to the mines, particularly during high intensity rainfall events].

TEMPORARY CONSTRUCTION IMPACTS SUCH AS INCREASES IN NOISE AND DUST, TRAFFIC DISRUPTION, AND EROSION AND SEDIMENTATION WOULD OCCUR ALONG INTERCEPTOR SEWER ROUTES AND NEAR STORM SEWER AND RECHARGE SYSTEM CONSTRUCTION SITES. MEASURES, HOWEVER, WOULD BE TAKEN TO MINIMIZE THESE IMPACTS. THE MANPOWER, MATERIAL, ENERGY, AND LAND USED IN THE REHABILITATION AND CONSTRUCTION OF FACILITIES WOULD BE UNAVAILABLE FOR OTHER USES.

THE POPULATION OF THE STREATOR FACILITIES PLANNING AREA IS STABLE AND IS NOT LIMITED BY THE AVAILABILITY OF WASTEWATER FACILITIES. [Both Warren & Van Praag and IEPA population projections show growth in the Streator area, although at differing rates. Should a zero growth plan be adopted, the growth projected by Warren & Van Praag and IEPA would be artifically retarded]. THE EIS PROPOSED ACTION, THEREFORE, WOULD NOT HAVE ANY SIGNIFICANT SECONDARY IMPACTS, SUCH AS INDUCED DEVELOPMENT AND ECONOMIC GROWTH. SECONDARY IMPACTS WOULD BE PRIMARILY CONSTRUCTION RELATED AND, THUS, MINIMAL AND SHORT-TERM.

5. ALTERNATIVES CONSIDERED IN THE EIS

ALTERNATIVES DEVELOPED AND CONSIDERED INCLUDED DIFFERENT OPTIONS FOR WASTEWATER AND STORMWATER COLLECTION, TREATMENT, AND MINE RECHARGE. THE COLLECTION OPTIONS WERE 1) SEWER SEPARATION, [Cost used were low in that the sewers proposed do not meet ultimate needs]; 2) REHABILITATION OF THE EXISTING COMBINED SEWER SYSTEM, [Cost used were low, because of higher rehabilitation costs now being experienced, because of the observed shortened service lives of certain types of rehabilitation and because the system as proposed is inadequate to transport sufficient combined flow to meet IPCB regulations]; and 3) SEWER EXTENSIONS. [Sewers considered may not meet ultimate needs]. THE TREATMENT OPTIONS FOR THE TREATMENT PLANT INFLUENT WERE 1) TERTIARY TREATMENT (WITH FILTRATION AND CHEMICAL COAGULATION), [Adequate nitrification unlikely]; 2) TERTIARY TREATMENT WITHOUT CHEMICAL COAGULATION, [Adequate nitrification unlikely]; 3) UPGRADED SECONDARY TREATMENT (WITH NITRIFICATION AND CHLORINATION), [Process as proposed will not meet 10/12 standard or nitrify]; and 4) EXISTING TREATMENT WITH EFFLUENT DISCHARGE TO THE MINES. [Will not meet current IPCB regulations]. OPTIONS TO TREAT EXCESS COMBINED SEWER FLOWS (IF THE EXISTING COLLECTION SYSTEM WERE USED TO CONVEY SANITARY WASTEWATER) WERE 1) PRIMARY TREATMENT AND CHLORINATION, 2) STORAGE, PRIMARY TREATMENT, AND CHLORINATION, AND 3) STORAGE AND MINE DISCHARGE. [Design flow rates on which all alternatives are based are insufficient to meet current IPCB regulations]. OPTIONS FOR MINE RECHARGE WERE 1) RECHARGE OF TREATMENT PLANT EFFLUENT DURING DRY-WEATHER PERIODS AND DISCHARGES FROM THE EXISTING COLLECTION SYSTEM AND ADDITIONAL STORM SEWERS AND 2) CONTINUOUS EFFLUENT RECHARGE AND DISCHARGES FROM THE EXISTING COLLECTION SYSTEM.

APPENDIX B. EVALUATION OF THE POTENTIAL FOR GROUND SURFACE SUBSIDENCE

INTRODUCTION

Law Engineering Testing Company (1978) investigated subsurface conditions in the Streator, Illinois, area to determine the potential for ground subsidence associated with the abandoned coal mines. The investigations were necessary to address major project-related issues, including whether current discharges to the mines are preventing subsidence and what effect not pumping wastewater and/or stormwater into the mines would have on subsidence, and the effect of subsidence on the project life of the existing sewer system or a new sewer system.

The investigations of the potential for subsidence consisted of four parts: 1) literature review; 2) field investigation; 3) laboratory testing; and 4) data evaluation. Findings, summarized below, pertain to the following:

- Geology and subsurface conditions
- Subsurface water conditions
- Coal mining
- Ground subsidence
- Factors related to subsidence
- Stability evaluation.

They will be critical to the selection of the most cost-effective wastewater management program.

GEOLOGY AND SUBSURFACE CONDITIONS

Geologic studies of Streator and surrounding areas have been published by the Illinois State Geological Survey (ISGS) since the late 1800's. A comprehensive review and synthesis of the geology of this area was completed by Willman and Payne (1942). This study has served as the primary geologic reference for the present evaluation of potential mine subsidence. Law Engineering Testing Company (LETCO) concentrated on the engineering characteristics of the Pleistocene deposits (glacial drift) and Pennsylvanian strata, because they directly influence the assessment of subsidence potential and related problems.

Throughout Illinois, overburden deposits consisting of Quaternary-aged glacial drift (Figure B-1) and stream alluvium overlie thick sequences of Paleozoic sedimentary rock. A generalized geologic column for the Streator area was developed from the geologic literature and from borings drilled by LETCO (Figure B-2, Tables B-1 and B-2). A total of thirteen soil and rock borings, ranging in depth from 53.3 feet to 114.0 feet, were drilled (Figures B-3 and B-4). Typical subsurface profiles based on interpretation of the subsurface conditions in the Streator area are summarized in Figures B-5 through B-9.

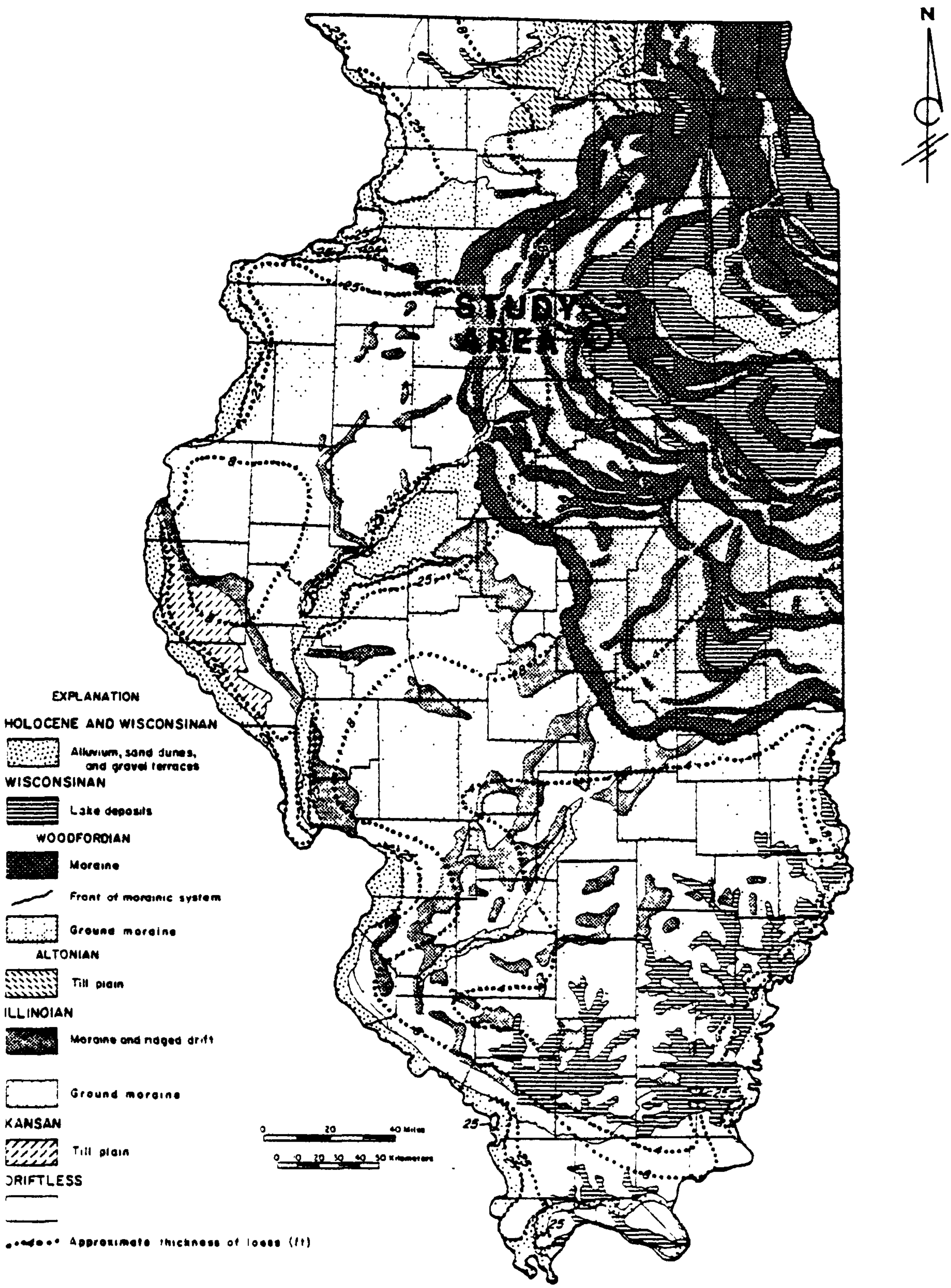
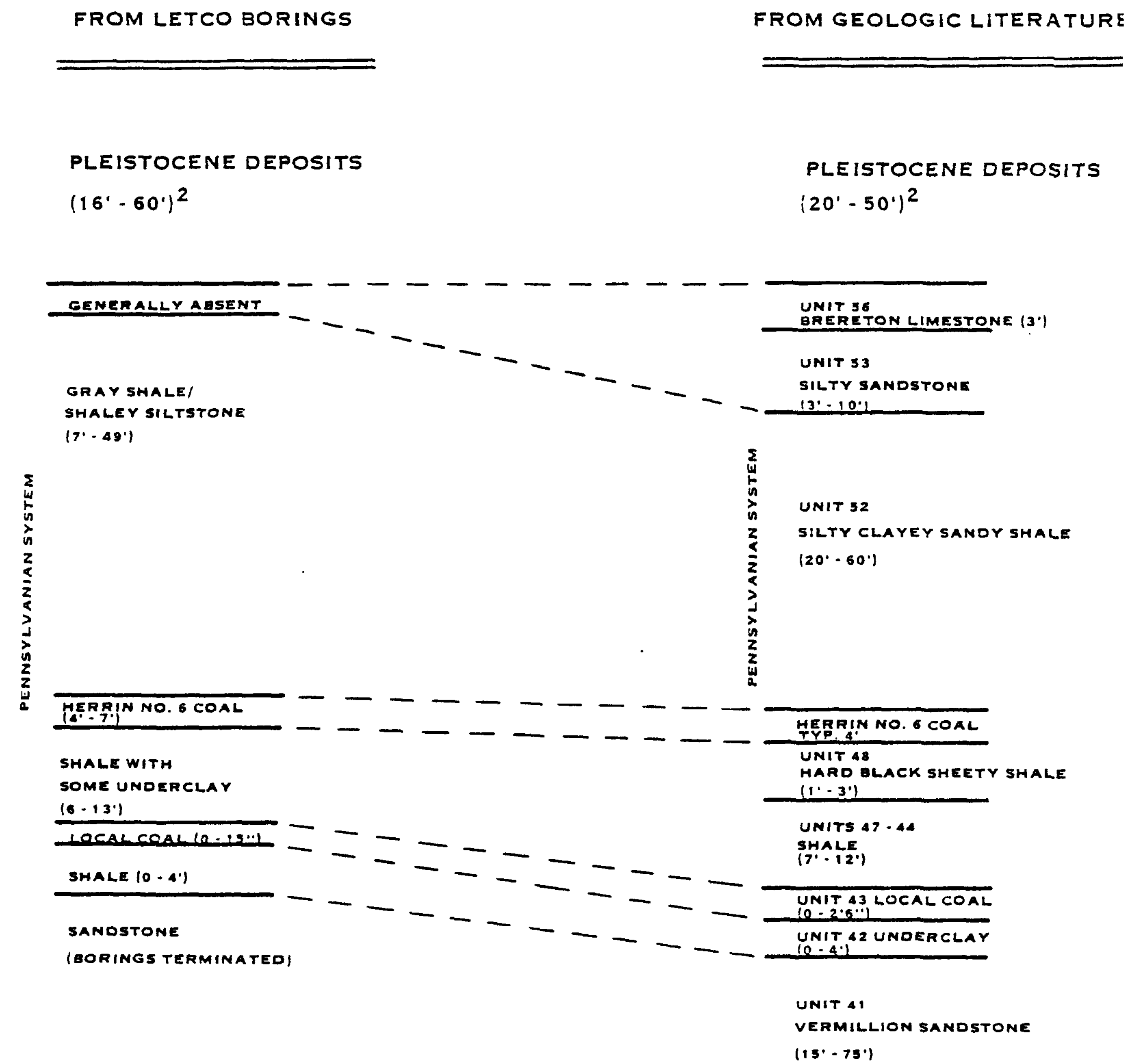


Figure B-1. Generalized glacial geology of Illinois (Piskin and Bergstrom 1975).



[1] After Willman and Payne 1942

[2] Typical range of thickness

Figure B-2. Typical geologic section in the Streator, Illinois, area.

Table B-1. Summary of subsurface conditions in the Streator, Illinois, area.

Boring Location	Map Location (Figure B-3)	Approximate Ground Surface Elevation*	Glacial Drift Thickness (feet)	Roof Rock Thickness (feet)	Herrin No. 6 Coal Thickness/Depth (feet)	Lower Coals Thickness/Depths
LETCo Site	B-1	625	39.5	64.4	5.1 @ 103.9	Local seam: 8" @ 124.2'
LETCo Site	B-3	612	27.0	34.2	3.3 @ 61.2 (void)	Local seam: 8" @ 73.0'
LETCo Site	B-21	628	60.0	29.8	6.3 @ 89.8	
LETCo Site	B-22	620	38.0	48.8	5.7 @ 86.8	
LETCo Site	B-23	630	53.0	6.8	3.8 @ 60.2	
LETCo Site	B-24	623	39.0	43.0	6.7 @ 82.0	Local seam: 1.3' @ 101.7'
LETCo Site	B-25	622	38.5	38.5	5.0 @ 76.0 (void)	
LETCo Site	B-26	620	37.3	21.5	5.0 @ 58.8	
LETCo Site	B-27	617	37.8	28.2	4.8 @ 66.0	
LETCo Site	B-29	585	16.0	15.0	4.8 @ 31.0 (void)	
CW&V Shaft[a]	1	620	26.0	35.5	5.5 @ 61.5	Local seam: 9" @ 92.8'
CW&V Shaft[a]	2	620	31.0	43.5	5.5 @ 74.5	
CW&V Shaft[a]	3	620	33.0	29.0	7.0 @ 62.0	
CW&V Shaft[a]	4	620	26.0	35.5	6.5 @ 61.5	
Acme Shaft[a]	5	620	40.0	63.0	7.0 @ 103.0	
CW&V Shaft[a]	6	630	46.0	73.0	5.2 @ 119.0	
CW&V Shaft[a]	7	631	60.0	37.0	5.3 @ 97.0	
CW&V Shaft[a]	8	630	57.0	46.5	5.0 @ 103.5	No. 4 coal:2.5' @ 186.9' No. 3 coal:2.5' @ 208.3' No. 2 coal:3.4' @ 244.3'
CW&V Shaft[d]	9	631	57.0	14.5	4.5 @ 71.5	No. 5 coal:2.5' @ 162.5' No. 4 coal:1.0' @ 182.3' No. 3 coal:3.0' @ 198.0'
Stubbs Shaft[d]	10	610	30.0	30.0	5.0 @ 60.0	Local seam: 3" @ 98.3' No. 4 coal:2.0' @ 146.9' No. 3 coal:2.5' @ 173.9' No. 2 coal:2.4' @ 198.3'
Streator Bottle Works*	11	590	5.0	4.0	4.5 @ 90.0	No. 4 coal:4.5' @ 95.0' No. 2 coal:2.0' @ 187.0'
Housing for the Elderly[b]	12	625	42.0	48.0	5.0 @ 90.0 (void)	
St. Mary's Hospital[c]	13	596	12.0	18.0	7.0 @ 30.0	
Golf Lane[e]	14	630	46.0	10.0	5.0 @ 61.0	
Marilla Lane[e]	15	630	47.0	14.0	5.5 @ 61.0	
CW&V Shaft[d]	15 (triangle)	632	57.0	14.5	4.5 @ 71.5	No. 4 coal:2.5' @ 162.5' No. 3 coal:1.0' @ 182.3' No. 2 coal:3.0' @ 215.5'
Peanut Shaft[d]	16 (triangle)	615	22.0	29.0	5.0 @ 51.0	No. 4 coal:2.5' @ 139.0' No. 2 coal:2.0' @ 180.5'
H&N Plumb Shaft[d]	17 (triangle)	630	57.0	46.6	5.0 @ 103.6	No. 4 coal:2.5' @ 186.9' No. 3 coal:2.5' @ 210.9' No. 2 coal:3.4' @ 224.3'
Acme Shaft[d]	24 (triangle)	620	60.0	43.0	7.0 @ 103.0	
Streator Clay[d]	31 (triangle)	612	24.3	50.3	5.5 @ 74.6	No. 4 coal:2.7' @ 173.7' No. 3 coal:1.0' @ 190.3' No. 2 coal:2.1' @ 220.3'

* Based on USGS map; values are feet msl

Sources:

[a] Illinois State Geological Survey

[b] Soil Testing Services, Inc. 1976

[c] Warzyn Engineering, Inc. 1961

[d] Willman and Payne 1942

[e] Renz

Table B-2. Summary of subsurface conditions in the Kangley, Illinois, area.

Boring Location	Map Location (Figure B-4)	Approximate Ground Surface Elevation[b]	Glacial Drift Thickness (feet)	Roof Rock Thickness (feet)	Herrin No. 6 Coal Thickness/Depth (feet)	Lower Coals Thickness/Depth
Lane-Western[a]	14	630	70.0	None	5.0 @ 70.0	4.0' @ 120'
Star Shaft[a]	17	630	51.0	3.9	6.5 @ 54.9	1" @ 125.8' 2.5' @ 148.5'
Acme Shaft[a]	18	630	37.5	30.0	4.5 @ 67.5	3.9' @ 116.0'
LETCo Site	B-5	635	74.0	--	Absent to 114.0	2" @ 103.4'
LETCo Site	B-31	631	69.0	--	Absent to 93.0	Not Encountered

[a] From Illinois State Geological Survey boring files

[b] Based on USGS map; values are feet msl

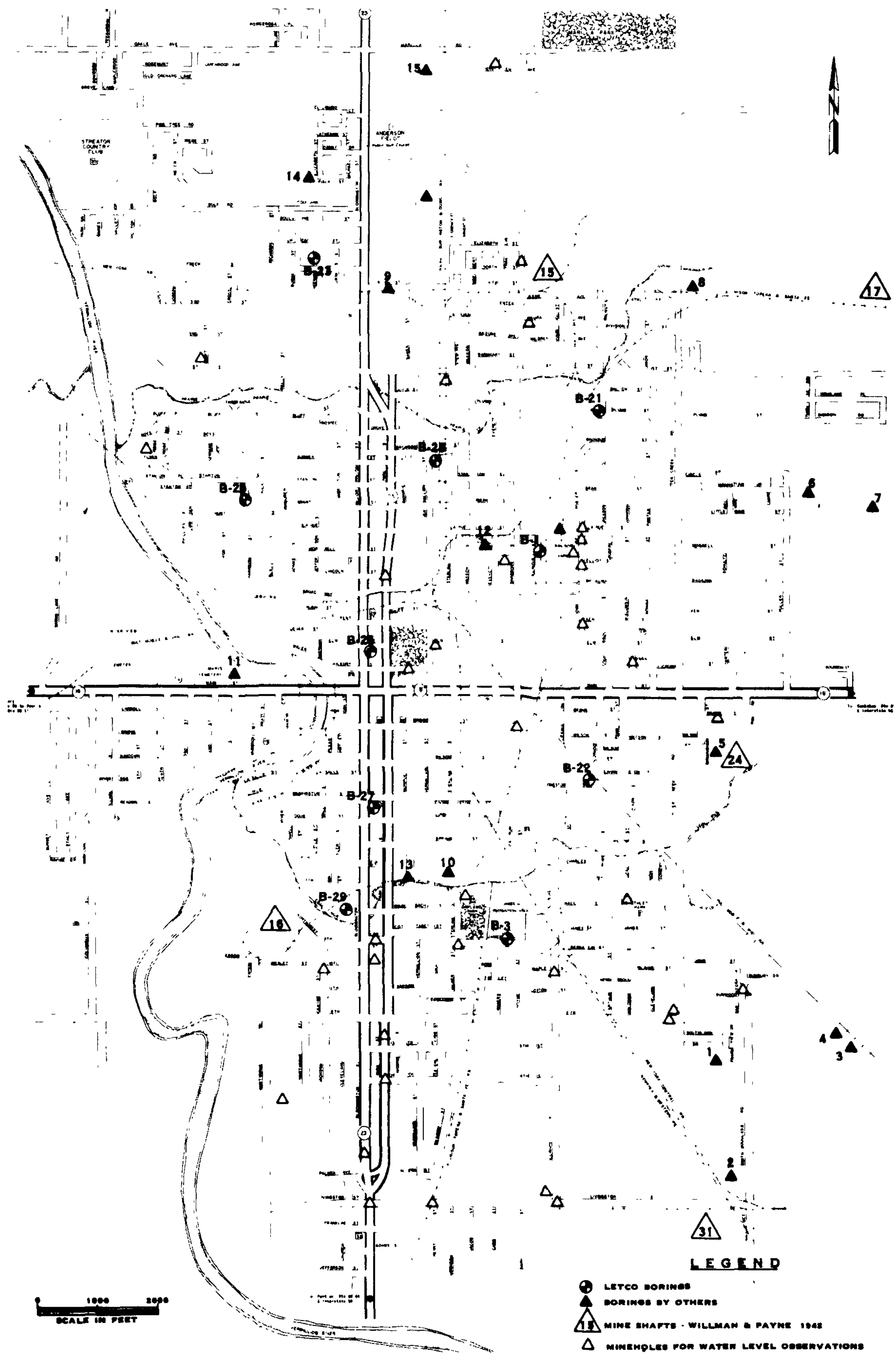
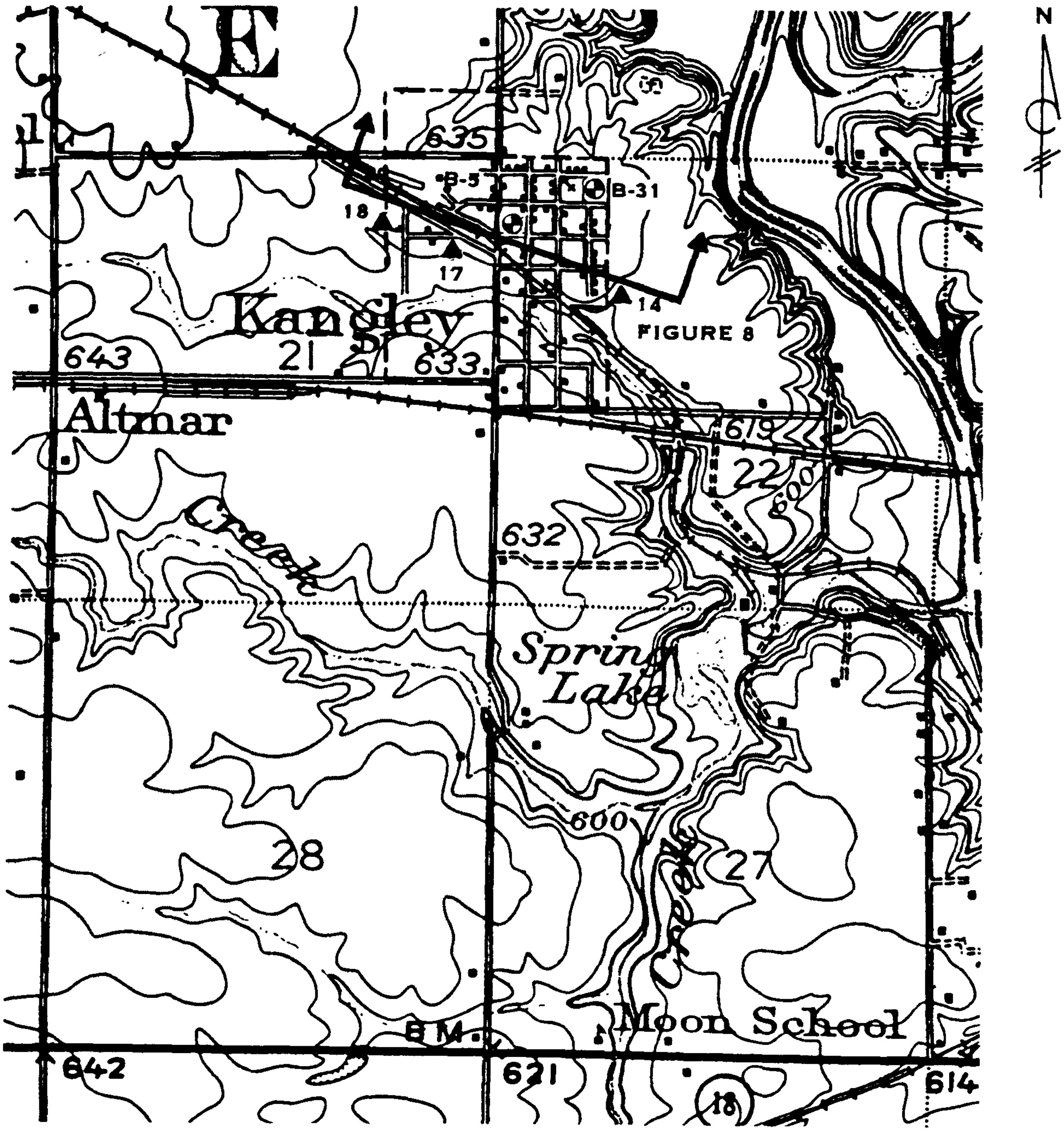


Figure B-3. Location of borings, mine shafts, and mineholes in the Streator, Illinois, area.



LEGEND

- LETCO BORINGS
- BORINGS BY OTHERS

0 2000
SCALE IN FEET

Figure B-4. Location of LETCO borings drilled in the Kangley, Illinois, area.

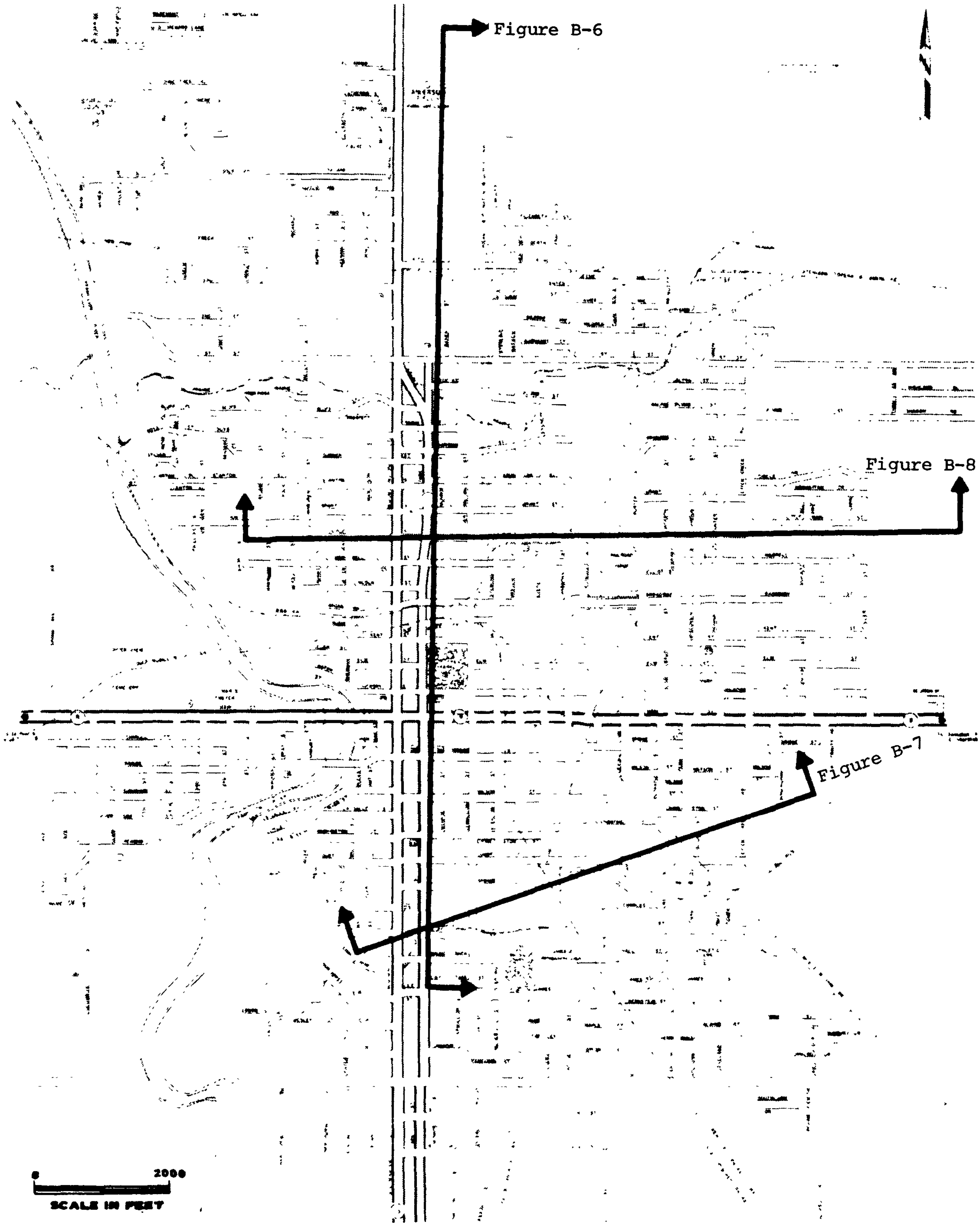


Figure B-5. Index map for subsurface profiles in the Streator, Illinois, area.

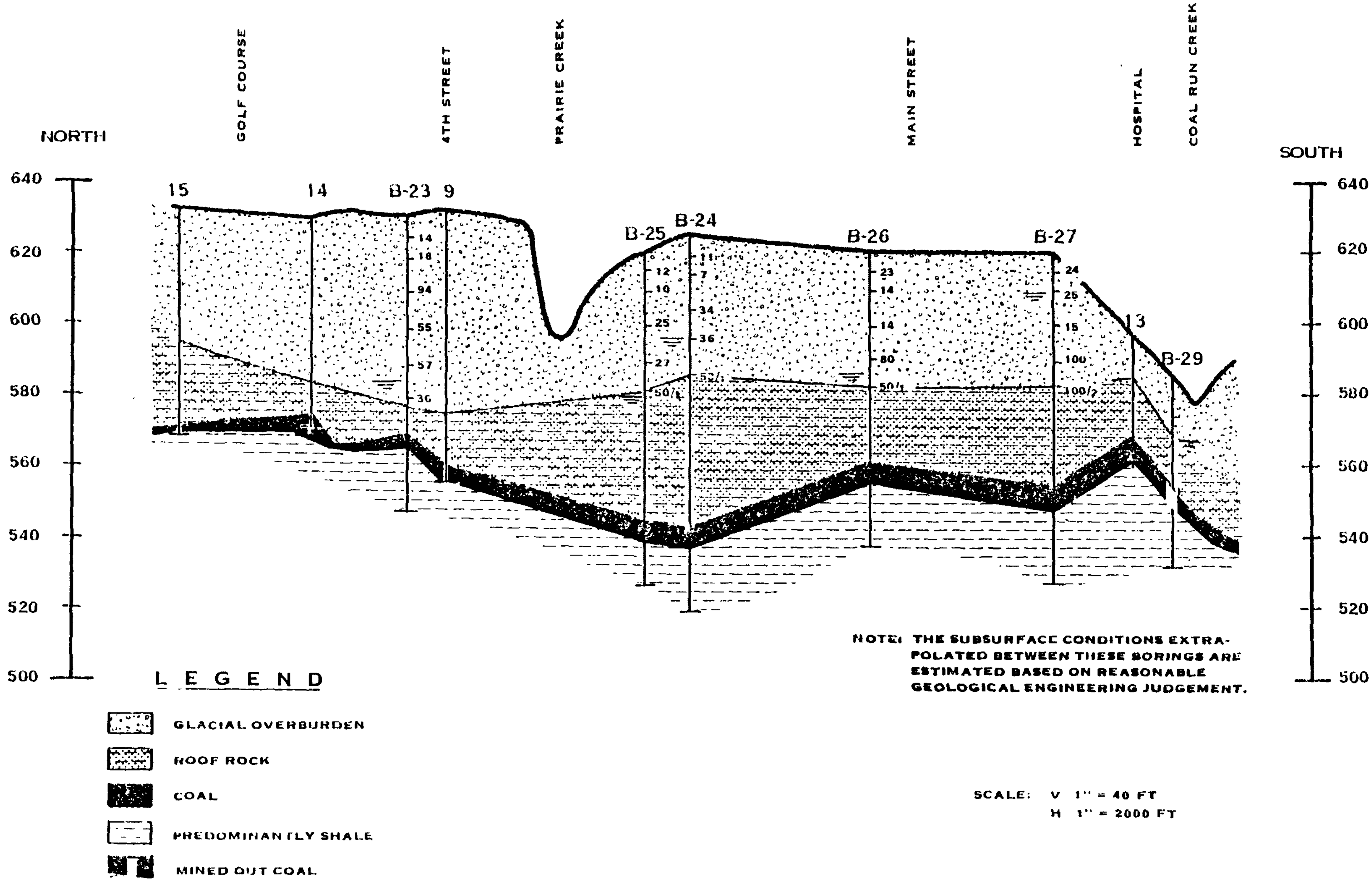


Figure B-6. North - south subsurface profile along Park Street, Streator, Illinois. The orientation of the profile is shown in Figure B-5, and boring locations are shown in Figure B-3.

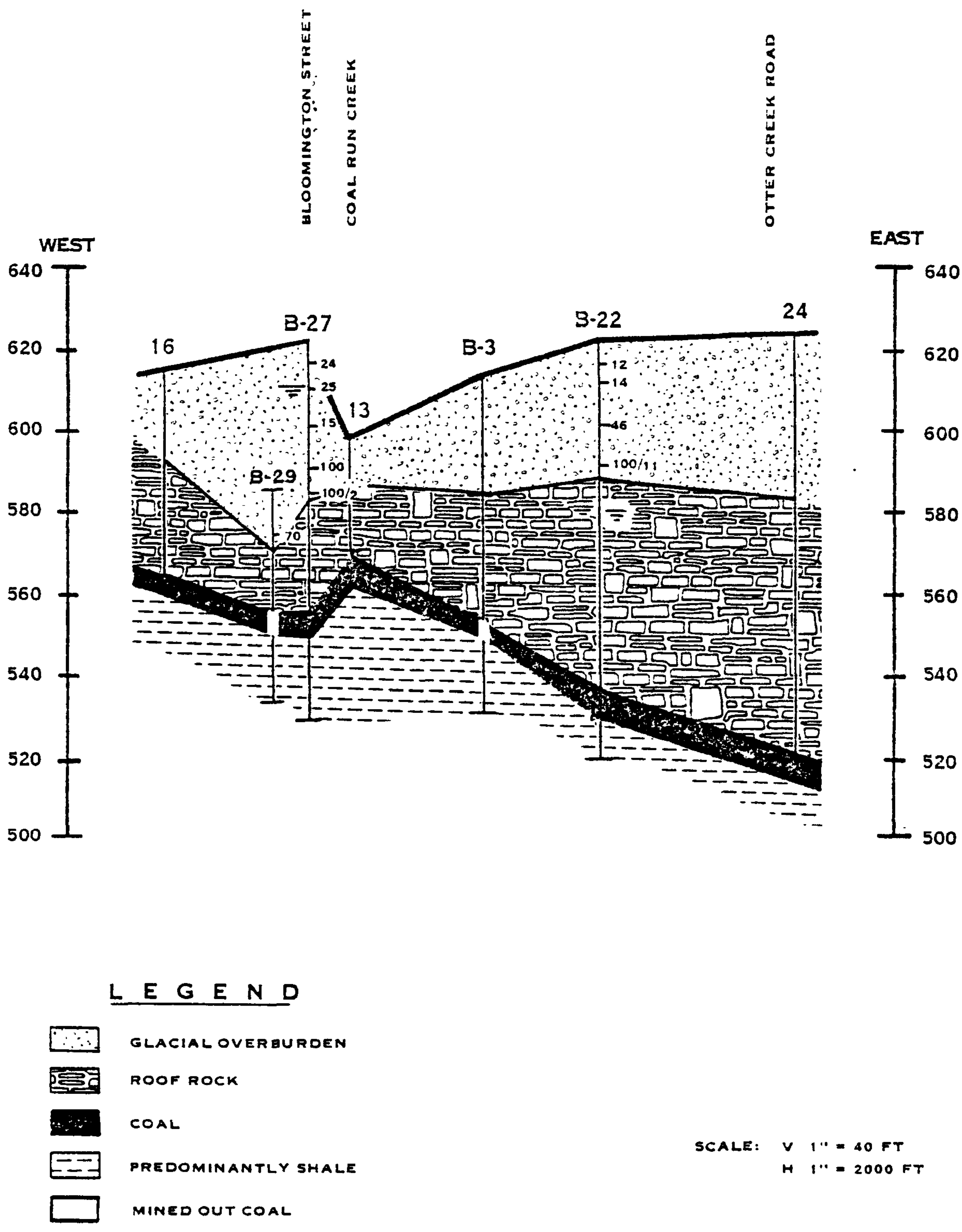


Figure B-7. East - west subsurface profile along Coal Run, Streator, Illinois. The orientation of the profile is shown in Figure B-5, and boring locations are shown in Figure B-3.

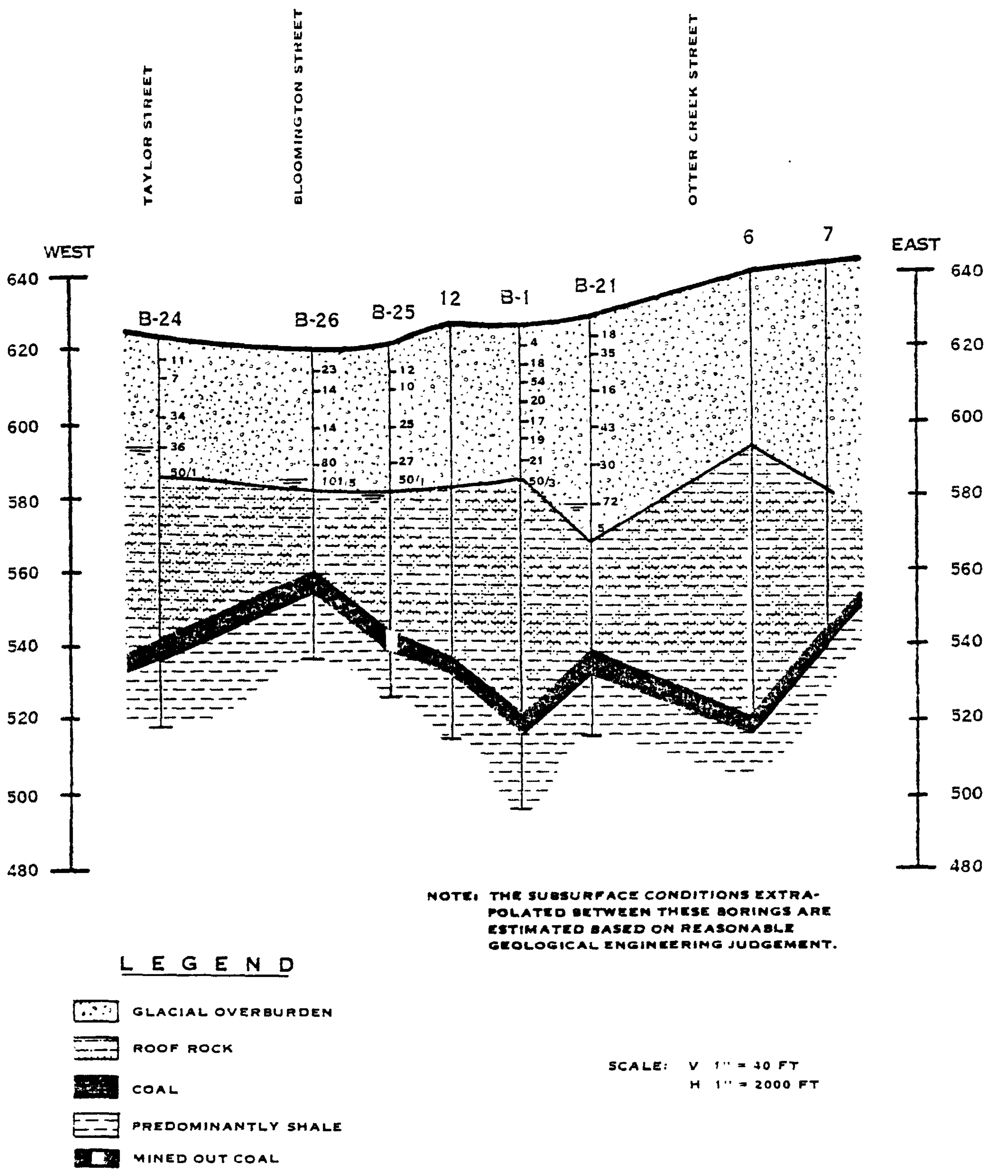


Figure B-8. East - west subsurface profile along LaRue Street, Streator, Illinois. The orientation of the profile is shown in Figure B-5, and boring locations are shown in Figure B-3.

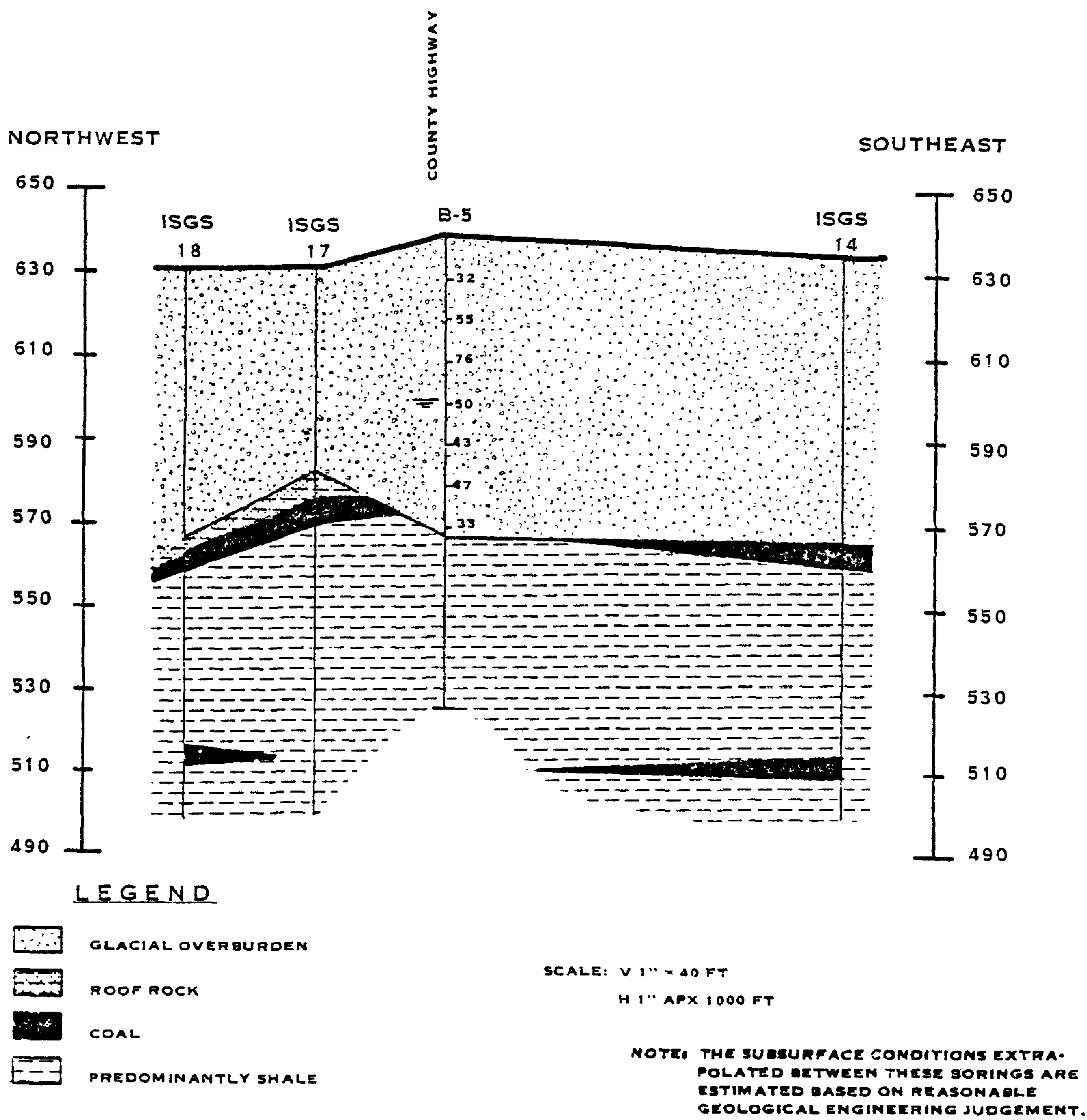


Figure B-9. East - west subsurface profile, Kangley, Illinois. The orientation of the profile and boring locations are shown in Figure B-4.

Pleistocene Deposits

Surface and near surface soils in the Streator area consist of glacial lake deposits laid down during the Wisconsinan stage of glaciation. (Piskin and Bergstrom 1975). The glacial drift regionally ranges in thickness from tens of feet to a few hundred feet. The soils are heterogenous deposits of sands, clayey silts, and silty clays with varying amounts of gravel. No detailed correlation of these deposits was possible between the widely spaced borings, however, silty sands and sands predominate in the central portion of Streator, with the amounts of silts and clays increasing towards the north and south. Results of standard penetration tests indicate the presence of very stiff to hard silts and clays and firm to dense sands.

The total thickness of the glacial drift can be estimated by comparing ground surface contours with bedrock topography. The total thickness is generally less than 50 feet and is typically 25 to 40 feet (Figures B-6, B-7, B-8, and B-10). Less than 30 feet of glacial drift exist in the areas around Coal Run, Prairie Creek, the Vermilion River, and the southwest part of town. Generally, the thicker deposits are in the east and northeast parts of Streator.

In the vicinity of Kangley, the thickness of surficial deposits is more variable. Depths range from less than 40 feet to more than 70 feet (Figure B-9).

Bedrock

Bedrock in the study area and in about two-thirds of Illinois is sedimentary in origin and is part of the Pennsylvanian System. These rocks generally exhibit repeating lithologic sequences within the stratigraphic column. A given sequence is referred to as a cyclothem and ideally consists of a basal sandstone, overlain by shale, limestone, underclay, and coal beds, which are overlain in turn by shales and limestones. In actuality, this ideal sequence seldom occurs, and only portions of the cyclothem are present.

The cyclothem of particular interest is the Brereton cyclothem, which is part of the Carbondale Formation and the Kewanee Group (Willman and others 1975). The Brereton is described as "the thickest and one of the most variable cyclothems in the area" (Willman and Payne 1942). The major significance of this sedimentary sequence to subsidence evaluation in the Streator area is the potential for variation with respect to thickness and composition of both mine floor and mine roof units. A generalized section of the Brereton cyclothem is presented in Figure B-2. This cyclothem is about 85 feet thick in the Streator area and thins towards the northwest. A typical thickness in the vicinity of Kangley is about 60 feet.

The most important commercial unit of the Brereton cyclothem is the Herrin No. 6 coal. In older geologic publications, this coal is called the Streator No. 7 coal. Another coal unit, the Colchester No. 2 coal is found at the base of the Carbondale and has been deep mined to some extent in Streator and Kangley. The No. 2 is referred to as the La Salle coal in older geologic publications.

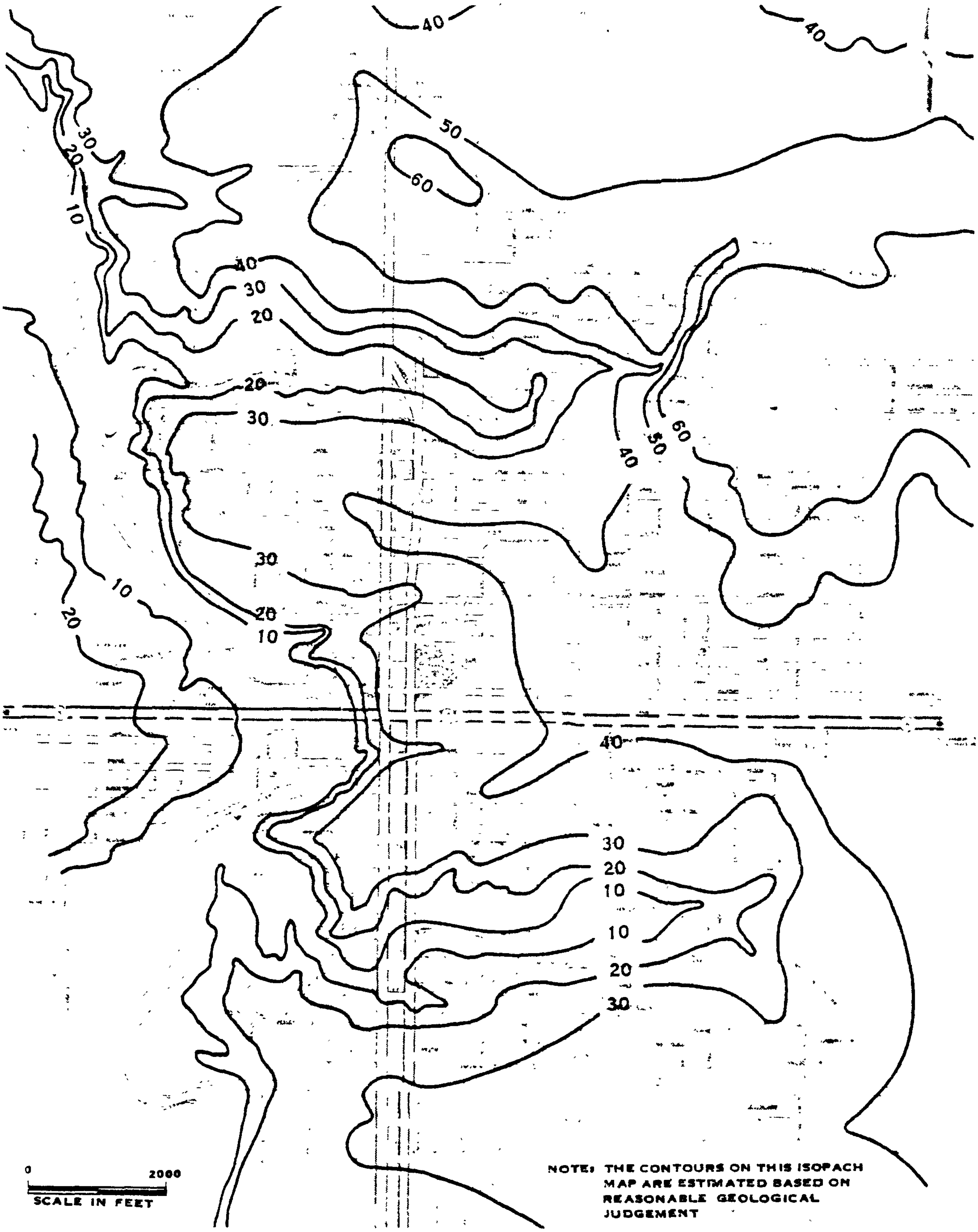


Figure B-10. Generalized thickness (in feet) of pleistocene deposits in the Streator, Illinois, area.

Mine Roof Rock

The rock units that constitute the roof overlying the Herrin No. 6 coal are primarily gray or greenish/gray sandy shale or shale-like siltstone. The thickness of these units ranges from less than 10 feet to more than 50 feet. With respect to the evaluation of subsidence potential, the following are particularly relevant:

- The roof rocks are primarily sandy shale and shaley siltstone. In place and immediately after coring, these rocks are generally intact with relatively few joints or partings. However, after exposure to drying and without confinement, these units tend to shrink and separate along bedding planes.

- In fresh samples of core, the hardness was generally soft to medium hard. The hardness tended to increase after exposure to air. Natural moisture contents ranged from 6% to 14% of the dry weight.

- The thickness of rock above the roof of the mines is variable (Figure B-11). Roof rock generally is thinnest in the southwest and northwest parts of town. Thicknesses of less than 20 feet are common. The thickness of roof rock, however, increases towards the east to more than 60 feet.

- The siltstones are fairly thick bedded, however, numerous shale-like laminations and severely weathered zones were encountered in the borings. Several very soft zones or small voids were encountered, indicating areas of probable roof collapse. LETCO Boring B-25 encountered two such voids, each approximately 2 feet thick (Table B-1, Figure B-3).

Herrin No. 6 Coal

The Herrin No. 6 coal has been mined extensively in the Streator area. The literature indicates that the thickness of the coal seam generally ranges from 3.0 to 5.0 feet. Results of LETCO borings and logs of old mine shafts indicate an average thickness of 5.4 feet (Table B-1). The coal appears to thin east, west, and south from Streator, but it is very thick in the Klein Bridge-Heenanville area, north of Kangley (Willman and Payne 1942), where it is locally 9.0 feet thick.

The regional dip of the bedrock to the east-southeast is apparent in the coal (Section 2.2.2.1.). Seam elevations are approximately 550 to 570 feet msl at the Vermilion River and decrease to around 510 to 530 feet msl along the east side of the study area (Figure B-12).

The coal is rarely flat-lying and has been described as "having a variable attitude with broad undulations 40 to 50 feet in amplitude" (Willman and Payne 1942, p. 131). These broad undulations are the result of an unconformity within the Brereton cyclothem, caused by a period of erosion of the underlying sandstones prior to deposition of the coal. Outcrop elevations along the Vermilion River vary as much as 25 feet within a horizontal distance of 100 feet, and drop shaft (minehole) depths vary as much as 20 feet within several hundred feet.

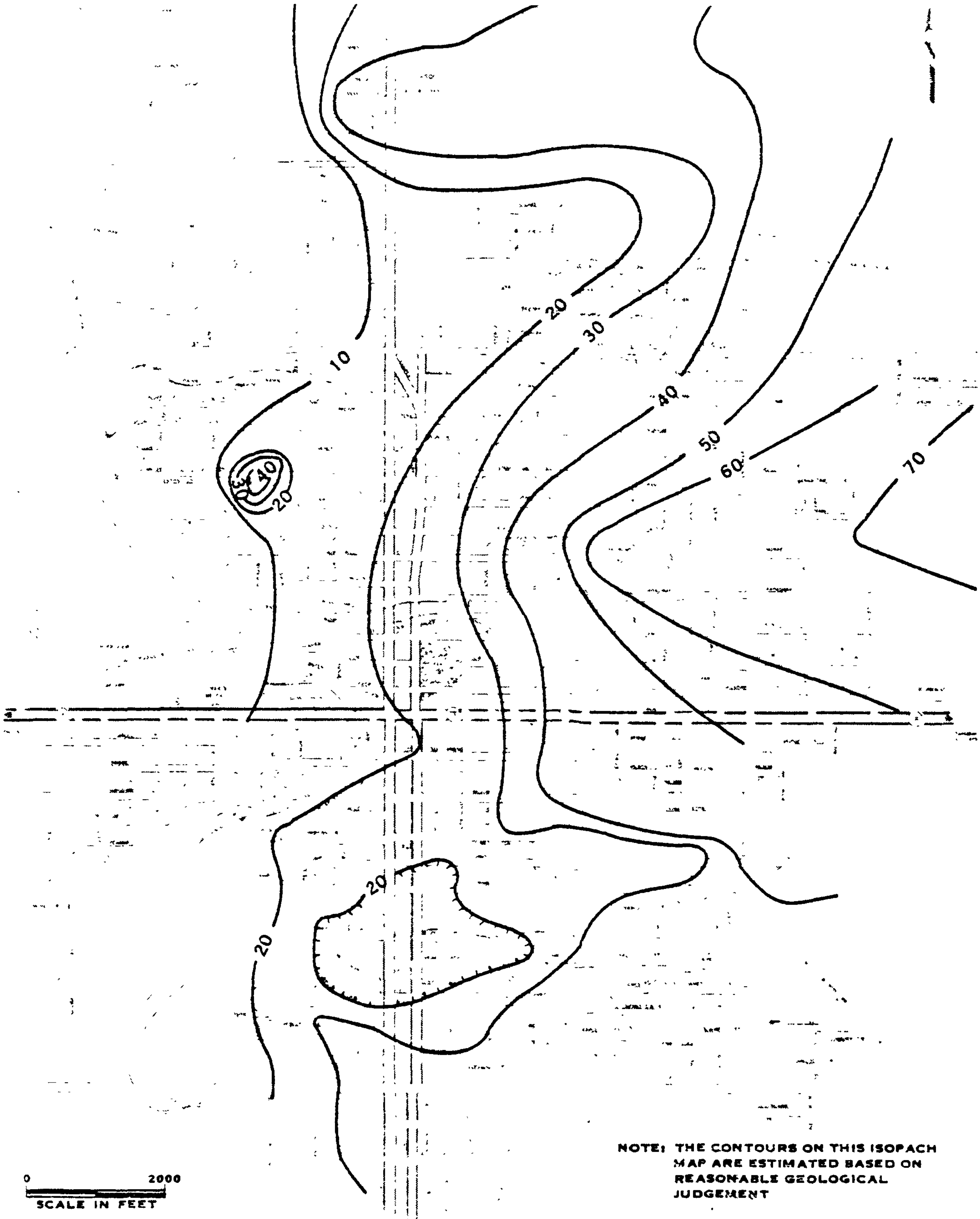


Figure B-11. Approximate thickness (in feet) of mine roof rock in the Streator, Ilinois, area.

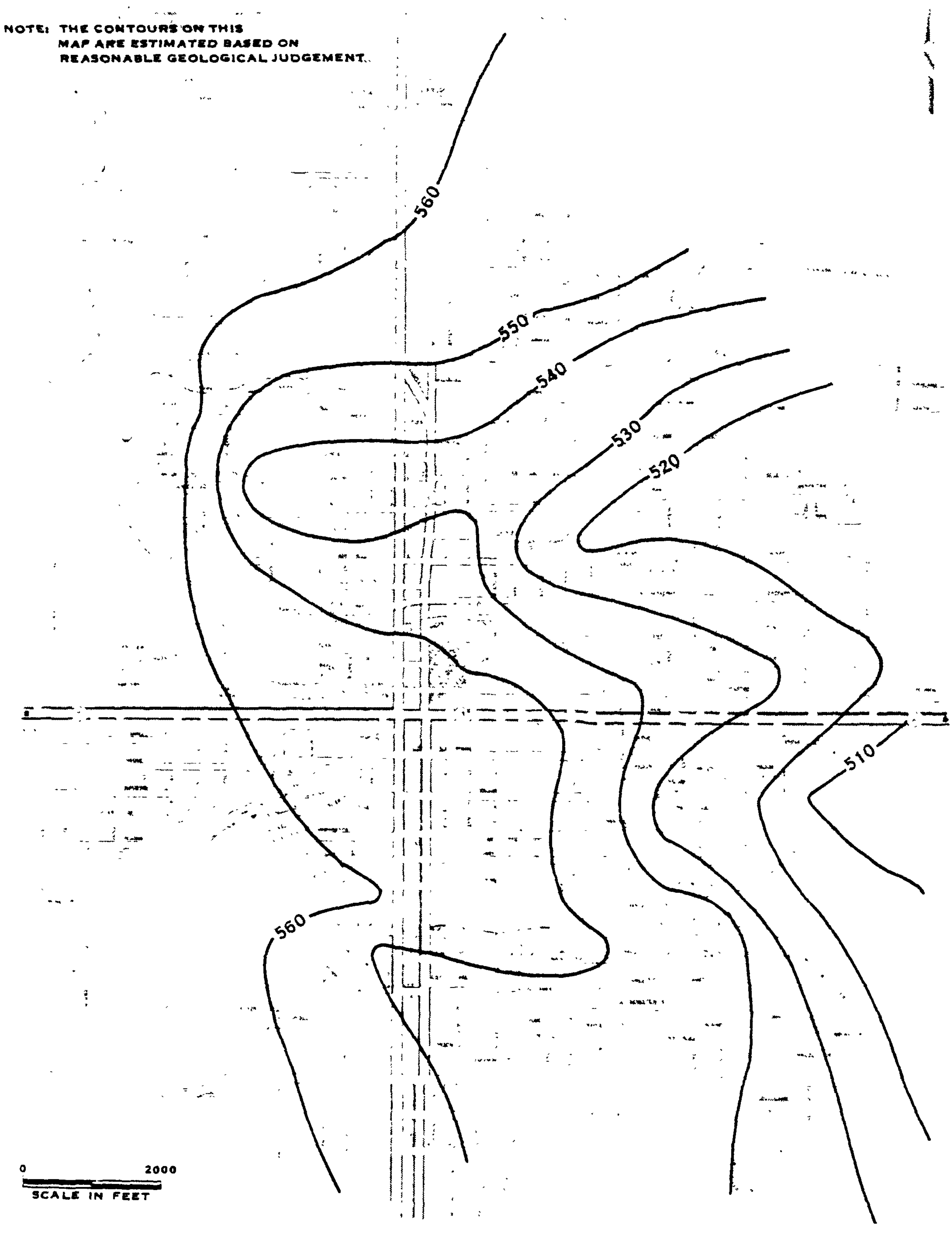


Figure B-12. Contours of the base of the Herrin No. 6 coal in the Streator, Illinois, area. Values are feet msl.

The top of the coal, in addition to exhibiting broad undulations, is very irregular. There are numerous depressions in the surface, 1.0 to 1.5 feet in depth, 5.0 to 6.0 feet in width, and as much as 20 feet long. These depressions are filled with roof clay, and where they occur, the top of the coal is missing (Cady 1915). The irregularities affect the thickness of the seam and probably are associated with stream channel scouring. The scouring is locally very severe and occasionally causes the coal to pinch out entirely. Depressions are more predominant in the southern part of the Streator area.

There is a prominant claystone or shale split in the lower portion of the coal, locally known as the "blue band", which is normally 3.0 inches to 1.0 foot thick. This parting is widespread and resulted in large quantities of spoil left in the mines. The coal above the split is relatively free from bedded impurities. The coal exhibits a distinct and uniform cleating, oriented N30°W.

Coal in the Kangley area has been found very near the base of the glacial drift (Table B-2 and Figure B-9). The coal was generally 7.0 to 8.0 feet thick and had a 7.0 inch to 1.0 foot clay seam in the middle portion. Roof rock in this area is generally very thin to non-existent. The two LETCO borings in the Kangley area showed no appreciable coal, indicating that it possibly was mined and that the roof has collasped. Large quantities of coal remain unmined north of Kangley because of poor roof conditions.

Mine Floor Units

The Herrin No. 6 coal rests on soft shales and/or underclays that form the floor of most of the mines. The shales range from a slate-like shale to a shale with thin layers of underclays and are generally from 10 to 12 feet thick. These shales are generally soft to medium hard and typically black to dark gray or olive in color. Most are fairly slate-like and contain abundant plant fossils and fish bone debris. The underclays are variable in thickness, ranging from 1.0 to 4.0 feet. They rarely occur immediately beneath the coal and have been mined commercially in the south part of Streator.

Vermilionville Sandstone

Underlying the shales and underclays is the basal member of the Brereton cyclothem, an argillaceous-to-silty, fine grained, thick bedded, competent sandstone, known as the Vermilionville Sandstone. The majority of the LETCO borings terminated in the upper part of this unit.

An unconformity within the Brereton cyclothem occurs at the top of this sandstone unit, where portions of the upper surface appear to have been channeled prior to deposition of the Herrin coal. This channeling accounts for the broad undulations and some local thickening of the coal.

Lower Coals

There are locally four cyclothems underlying the Brereton cyclothem in the Streator area. Each of these contains a coal seam and can be summarized as follows:

Cyclothem	Coal Member	Typical Thickness (feet)	Typical Depth (feet)
Brereton	Herrin No. 6	4 - 6	60 - 100
St. David	No. 5	2.5	162
Summum	Summum No. 4	2.5	160 - 185
Lowell	No. 3	1.5 - 2.3	180 - 200
Liverpool	La Salle No. 2	2.0 - 3.4	190 - 240

In addition to the Herrin No. 6 coal, the only coal mined to any extent in the Streator area was the No. 2 coal. This is a very high quality coal and was mined using the longwall method. The No. 2 coal also was mined in the Kangley area.

A local coal seam, 8.0 inches to 1.0 foot thick, was encountered about 15 feet below the No. 6 coal in several of the borings. This thin coal seam has been reported in the literature and may be found over much of the Streator area. This coal probably was not mined to any extent.

The No. 5 coal has been found only in the north part of Streator, near the golf course, in a CW&V shaft. It was very impure and contained about 50% shale.

SUBSURFACE WATER CONDITIONS

The Streator area is underlain by abandoned coal mines, the majority of which are presently flooded. From the time the mines were closed, natural infiltrating water, stormwater runoff, and wastewater have entered or been discharged to the mines and have completely inundated them. The water levels in the mines are such that the roof rock and overlying soils also are inundated to a certain extent.

Appreciable downward seepage of mine water from either the Herrin No. 6 or the La Salle No. 2 coal mines to lower lying aquifers, such as the Galena-Platteville Group and the Glenwood-St. Peter Formation, should be minimal because of the relative impervious character of the shales and siltstones of the Pennsylvanian System. The amount of seepage is probably less than the natural infiltration to the mines because of the thicker sequences of rock below the mines.

Historic Water Levels

Pumps were used during mining operations to drain the mines. Old drawings and maps show pump shafts in the eastern part of Streator where the coal was lowest. The size of the pumps used and the quantities of water removed from the mines are not known. A retired mine inspector reported that in most areas the mines were wet and pumps were required.

Mine records indicate that occasional "quick sand" conditions were encountered when roof rock was penetrated. In these cases, perched water from the overlying glacial deposits drained into the mines.

After abandonment of the mines and the pumping ceased, the mines apparently were flooded slowly through natural infiltration and possibly as a result of some wastewater disposal. According to interviews with local residents, during the localized reopening of the mines in the 1930s, the individual mines were pumped prior to any pillar robbing.

Present Water Levels

LETCO monitored water levels in the abandoned mines from September 1977 to April 1978. Fifty-three mineholes were monitored, as shown in Figure B-13. Water level readings represent the static head of the water in the mines (piezometric levels; Table B-3). At most locations, the water levels fluctuated less than 3.0 feet, however, fluctuations of as much as 20 feet were noted at several locations. Significant fluctuations probably are attributable to clogged mineholes or to mines with limited storage capacities that are isolated from adjacent mines.

Figure B-14 is a piezometric contour map illustrating water level elevations measured on 22 April 1978. The water levels shown are considered typical and representative of existing water level conditions. Some seasonal fluctuations, however, occur. The contours indicate a general downward gradient towards the west. At a documented subsidence location, water was observed flowing rapidly towards the river (Figure B-17, Table B-5, Location No. 5), which confirms the westward gradient.

A comparison of mine level elevations (Figure B-12) with the recorded water levels (Figure B-14 and Table B-3) indicates that the mines are flooded except along the river and that under normal conditions water levels are generally elevated 20 to 60 feet above the roof of the major mines. Based on an average coal seam thickness of 5.0 feet and on knowledge that some mining spoil was left in the mines, LETCO estimated that roughly 20 billion gallons of water are presently in the mines. This estimate includes the large Acme Coal mine to the east and the two CW&V No. 2 mines to the northeast of Streator (Figure B-16).

COAL MINING

History

Streator and Kangley are in the oldest mining district of the State. The two workable coal seams in the area, the Herrin No. 6 and the La Salle No. 2, have been mined extensively. The location of the No. 6 hindered the development of the deeper No. 2 coal for many years, although the deeper coal is of a better quality.

Coal mining began in the 1860s, reached its peak in the 1890s, and began to decline around 1900. The majority of the mines were abandoned between 1885 and 1917. A period of renewed mining activity occurred in the early 1930s, when many of the abandoned mines were pumped dry and the pillars were robbed (Angle 1962). The last notable production was in 1948, when 6,403 tons were mined in a slope mine near the Vermilion River in the southern part of Streator (Renz).

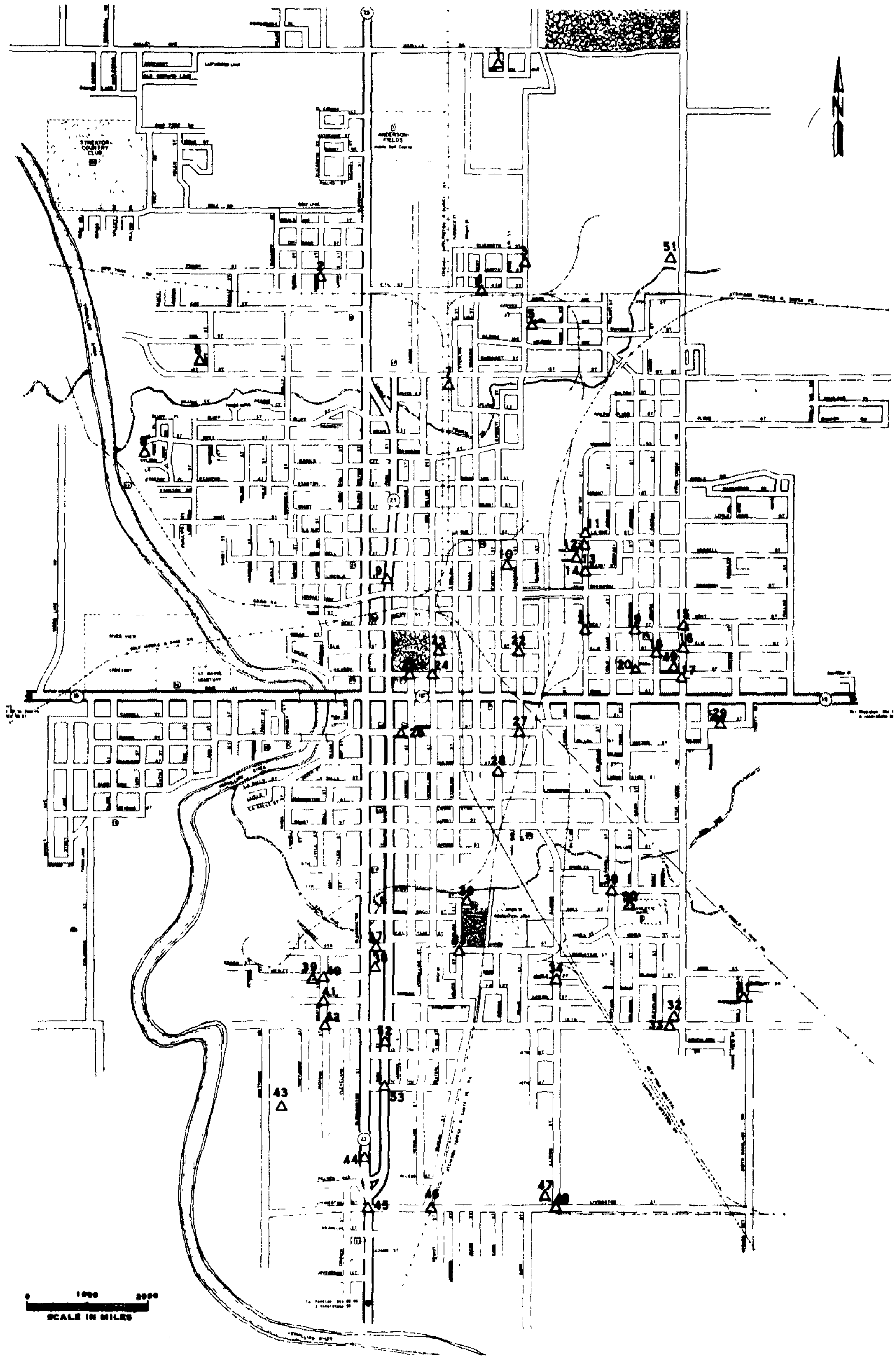
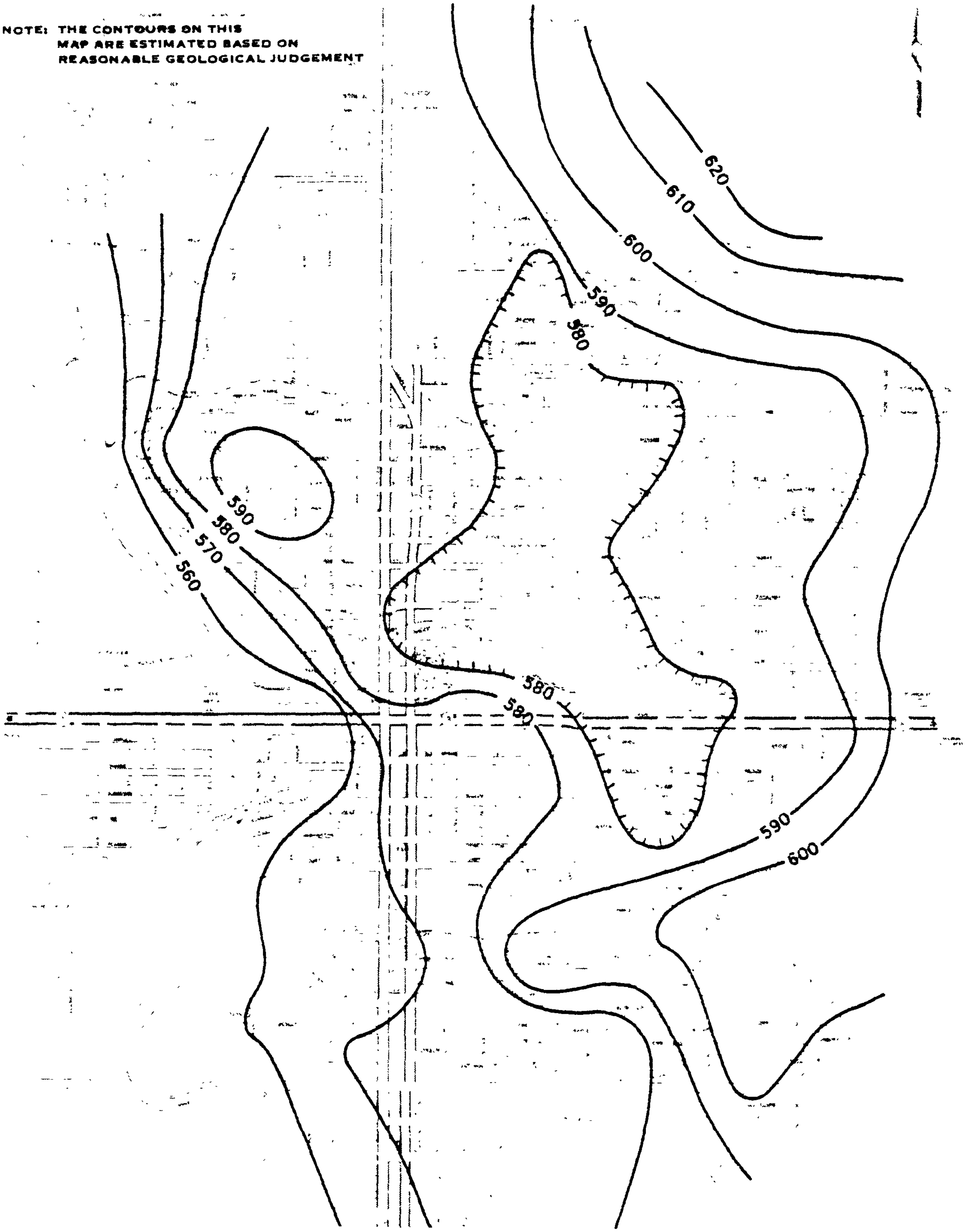


Figure B-13. Location of mineholes used to monitor water levels in the abandoned mines beneath the Streator, Illinois, area.

Table B-3. Water levels in the mineholes. The values indicate the static head of the water in the mines (in feet).

Map Location (Figure B-13)	Approximate Ground Surface Elevation*	Monitoring Dates						
		9/15/77	9/24/77	10/5/77	2/19/78	3/15/78	3/22/78	4/22/78
1	632		28.5	30.0	29.0			29.3
2	630	50.5	54.3					
3	631						38.0	
4	635	55.5	56.3					
5	628						45.0	
6	618		47.0	47.0	46.0			33.2
7	618					39.0		
8	618		37.5	37.5	37.0			38.4
9	616					42.0		
10	628	49.0	49.0	48.0	47.5			50.0
11	626						43.0	
12	626						44.0	
13	624	40.8	40.6	42.3	41.0			42.1
14	620						42.0	
15	626	43.0	45.5					
16	623	44.0	42.8					
17	621	41.0	41.3					
18	624	49.0	45.2					
19	625	40.0	40.3					
20	621						48.0	
21	622						42.0	
22	619	37.0	47.6					
23	619						42.0	
24	619	40.0	40.3					
25	620						40.0	
26	618	40.0	39.2					
27	620						40.0	
28	617	36.0	38.9					
29	620	25.0	23.5	39.7	34.0			35.9
30	620	27.0	19.9					
31	618						27.0	
32	620		20.0	20.8	19.0			16.0
33	620						27.0	
34	612					46.0		
35	612					40.0		
36	613			20.0	19.0			19.0
37	590					24.0		
38	612					42.0		
39	613	45.0	43.8					
40	613						42.0	
41	614	38.0	44.4					
42	615		51.2					
43	615		28.0	12.0	11.0			15.0
44	619					54.0		
45	619					52.0		
46	619						48.0	
47	617		40.0	40.7	40.0			40.0
48	617						36.0	
49	621	41.3	41.0	42.5	41.0			42.3
50	615		19.0	19.3	18.0			15.5
51	632		14.5	17.0	15.0			12.0
52	620					47.0		
53	620					42.0		

* Based on USGS map; values are feet msl



F ıre B-14. Contours of mine water levels measured on 22 April 1978. Values are feet msl.

The Chicago, Wilmington and Vermilion (CW&V) Old No. 1 mine was the largest mine in the area and covered almost the entire area of section 25 of township 31N, R. 3E. This mine was abandoned in 1892. The CW&V Coal Company also operated several other large mines in Streator. The Acme Coal Company was the second largest producer and ran the second largest mine until its abandonment in 1917.

Extent

The present condition of the mines prohibit inspection, therefore, the extent of mining must be based on available documents (maps), which may or may not reflect the final configurations of the mines. Composite mine boundary maps (Figures B-15 and B-16) were developed by LETCO from unpublished mine maps prepared by ISGS and the late F. H. Renz, past Streator City Engineer. The boundaries were drawn primarily from photographs of individual maps of various scales and should be considered approximate. Furthermore, areas shown as unmined may have been mined and not mapped.

The irregular pattern or absence of mining in an area may be indicative of poor roof rock or abnormal water problems. A review of the mine notes indicated that roof failures and cave-ins did occur. The H&N Plumb Mine, in northeast Streator, was severely plagued with water problems until its abandonment in 1940 (Angle 1962).

Methane gas was present to some extent during mining operations. Isolated pockets of gas occasionally accumulated in the higher rolls in the coal. Post-mining accumulations of methane also have been reported (Table B-5), and some mineholes and abandoned mine shafts have caught fire and/or exploded.

The extent of interconnections between the mines cannot be determined completely. Connections between many of the mines were inferred on several mine maps prepared by Renz. It was common practice for miners to dig small emergency escape tunnels from one mine to another. It also is possible that pirate mining and pillar robbing may have created interconnections at various locations. Some of the interconnections, however, may have been sealed off by subsequent roof collapse.

Methodology

The majority of the Herrin No. 6 coal was mined by the room and pillar method. Using this method, coal is removed by mining relatively long narrow rooms and cross cuts, usually at right angles to these rooms. The remaining coal is left in the form of pillars, or ribs, that support the weight of the rock overlying both the pillars and the mined areas. The amount of coal extracted using this mining method ranged from 40% to 70%. Table B-4 lists typical coal extraction ratios and general mine dimensions for several mines in the Streator area.

The most economical results were obtained by advancing the room entry to its full length and then mining the coal back towards the haulageway. This would allow pillar drawing to begin as soon as the room was completed. The extent and amount of pillar drawing is unknown, however, several Renz mine maps indicate areas where all of the pillars were pulled.

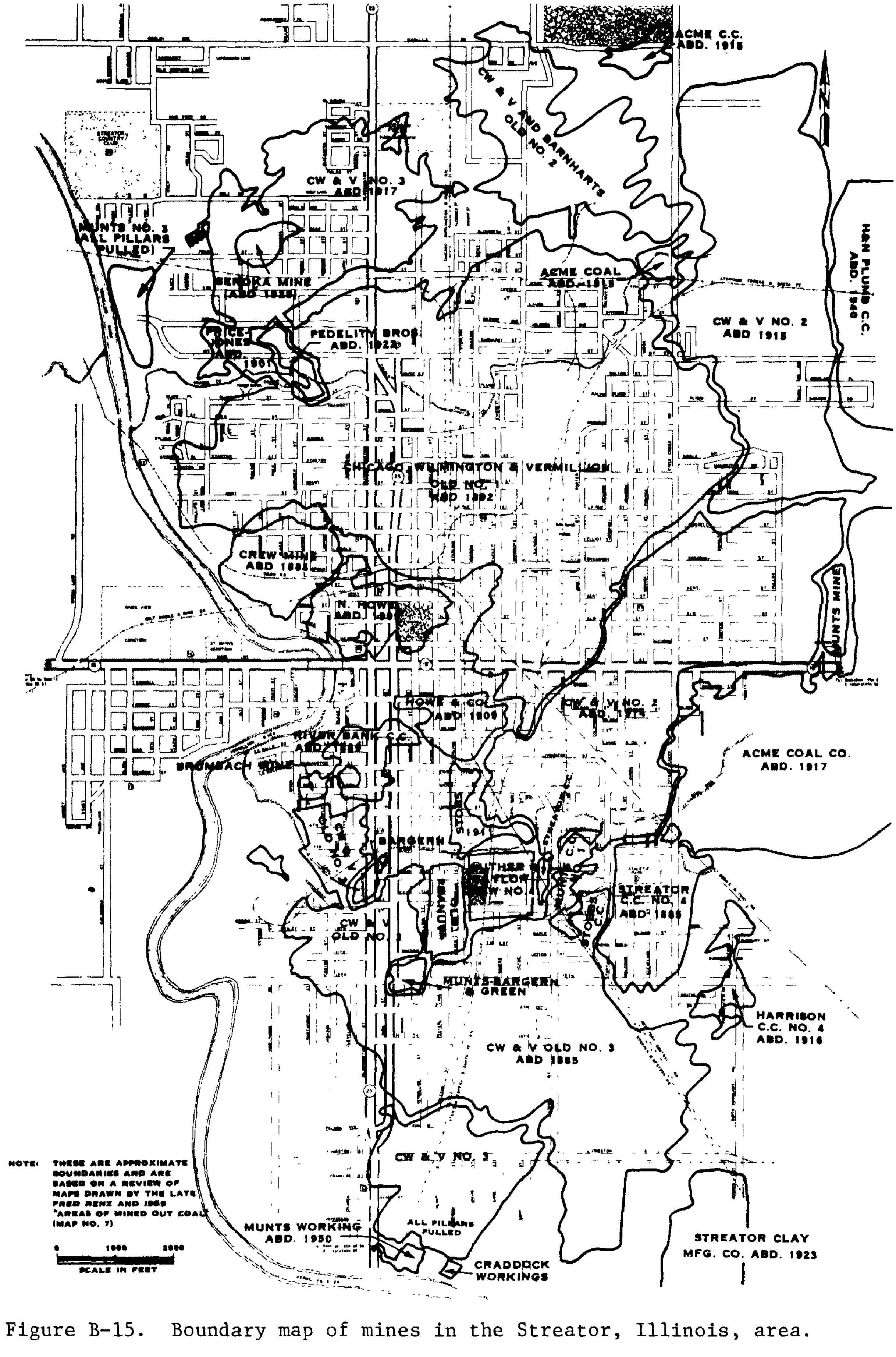


Figure B-15. Boundary map of mines in the Streator, Illinois, area.

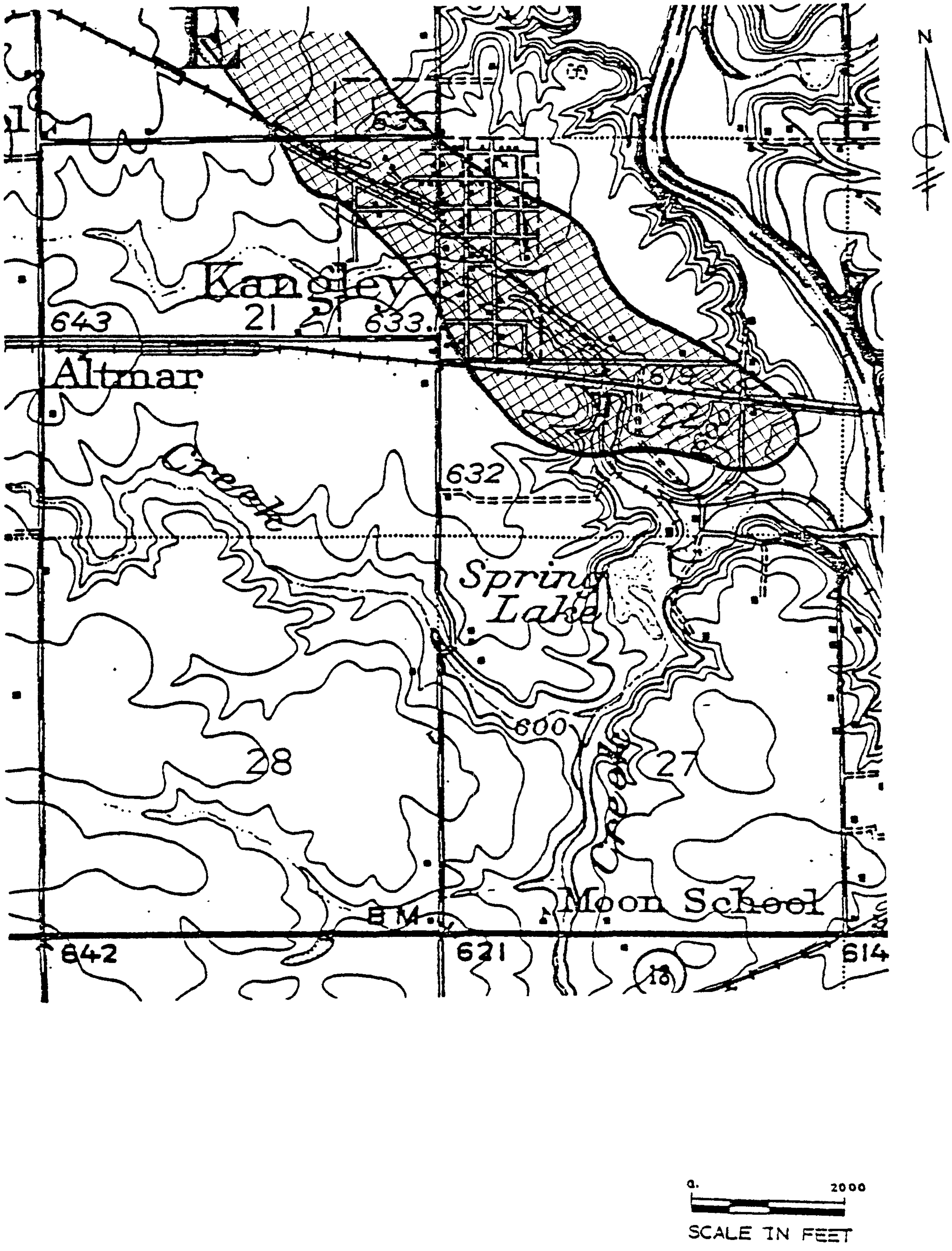


Figure B-16. Boundary map of mined area in the Kangley, Illinois, area.

Table B-4. Typical coal extraction ratios and mine geometry.

Mine	Approximate Extraction Ratio (%)	Typical Room Width (feet)	Typical Pillar Width (feet)	Remarks
CW&V Old No. 3	78	14	4	Rooms 220' Long
Harrison	61	20	12-14	
CW&V Old No. 1	66	10	5	Rooms 200-240' Long
Stobbs @ Sterling St.	67	15-20	10-19	
Munts No. 3	66	20	10	All Pillars Pulled
CW&V No. 3	69	22	8-15	Rooms 300' Long
CW&V No. 2	53	18	16	Rooms Approximately 70' Long
South Howe	64	14	8	
Luther & Taylor New No. 4	69	20	9	
North Howe	58	14	10	Pillars Pulled
Large Acme	69	20-25	10	
Bargern	53	16	14	
Crew				Pillars Pulled

Strip mining and open pit mining were used to some extent in southwest Streator near the Vermilion River. The overburden is sufficiently thin there to permit that type of mining.

The majority of the spoil and coal by-products were disposed of in large waste piles located around Streator and Kangley. Over the years, these piles have degraded and have been partially eroded. An indeterminant quantity of spoil also was left in the mined-out rooms of the mines.

Mining of Lower Coals

The only other coal seam mined to any extent was the La Salle No. 2 coal seam, found at depths ranging from 181 feet to 244 feet. The No. 2 was a much higher grade coal than the Herrin No. 6. It generally was mined using the longwall method of mining, which allows for up to 95% recovery of the coal. Because of this method of mining, the Streator area became known as the Longwall District.

The longwall method involves mining a long, continuous working face. The roof is supported for only a short distance behind the advancing "long wall." Behind this support zone, the roof is allowed to fall, occasionally resulting in considerable disturbance of the ground surface. The haulageway and shafts generally are supported by pack walls built of mine timbers or mine waste materials. The amount of subsidence in a longwall mining area depends to some degree on the quality and the quantity of the waste materials used for support. If the material were rock and if it were carefully placed, it may act as a vertical support for the roof much in the same way as coal pillars support the roof when the room and pillar method is used (Ganow 1975).

MINE SUBSIDENCE

History

There have been numerous accounts of subsidence associated with coal mining in the Streator study area since the initiation of mining operations. Evidence of subsidence varies from gentle distortions that crack plaster and jam doors and windows to large pot holes along streets that have affected as many as three houses.

During the early mining period, "sink holes were abundantly present and so numerous that they constituted a serious hazard to farming operations" (Quade 1935). One subsidence occurrence so badly damaged a tract of land and a building that the coal company deeded a new tract of land to the owner and reconstructed the building (Quade 1935).

The Renz maps show scattered areas as reserved (not mined), including downtown areas between Hickory and Bridge Streets, from Bloomington to Sterling Streets. In 1883, the CW&V Coal Company sold the mineral rights, thereby reserving the coal to the property owners in the downtown area, for $0.50/sq. ft. (Angle 1962). The coal also is shown as reserved under St. Mary's Hospital, at the corner of Bloomington and Spring Streets.

Documented Subsidence

As part of their investigations, LETCO reviewed old photographs of subsidence cases and interviewed local citizens to document areas of past subsidence. Figure B-17 and Table B-5 summarize 33 known cases of subsidence. Most of the documented cases are based on personal communication and reflect subsidence generally over the past 20 years. Remedial measures, in most cases, have consisted of repairing the affected utilities and backfilling with any available miscellaneous material. For the most part, subsidence has not seriously affected structures, although bracing systems sometimes have been required.

Subsidence generally was abrupt, occurring with no warning. The deeper depressions probably were associated with gradual raveling and sluffing of roof material, which weakened support for the glacial drift and caused subsidence.

Subsidence associated with deep mining of the No. 2 seam occurred as large sags approximately 4.0 to 6.0 inches deep. These sags usually formed immediately after mining and are common to this mining method (Quade 1935). No areas of recent subsidence were found that can be related to longwall mining.

Future Subsidence

Records of recent (last 20 years) subsidence and the presence of subsurface voids indicate that subsidence is not "complete", as might be expected when compared to other mined areas. The time and location of future subsidence cannot be predicted in the Streator area. Certain areas, however, are more susceptible to subsidence than others, as will be discussed below.

FACTORS RELATED TO SUBSIDENCE

Geologic Features

The areas of documented subsidence in Streator generally coincide with one or more of the four following subsurface conditions:

1) Thin roof rock (Figure B-11)

2) Thin glacial drift (Figure B-10)

3) Thin roof rock and thin glacial drift

4) Soft or fractured roof rock.

The relationship between subsurface conditions and areas of known subsidence is shown in Figure B-18. The amount and rate of subsidence generally is less where the overburden and roof rock is thick (Dunrad 1976). The presence of a competent zone of rock, typically comprised of sandstone or limestone, also tends to retard or restrict roof failures. There is, however, a general absence of massive competent rock above the coal in the Streator area.

Another factor related to geologic features and the potential for subsidence is the quality of the strata underlying the coal seams. Soft under-

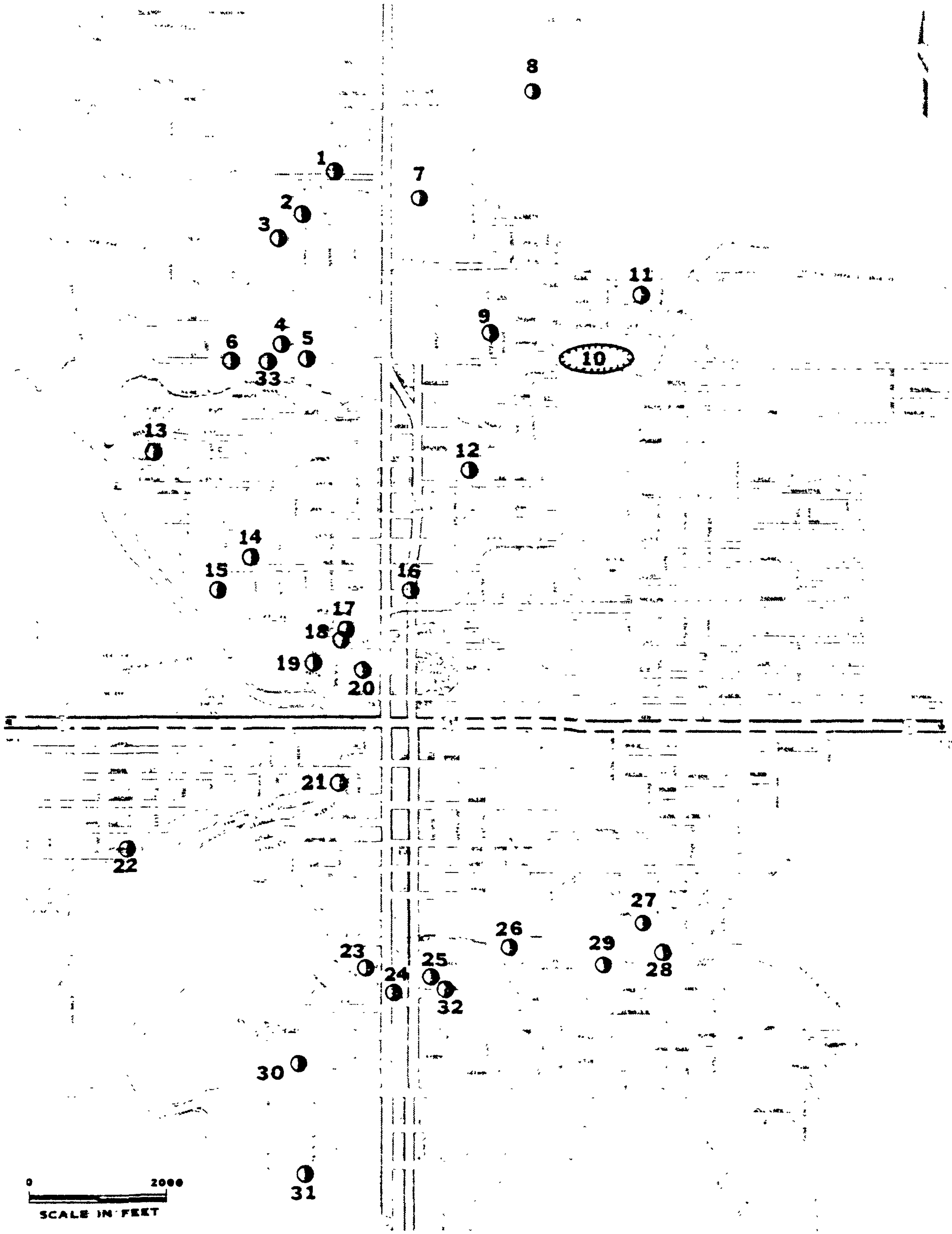


Figure B-17. Location of documented ground subsidence in the Streator, Illinois, area.

Table B-5. Areas of documented mine subsidence.

Map Location Number (Figure 17)	Location	Approximate Diameter (feet)	Approximate Depth (feet)	Date	Occurrence	Estimated Subsurface Conditions (feet)
1	Golf Lane & Heenan Street	35	50-60	Fall, 1974	Rapid subsidence with at least 10' of water in bottom. Backfilled with 3 automobiles, stoves, rubbish, brickbats, etc.	50 Glacial Drift 25 Roof Rock
2	Chicago Avenue, west of Burns St.	20	8	1975	Middle of street subsided; sewer sheared.	50 Glacial Drift 10 Roof Rock
3	French Street & Richards Street	3	5	1974	Front yard of house subsided; no utilities involved.	45 Glacial Drift 10 Roof Rock
4	Kelly Street, west side	6	15	1966	Backyard of house subsided several times.	20 Glacial Drift 10 Roof Rock
5	1st Street & Kelly Street	6	30	1960	Front yard of house subsided; water in bottom of hole observed flowing toward river.	20 Glacial Drift 10 Roof Rock
6	1st Street	Length of Street	1-2	Present	Length of street has rolling topography; road maintenance required.	15 Glacial Drift 10 Roof Rock
7	Anthony's Manufacturing Plant, N. Bloomington Ave.	20	15	1960±	Front parking lot subsided. Several mine-holes around plant have had to be sealed over the years due to presence of methane gas and gas fires under foundation of plant.	60 Glacial Drift 20 Roof Rock
8	Cornfield east of Golf Course	Small		Present	Entire cornfield has depressions that do not drain.	45 Glacial Drift 30 Roof Rock
9	Sterling Street, east side	8	10	Summer, 1974	One of a pair of trees subsided overnight after a heavy rain; sewer sheared.	40 Glacial Drift 20 Roof Rock
10	19th Street, north of Prairie Creek	1000	25	1920 ±	Old USGS map shows a lake known as "Cave Hole Pond".	40 Glacial Drift 30 Roof Rock
11	Walnut Street north	4	5		Backyard of house subsided.	55 Glacial Drift 30 Roof Drift

Table B-5. (continued).

Map Location Number (Figure 17)	Location	Approximate Diameter (feet)	Approximate Depth (feet)	Date	Occurrence	Estimated Subsurface Conditions (feet)
12	Vermilion Street, east side				One quarter of parking lot for GMC dealership subsided.	38 Glacial Drift 29 Roof Rock
13	Sylvan Lane at Ridge Road	2	3	December, 1977	Front yard of house subsided.	20 Glacial Drift 10 Roof Rock
14	Harrison Street & Morrell Street	10	30 (Conical Shaped)	1967	Sidewalk subsided.	30 Glacial Drift 10 Roof Rock
15	Football field beside Streator High School	20	30	Fall, 1976	Rapid subsidence in west end zone of football field; sewer sheared.	20 Glacial Drift 10 Roof Rock
16	Park Street at Lincoln Street	15	8	1974	Void under pavement at intersection of streets; discovered during excavation for gas line. Pavement was broken through with jackhammer and backfilled.	35 Glacial Drift 25 Roof Rock
17	Rush Street at Henderson Residence			1972 & 1977	Rapid subsidence in yard; backfilled with 75 tons of sand.	
18	Rush Street, SE corner	4	15	1965	Rapid subsidence at corner of foundation of house; house unharmed.	
19	Cedar Street, middle of block, south side	15	4-6	Winter, 1977 3 times earlier	Rapid subsidence; water line sheared.	20 Glacial Drift 15 Roof Rock
20	114 Elm Street north side	Length of street	1	3 different times over last 30 years	Differential sidewalk subsidence.	25 Glacial Drift 20 Roof Rock
21	Pleasant Street near Bridge Street	5		1963	Continuous raveling of soil over 30 day period; near backdoor of house.	20 Glacial Drift 20 Roof Rock
22	Reading Street	3	Conical		Inverted conical collapse; 5 truck loads of material were needed to backfill.	
23	F.X. Neuman Brick Yard & Leray Roofing			1975 to present	Settlement of building foundation near alley over sewer line. May not be due to mine subsidence.	16 Glacial Drift 15 Roof Rock

Table B-5. (concluded).

Map Location Number (Figure 17)	Location	Approximate Diameter (feet)	Approximate Depth (feet)	Date	Occurrence	Estimated Subsurface Conditions (feet)
24	Bloomington Street, east side, south of Coal Run	2			Gas escaping from minehole, caught fire, and had to be sealed.	10 Glacial Drift 20 Roof Rock
25	Monroe Street, west side, at Brumbach St.	15	12	1975	Corner of street subsided; no utilities involved.	15 Glacial Drift 20 Roof Rock
26	Oakland Park	General subsidence over 1 acre			Ground surface adjacent to school settled around large trees, resulting in poor drainage.	10 Glacial Drift 20 Roof Rock
27	Charles Street	60	20	1963	Subsidence across width of street from curb to curb.	10 Glacial Drift 30 Roof Rock
28	Powell & Charles, south side of intersection	50 in length	20	1966	Rapid subsidence of street; sewer line sheared.	20 Glacial Drift 30 Roof Rock
29	Illinois Street near Hall St.	200 by 15	3-4	1965 Summer	Sidewalk, yard, and street subsided; water lines sheared. 3 to 4 houses were jacked up and their basements were repaired.	20 Glacial Drift 30 Roof Rock
30	11th Steet, west end	5	6	1977 Summer	Rapid subsidence in front yard of house; sewer and water lines sheared.	20 Glacial Drift 20 Roof Rock
31	Hawthorne Road, west side	5-8	1		Yards in this area appeared to have subsided.	20 Glacial Drift 20 Roof Rock
32	South Monroe Street, east side	15	20	1948 ±	Portion of street corner collapsed.	15 Glacial Drift 20 Roof Rock
33	1st Street	15	20	1965 ±	Portion of street collapsed.	15 Glacial Drift 10 Roof Rock

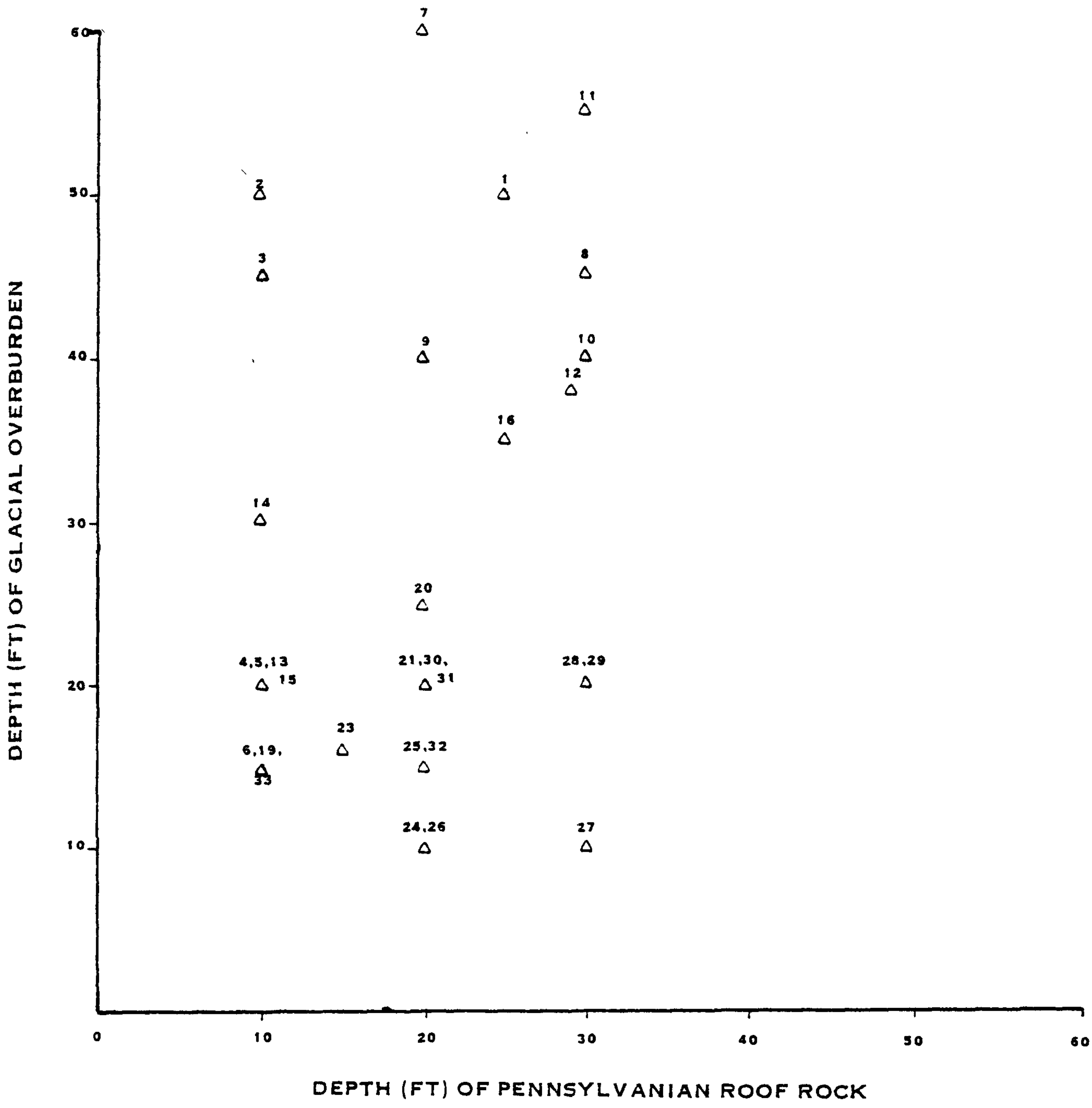


Figure B-18. Subsurface conditions of areas of known subsidence. Numbers refer to subsidence locations shown in Figure 17 and Table B-5.

lying strata can cause pillars to settle and/or result in a bearing capacity failure of the pillars.

Another possible cause for subsidence associated with the room and pillar method of mining is the deterioration of the pillars, roof, and floor with time. The net effect of water and chemical reaction with the different units is not well defined.

Hydrologic Factors

The existing water levels in the mines and overlying strata minimize the stress within the roof rock units. Lower water levels would increase the stress and thus would increase the load to be carried by the immediate roof, pillars, and floor.

If mine recharge were restricted to natural infiltration, only a small portion of the present amount of recharge would enter the mines (Section 2.3.3.). Declines in water levels of as much as 20 feet would be expected.

If sewage discharges to the mines were eliminated and only stormwater were allowed to enter the mines, the amount of recharge would not be sufficient to maintain the water levels during dry periods of the year. The Streator area can be quite dry in the summer months, which causes groundwater levels and river flow to drop significantly. A fluctuating water table would increase the danger of mine instability.

Mining Conditions

Subsidence usually occurs at the time of mining or shortly thereafter. Room and pillar mining generally causes more severe subsidence problems than the longwall method, because of the greater potential for differential movement. Subsidence associated with longwall mining generally occurs during mining operations and is usually in the form of large sags, which have a depth roughly three-quarters of the thickness of the coal seam. Subsidence associated with room and pillar mining is more isolated and depends primarily upon:

1. Coal Extraction Ratios

2. Dimensions of pillars

3. Sizes of rooms and roof spans

4. Strength of roof, coal, and floor.

The coal extraction ratio is the area of mined coal divided by the total area. Extraction ratios of typical mines in the Streator area, based on the Renz mine maps, ranged from 50% to 78% prior to any pillar drawing or robbing (Table B-4). Approximate room dimensions and pillar sizes also are presented in Table B-4.

The extent of pillar drawing during mining and the amount of subsequent pillar robbing are unknown. Pillar robbing in abandoned mines was prevalent in the 1930s, especially in southwest Streator south of the Vermilion River.

STABILITY EVALUATION

Stability Criteria

There are three general conditions that determine the stability of an underground room and pillar coal mine. These are: 1) the stability of the roof; 2) the stability of the pillars; and 3) floor deformation. The latter may involve either settlement of a pillar and/or bearing capacity failure of a pillar with associated lateral or upward movement of the floor. If the immediate roof is unstable, the other conditions are of relatively little significance. Where the roof is marginally stable, deformation of the pillars and/or floor can affect adversely the roof rock.

Existing Conditions

In general, data derived in this study of the Streator area indicate that the roof is marginally stable to unstable. This is based on measured properties of the roof rocks, stability computations involving simple beam theory, and correlation with documented subsidence areas. Factors of safety of less than 1.0 were computed for several cases using existing subsurface conditions. Examination of the rock core from the roof revealed primarily soft shale or siltstone and an absence of any competent layer or zone that would retard progressive roof failure.

The stability of the pillars with respect to crushing can only be estimated. Intact samples could not be obtained for testing, and examination of the pillars to determine the effects of joints and chemical deterioration in the coal mass is not physically possible because of the flooded condition in the mines. However, based on the pillar dimensions obtained from study of mine maps, it is likely that some pillar yielding and crushing has occurred.

In general, the floor of the mines consists of shale and no thick plastic underclay immediately underlying the pillars. Underclays, however, were encountered within a few feet below the base of the pillars in several of the borings. The strength of the shale samples is relatively low, indicating that softening has occurred over the more than 50 years since the mines were inundated.

Impact of Lower Mine Water Levels

Lower water levels in the mines, resulting from restricted discharge to the mines, would increase stress within the roof rock units. The computed factors of safety for roof stability were reduced by approximately 25%. Induced stress associated with lower water levels also could be expected to initiate settlement or bearing capacity failures of the pillars and floor.

CONCLUSIONS

1. The abandoned mines are flooded, and the present wastewater/stormwater disposal practices are responsible for the elevated water levels in the mines.

2. Conditions conducive to subsidence exist in the Streator area. The most susceptible areas are those where thin roof rock and/or thin glacial overburden exist. Although the only evidence of subsidence in the Kangley area are a few depressions in a lawn, poor quality and thin sections of roof rock make this area also susceptible to subsidence.

3. Recent ground subsidence has occurred and probably will continue based on present conditions.

4. In the northwest part of Streator, weak and thin roof rock material indicates areas particularly susceptible to future subsidence.

5. Areas in the central and eastern part of Streator may be less sensitive to changes in mine water levels. These are areas of substantial roof rock thickness. The mines there also are lower topographically, and thus, the water levels in the mines would tend to fluctuate less.

6. Significant lowering of the existing water levels would increase stresses in the roof, pillars, and floor and, therefore, would increase the potential for subsidence. There is no "safe" level at which mine water should be maintained. Fluctuation in water levels must be minimized. Inundated mines should never be allowed to drain, because air entering the mines would cause drying and subsequent deterioration of the pillars and any wooden roof support system.

7. Lowering existing water levels can be prevented by maintaining recharge equal to the present sanitary and industrial inflows to the mines. Additional discharges will have to make up for flows diverted from the mines. Recharge will have to be regulated carefully to maintain stable levels.

8. There are areas where recharge is not needed and where present discharges may be eliminated:

   a. No recharge is needed in unmined areas.

   b. No recharge may be needed in mines immediately adjacent to discharge (leachate) areas.

9. Elimination of discharges to the abandoned mines would not eliminate totally leachate discharges to the Vermilion River, because natural infiltration to the mines would continue. The leachate quantity, however, would be considerably less. The mines would never completely drain naturally. Drainage is a function of floor elevation and natural seepage. Because of the general eastward dip of the coal away from the discharge points along the river and the sometimes severe rolling of the coal, pumping would be necessary to dewater the mines.

APPENDIX C. WATER QUALITY INVESTIGATIONS IN THE STREATOR, ILLINOIS, FPA

INTRODUCTION

The segment of the Vermilion River in the Streator FPA receives pollutant loads from several sources in addition to the sewage treatment plant (STP) (Section 3.3.1.3). Pollutant sources include mine leachates, stormwater runoff, combined sewer overflows, and flows from broken or cracked sewer lines.

Much of the stormwater runoff, combined sewer overflows, and flows from damaged sewer lines enter the Vermilion River via Coal Run and Prairie Creek. These two tributaries drain most of the Streator urban area, and major sewer interceptors are located along their banks.

Leachates originate from the abandoned coal mines beneath Streator that receive domestic and industrial wastewaters and combined sewer overflows. It appears that leachates enter the Vermilion River directly or via Prairie Creek. Leachate points discharging to the Vermilion River were located by WAPORA, Inc., during a field inspection on 7 September 1977. The river flow was low at the time (320 cfs near Leonore, Illinois). Discharges were identified as mine leachates by the red stained areas (caused by ferric compounds) along the river bank at the point of seepage. Most of the sites are within the river channel and are under water during high river flows. Points at which leachates discharge to the Vermilion River are shown in Figure C-1 and are described in Table C-1.

IEPA INVESTIGATION, 1974

IEPA conducted a detailed sampling program on the river near Streator on 24 October 1974 during preparation of the draft Facilities Plan. This was a study to determine how mine leachates affect water quality in the Vermilion River. Single, grab samples were collected at different leachate sites and at various points along the Vermilion River and its tributaries. Six out of the 14 sampling locations were along the Vermilion (Figure C-2). Table C-2 presents the results of the analyses (on the significant water quality parameters) for those Vermilion River samples. The river flow during the study was 20 cfs, which was near the minimum flow of 16 cfs recorded during the 1974-1975 water year. This low flow condition did not allow for much dilution of pollutant loads, and thus, water quality impacts could be detected for this critical stream condition. Results from Station 7M reflect water quality conditions at the dam. Although the data do not represent true upstream river conditions due to the effects of the impoundment, the data represent background conditions necessary to detect downstream changes in river water quality.

The data from Station 11M indicate that there were significant changes in water quality within less than 1.0 miles downstream from Station 7M. However, no significant pollutant sources, including mine leachates, have been identified within that segment of the river. The fecal coliform count at Station 11M violated the State standard of 200/ml. Iron and ammonia-nitrogen concentrations also increased, although neither violated standards. The concentration of total phosphorus (17 mg/l) was extremely high for a river sample. Raw sewage has an average concentration of about 10 mg/l total phosphorus (US-EPA 1976c). Therefore, the high concentration reported cannot be indicative of average conditions and may be the result of a sampling, analytical, or reporting error.

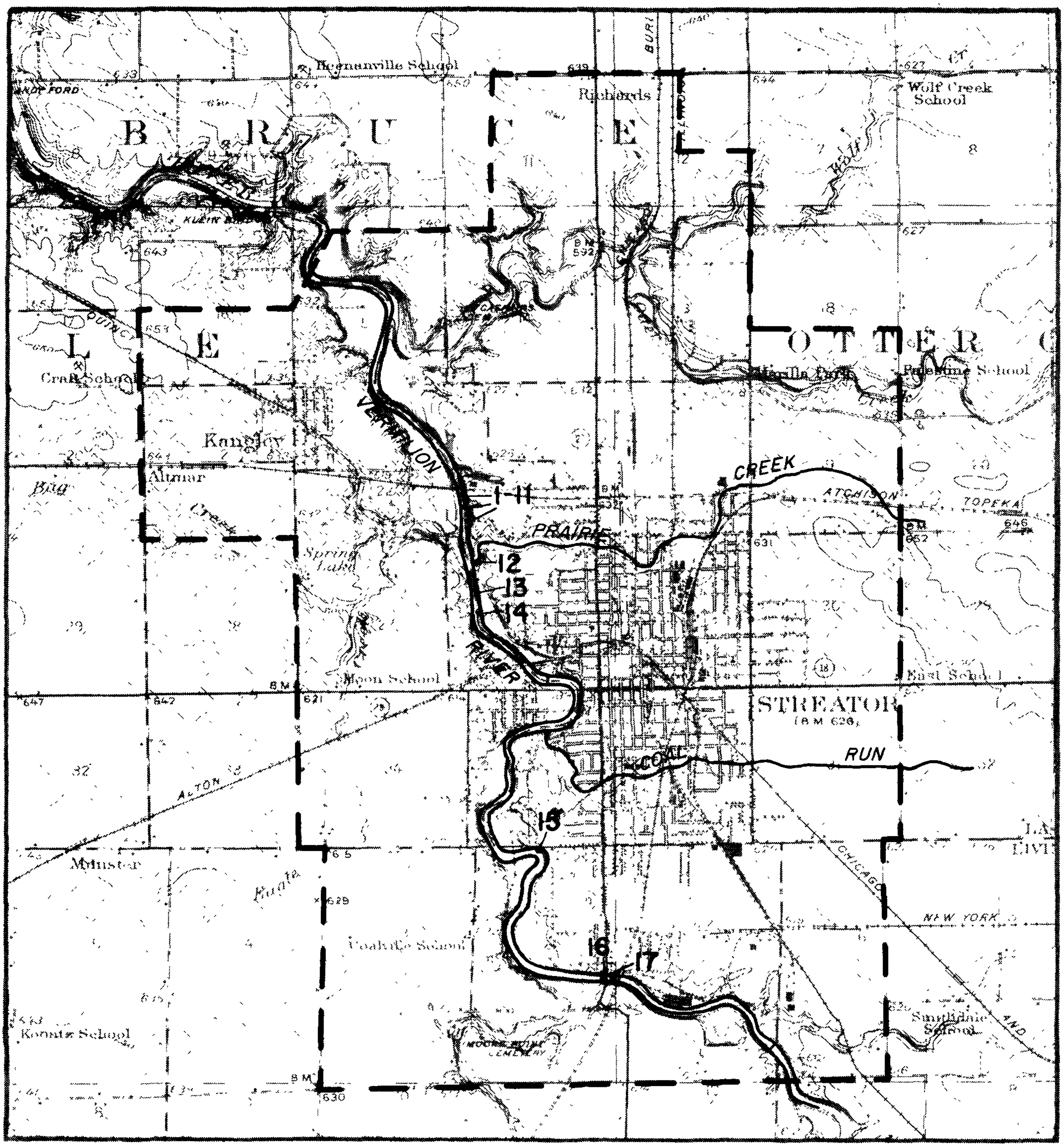


Figure C-1. Location of mine leachates discharging to the Vermilion River in the Streator, Illinois, FPA on 7 September 1977.

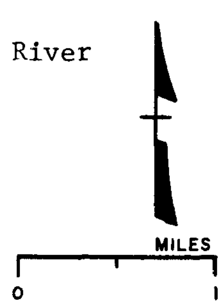
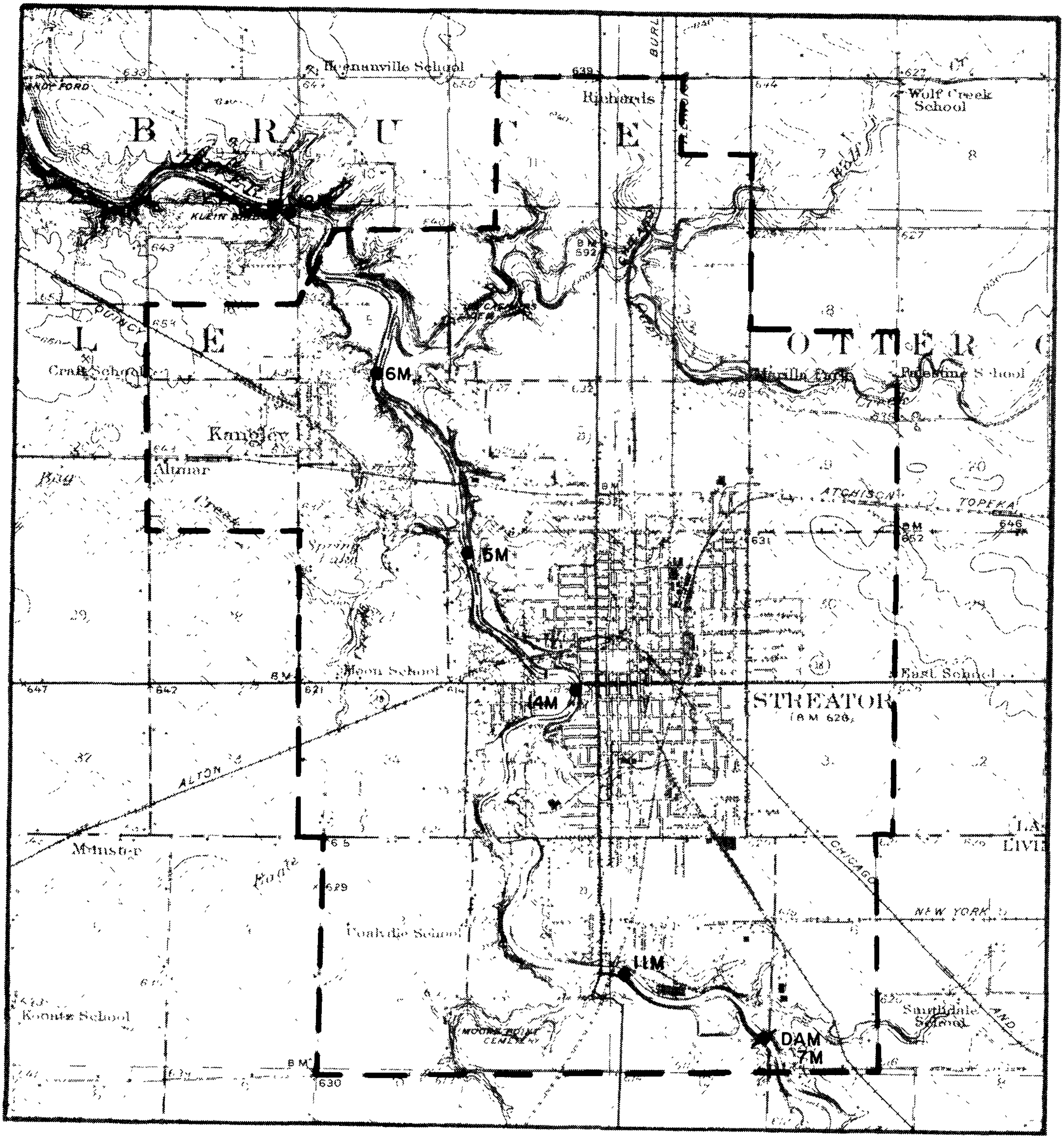


Table C-1. Locations at which mine leachates discharge to the Vermilion River in the Streator, Illinois, FPA. Leachate sites were located during field investigation conducted on 7 September 1977.

Location	Description
1-11	On the east bank of the Vermilion River between Egg Bag Creek and Prairie Creek. Individual discharges were small but larger than trickles.
12	Discharges into Prairie Creek approximately 50 feet upstream from its confluence with the Vermilion River. Leachate flow originates approximately 200 feet from the creek. Several small seepage points contribute to the flow in the main leachate channel. The channel supports massive algal, bacterial, and fungal growths and is malodorous. The flow near Prairie Creek was large.
13	Upstream from Prairie Creek, approximately 50 feet downstream from the STP discharge. Leachate volume was small.
14	Upstream from the STP outfall, directly under the high tension lines at the south end of the STP property. The leachate discharge was small.
15	At the southern border of Streator and La Salle County, at the west end of 12th Street. The discharge was not small but not nearly as large as the discharge at 12.
16 and 17	Located close together, in Livingston County just upstream from the Highway 23 bridge.



■ IEPA water quality sampling station

● IEPA 1974 special study sampling station

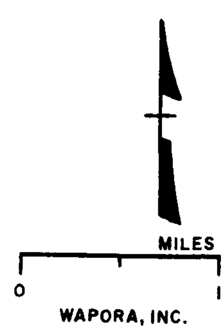


Figure C-2. IEPA water quality sampling locations in the Streator, Illinois, FPA.

Table C-2. Summary of water quality data obtained at sites in the Streator FPA (Adapted from IEPA Special Analysis 1974). Values in excess of the current State water quality standards are marked with an asterisk (*).

Sample Designation (listed from upstream to downstream)	DO (mg/l)	pH	Fecal Coliforms (#/100ml)	Cu (mg/l)	Fe (mg/l)	NH_3-N (mg/l)	Total P (mg/l)
7M	7.7	8.1	50	0.01	0.3	0.1	0.20
11M	7.1	7.5	4,200*	0.00	0.9	0.7	17.
14M	9.1	7.8	5,700*	0.00	1.0	0.7	7.4
5M	5.8	7.6	300,000*	0.01	1.3*	3.3*	3.7
6M	4.4*	7.6	17,900*	0.01	0.7	2.9*	3.5
12M	8.2	7.8	7,400*	0.00	1.1*	1.4	3.6

Station 14M is located approximately 3.5 river-miles downstream from Station 7M. A few small leachate flows discharge into the Vermilion River between the two sampling locations. Other pollutant sources include urban runoff and the flow from Coal Run that receives raw sewage from sewer overflows and a broken interceptor. This raw sewage probably caused the fecal coliform count increase at this station. Other constituents indicative of increased wasteloads did not increase. The DO concentration was higher than at the previous station. The ammonia level remained constant, and the phosphorus concentration decreased to 7.4 mg/l.

The water quality conditions at Station 5M show a considerable change from conditions measured at Station 14M. The data appear to reflect the impacts of the effluent from the Streator STP, which is located approximately 0.5 miles upstream from the station. Concentrations of fecal coliforms and ammonia-nitrogen (principal pollutants discharged) increased, and the DO concentration decreased as a result of the discharge of oxygen consuming matter. State water quality standards for fecal coliforms, iron, and ammonia-nitrogen also were violated. However, the treatment plant is not the only pollutant source upstream from Station 5M. Some mine leachate points occur along the Vermilion downstream from Station 14M and several significant leachate flows discharge into Prairie Creek, which joins the Vermilion upstream from Station 5M. Urban runoff and combined sewer overflows along the Kent Street and Prairie Creek interceptors also contribute pollutant loads to the river.

The data in Table C-2 for Station 6M, like data for Station 5M, reflect poor water quality conditions and probably also indicate effects of upstream pollutant loads. The low DO concentration of 4.4 mg/l indicates that the point of maximum oxygen utilization in the decomposition of organic matter probably is located downstream from Station 5M and near Station 6M. The State standards for DO, fecal coliform, and ammonia-nitrogen were violated at this point.

Station 12M is about 3.0 miles downstream from Station 5M and about 1.5 miles downstream from Station 6M, located at Klein Bridge (the location of Illinois Water Quality Station DS-05). The water quality data reviewed for this station indicate that the Vermilion River is recovering by this point from the impacts of the various wasteloads. DO concentration increased from 4.4 mg/l at Station 6M to 8.2 mg/l at Station 12M. Concentrations of fecal coliform and ammonia-nitrogen decreased from those concentrations at Station 6M. The fecal coliform level, however, still violated the State standard. The contribution of relatively sewage-free flow from Otter Creek, the largest tributary in the Streator FPA, could have improved water quality in the Vermillion River by diluting the water in the main stem.

WAPORA INVESTIGATIONS, 1977

Field investigations conducted by WAPORA, Inc., were designed to determine the chemical characteristics of the mine leachates and to determine if leachates have an adverse impact on water quality of the Vermilion River. Water quality impacts would dictate the types of wastewater management alternatives that need to be developed.

Sampling excursions were conducted on 3 October 1977 and on 19 December 1977. During both excursions, flow in the Vermilion River was high. The flow near Leonore was 6,330 cfs on 3 October 1977 and 5,480 on 19 December 1977. Only two of the leachate sites located on 7 September 1977 (#12 and #14, Figure C-1) could be sampled. All other sites were under water. Additional leachate sites, however, were located along Prairie Creek and sampled. Leachates along Prairie Creek are discharged from the hillside where mining occurred. The leachate sites are situated high enough above the stream channel that high stream flows would not cover the seepage points. No leachate sites were located along Coal Run. The floodplain of the stream is broad and the hydrologic gradient of the mines trends away from Coal Run (Appendix B). Stream and leachate sampling sites are shown in Figure C-3 and are described in Table C-3. Samples of the Vermilion were taken along the east bank and not at mid-stream, because the river flow was too high and fast. Results of water quality analyses are presented in Tables C-4 and C-5.

Leachates that were sampled appear to originate from one mine, the Chicago, Wilmington, and Vermilion "Old" No. 1. This mine is the largest in the area (Appendix B) and must receive considerable flows from residences, industries, commercial establishments, and combined sewer overflows. Several physical, chemical, and biological processes occur in the water-filled mine and alter the characteristics of leachates. These processes include sedimentation of suspended solids, dissolution of minerals in the geologic formation, chemical and biological decomposition of organic matter, and bacterial die-off. The rates of these processes depend on the chemical and biological characteristics of the waters, the physical characteristics of the mine, including the surface area in contact with the water, the hydrologic gradient, and retention time. Filtration between the mine and points of seepage also alter the water quality of leachates.

The chemical characteristics of leachates indicate that the water undergoes a high level of treatment in the mine (Tables C-4 and C-5). The leachates were very clear and their BOD_5 was low, indicating that there is some sedimentation, filtration, and decomposition of organic matter. Ammonia concentrations and fecal coliform counts, however, were high, confirming domestic wastewater contributions to the mine. The leachates were also malodorous. The odors are due to sulfides, indicating that the dissolved oxygen in the mine waters may be quite low, lower than the concentrations at the leachate sampling sites. The high ammonia and low nitrate concentrations further attest to the reducing environment of the mine.

The leachates had high alkalinity and hardness levels and had a neutral pH, ranging between 6.8 and 7.3. In the mine, carbonic acid is formed by solution of carbon dioxide in water and causes the dissolution of minerals in the formation. Carbonate minerals in solution then buffer the pH. Because a reducing environment is indicated, the pH should not be lowered significantly by the oxidation of pyrite (FeS_2). Iron concentrations in the leachates were high, indicating that there may be other sources of iron.

Leachates from the mines appear to affect water quality in Prairie Creek. Prairie Creek, however, exhibited degraded waters upstream from the leachate sampling stations. The fecal coliform count and the chemical oxygen demand were greater at sampling location F than at any of the leachate sampling

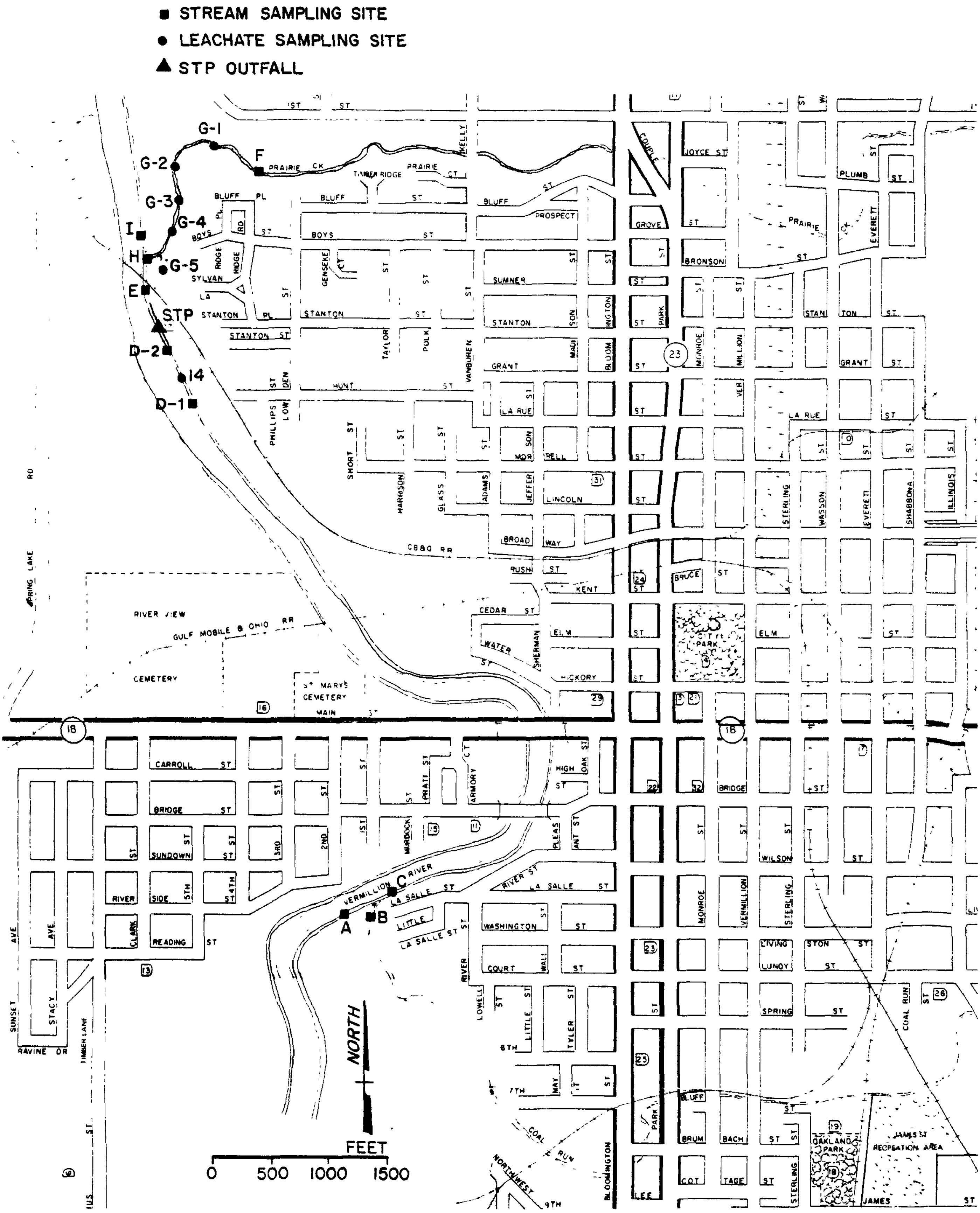


Figure C-3. Location of stream, leachate, and STP outfall sampling sites in the Streator, Illinois, FPA. Sampling was conducted on 3 October 1977 and 19 December 1977.

Table C-3. Stream, leachate, and STP outfall sampling sites in the Streator, Illinois, FPA. Sampling was conducted on 3 October 1977 and 19 December 1977.

Location	Description
A	On the Vermilion River approximately 140 feet upstream from the Coal Run confluence.
B	On Coal Run approximately 150 feet upstream from its confluence with the Vermilion River.
C	On the Vermilion River approximately 300 feet downstream from the Coal Run confluence.
D-1	On the Vermilion River at the south end of the STP property, upstream from mine discharge #14.
14	Mine leachate discharging into the Vermilion River from the river bank upstream from the STP outfall, directly under the high tension lines at the south end of the STP property. Flow was larger than observed on 7 September 1977.
D-2	On the Vermilion River downstream from mine discharge #14, approximately 150 feet upstream from the STP outfall.
STP	Approximately 300 feet upstream from Prairie Creek. The outfall pipe was under water during both sampling visits.
E	On the Vermilion River between the STP outfall and the Prairie Creek confluence at the CB&Q RR bridge.
F	On Prairie Creek approximately 100 feet upstream from G-1.
G-1	Discharge into Prairie Creek farthest upstream. The flow in the channel comes from a large, gently sloping area where there are several seepage points.
G-2, G-3, G-4	Discharges to Prairie Creek originating from the side of a steep hill. The flows are large and malodorous. The channels are red stained (from ferric compounds) and support large algal, bacterial, and fungal growths.
G-5	Mine leachate channel at the source and approximately 60 feet upstream from where flows enter Prairie Creek. (Table C-1, #12).
H	On Prairie Creek approximately 25 feet upstream from its confluence with the Vermilion River. Because of the high flow in the Vermilion River, flows from the Vermilion River and Prairie Creek were mixing.
I	On the Vermilion River approximately 300 feet downstream from the Prairie Creek confluence.

Table C-4. Results of analyses of leachate samples taken on 3 October 1977. Sampling locations are depicted in Figure C-3 and are described in Table C-3. All values in mg/l unless otherwise noted.

	Sampling Location										
Constituent	D-1	14	G-1	G-2	G-3	G-4	G-5[a]	G-5[b]	H	I	Illinois Stream Water Quality Standard
Fecal Coliform (#/100 ml)	600	20	1,917	440	600	1,800	640	1,320	2,560	2,200	200
BOD_5	<1	1	1	3	2	<1	3	3	<1	1	
COD	59.4	11.8	11.7	19.4	19.4	23.3	11.7	31.1	19.4	38.9	
Ammonia-N	0.2	2.1	2.7	3.0	3.0	3.3	3.5	3.1	0.6	0.3	1.5
TKN	1.79	2.10	2.91	3.25	3.02	3.25	3.02	2.91	1.00	1.6	
Nitrate-N	1.42	0.05	0.13	0.05	<0.05	<0.05	<0.05	<0.05	1.19	1.42	
Total Phosphate as P	0.98	0.32	0.11	0.25	0.25	0.36	0.34	0.29	0.08	0.49	
Total Dissolved Solids	281	994	769	779	798	783	805	776	451	664	1,000
Alkalinity as $CaCO_3$	146	376	358	372	364	360	367	358	255	169	
Total Hardness as $CaCO_3$	231	645	487	478	481	474	475	475	386	260	
Calcium	61	80	110	110	110	110	100	190	110	73	
Chloride	13.9	102	111	112	113	107	102	103	45.7	19.4	500
Fluoride	0.47	0.43	0.61	0.61	0.62	0.68	0.62	0.66	0.36	0.32	
Sodium	6	97	105	108	106	106	103	107	28	10	
Sulfate	43.0	310	150	160	174	58	162	158	91	50	500

Table C-4. (concluded).

Constituent	Sampling Location D-1	14	G-1	G-2	G-3	G-4	G-5[a]	G-5[b]	H	I	Illinois Stream Water Quality Standard
Chromium	0.007	0.016	0.008	0.009	0.010	0.011	0.009	0.008	0.005	0.007	
Copper	0.015	0.019	0.014	0.008	0.018	0.015	0.018	0.014	0.012	0.014	0.02
Iron	1.84	8.24	1.08	2.19	2.55	3.11	3.30	3.24	0.74	1.58	1.0
Lead	0.011	0.013	0.012	0.010	0.010	0.010	0.011	0.010	0.010	0.010	0.1
Manganese	0.17	0.85	0.32	0.34	0.29	0.28	0.33	0.33	0.09	0.14	1.0
Mercury	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	
Zinc	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	1.0
Pesticides and PCBs	UD	UD	UD	UD	UD	UD	UD	UD	UD	UD	
Temperature (°C)	14.7	14.7	20.0	14.4	13.3	14.4	15.6	15.6	15.0	14.4	
pH	7.0	6.8	6.8	7.3	7.2	7.2	6.8	6.8	6.9	6.9	

a Sample taken at source.

b Sample taken 60 feet upstream from Prairie Creek.

UD Undetectable.

Table C-5. Results of analyses of leachate samples taken on 19 December 1977. Sampling locations are depicted in Figure C-3 and are described in Table C-3. All values in mg/l unless otherwise noted.

Constituent	Sampling Location A	B	C	14	D-2	STP	E	F	G-1	G-2	G-3	G-4	G-5	H	I	Illinois Stream Water Quality Standard
Fecal Coliform (#/100 ml)	1,500	14,400	2,400	800	1,000	2,300	2,000	3,000	580	290	190	330	2,200	8,200	1,500	200
BOD_5	4	4	4	2	6	11	5	3	5	3	3	2	4	3	6	
COD	18	22	18	18	59	79	63	118	22	14	14	7	71	18	36	
Ammonia-N	0.1	1.1	0.2	2.4	0.1	6.2	0.2	0.6	2.4	0.7	3.0	3.0	2.4	2.0	0.2	1.5
TKN	1.5	1.9	1.5	2.5	1.6	7.2	1.7	0.8	2.7	2.9	2.9	3.4	3.4	2.0	1.8	
Nitrate-N	0.78	0.86	0.90	0.03	1.2	0.40	1.9	1.4	0.09	0.04	0.03	0.03	0.05	0.66	0.97	
Total Phosphate as P	0.29	0.46	0.33	0.28	1.17	1.48	0.73	0.17	0.14	0.23	0.32	0.36	0.30	0.24	0.71	
Total Suspended Solids	143	94	133	19	170	6	184	10	8	4	8	11	6	9	169	
Total Dissolved Solids	287	373	313	1,263	265	717	281	442	765	750	754	751	721	620	285	1,000
Alkal nity as $CaCO_3$	152	188	155	384	151	317	153	218	377	372	372	373	372	322	153	
Total Hardness as $CaCO_3$	244	296	250	581	232	492	244	362	448	448	447	440	440	402	249	
Calcium	53	66	53	51	122	110	53	74	103	104	102	99	94	84	52	
Chloride	24.0	34.0	22.0	20.5	110	122	23.0	21.0	39.5	88.0	83.5	107	95.7	52.0	23.0	500

Table C-5. (concluded).

Constituent	Sampling Location A	B	C	14	D-2	STP	E	F	G-1	G-2	G-3	G-4	G-5	H	I	Illinois Stream Water Quality Standard
Sodium	6	14	6	96	6	65	6	18	109	105	103	102	99	48	7	
Sulfate	52	78	56	127	62	98	55	61	97	72	102	108	90	93	58	500
Arsenic	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	1.0
Cadmium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.05
Chromium	0.013	0.018	0.018	0.004	0.016	0.003	0.013	0.004	0.003	0.004	0.003	0.003	0.003	0.003	0.016	
Copper	0.005	0.008	0.005	0.005	0.009	0.005	0.011	0.005	0.004	0.004	0.003	0.009	0.003	0.004	0.010	0.02
Iron	6.1	5.0	5.0	6.3	5.1	1.0	5.2	1.5	3.2	3.7	3.6	3.6	4.9	3.1	5.6	1.0
Lead	0.015	0.007	0.009	0.015	0.018	0.014	0.014	0.016	0.008	0.007	0.018	0.014	0.018	0.009	0.018	0.1
Manganese	0.22	0.20	0.21	1.23	0.20	0.24	0.28	0.12	0.22	0.37	0.31	0.26	0.46	0.21	0.26	1.0
Zinc	0.012	0.009	0.012	0.003	0.012	0.007	0.013	0.008	0.003	0.002	0.002	0.002	0.003	0.006	0.013	1.0
Water Temp. (°C)	3.3	4.3	3.5	10.5	3.0	10.0	3.8	4.9	8.9	12.0	13.1	14.0	13.0	6.9	3.0	
pH								7.1	6.9	6.9	6.8	6.8	7.1	6.8	7.4	
DO	8.2	7.7	8.1	4.3	8.5	7.1	9.6	9.2	7.2	6.7	5.3	4.8	5.5	7.0	8.2	5

locations (Figure C-3). The nitrate concentration was high, and the iron concentration exceeded the Illinois stream water quality standard. Leachates, however, contained higher concentrations of ammonia, total dissolved solids, and iron. Leachates also had higher alkalinity and hardness levels and lower dissolved oxygen concentrations. Downstream from the leachate discharges, at sampling location H, the BOD_5 level was the same as at location F, but fecal coliform counts, ammonia, and iron concentrations were higher. Because the distance between sampling locations F and H is less than 0.25 mile, the water quality degradation most probably was attributable to the mine leachates and not to other pollutant sources.

Leachates do not appear to have an adverse impact on the water quality of the Vermilion River (Tables C-4, C-5). Constituent concentrations downstream from the STP and downstream from Prairie Creek, between river sampling locations E and I, did not differ significantly. Impacts attributable to leachates along Prairie Creek, however, are difficult to differentiate, because pollutant loads from the STP enter the Vermilion River less than 0.25 mile upstream from the Prairie Creek confluence. Impacts at river sampling location H could be caused by loads from the STP and/or from leachates entering Prairie Creek.

Impacts from leachate pollutant loads may be greater when flows in the Vermilion River are low. There would be less flow available for dilution. Loads from leachate sites, however, may not be as large during low flow periods when no stormwater enters the mines. Leachate flows observed at locations 12 and 14 on 3 October 1977 and on 19 December 1977 (those sites discharging to the Vermilion River that were not under water) appeared to be larger than flows observed on 7 September 1977.

Pollutant loads of certain constituents from the Prairie Creek leachate sites (G-1 through G-5) and in Prairie Creek upstream from these sites (F) were calculated and are presented in Table C-6. Some of these combined loads were substantial, and if leachate flows and concentrations are anywhere as high when flows in the river are low as when flows are high, the impacts could be significant. The BOD_5 load from the leachate sites along Prairie Creek was calculated to be 188 lbs/day, and the BOD_5 load in Prairie Creek upstream (location F) was calculated to be 236 lbs/day. The total BOD_5 load to the Vermilion River from Prairie Creek, therefore, was approximately 424 lbs /day. The BOD_5 load from the STP during the period from July 1976 to June 1977 was 218 lbs/day, at 14.5 mg/1. It must be realized, however. that the BOD_5 load in the Vermilion River at sampling location A was approximately 118,149 lbs during 3 October 1977, substituting the flow near Leonore for the flow at Streator.

Pollutant loads from the STP and Coal Run appear to have little impact on the water quality of the Vermilion River (Table C-5). Pollutant loads from these sources may have a more significant impact when flows in the river are low. At the time of sampling, the water quality of Coal Run was poor, particularly because of the high fecal coliform count and the high iron concentration. The iron may enter the stream via leachates, although no leachate discharge points were located. A major source of pollutants must be the broken interceptor along the streambank downstream from Highway 23. Flow from the interceptor was observed entering the creek. The odor at this location was very strong.

Table C-6. Pollutant loads in mine leachates along Prairie Creek and upstream in Prairie Creek. Loads were calculated from concentrations and flows measured on 19 December 1977 and are expressed as lbs/day.

	Sampling Location							
	G-1	G-2	G-3	G-4	G-5	Subtotal	F	Total
Flow (cfs)	3.9	0.9	1.0	3.7	0.8		14.6	
Constituent								
BOD_5	105	14	16	40	13	188	236	424
Ammonia-N	51	3.3	16	60	8.7	139	47	186
Nitrate-N	1.9	0.2	0.2	0.6	2.9	5.8	110	116
Total Phosphate as P	2.9	1.1	1.7	7.2	1.1	14	13	27
Total Dissolved Solids	16,096	3,563	4,067	14,907	2,928	41,561	34,808	76,369
Chloride	831	418	450	2,124	227	4,050	1,654	5,704
Sulfate	2,041	342	550	2,144	406	5,483	4,804	10,287
Iron	67	18	19	71	14	189	118	307

The impact of pollutant loads entering the Vermilion River between river sampling locations A and I appears negligible. Water quality upstream from Coal Run and downstream from Prairie Creek was similar. The fecal coliform count and the iron concentration were particularly high at both locations.

APPENDIX D. PRELIMINARY COST ESTIMATES OF SYSTEM ALTERNATIVES

COST METHODOLOGY

1.) Costs for the sanitary sewer system were determined from the draft Facilities Plan (Warren & Van Praag, Inc. 1975). The layout of the system outlined in the Plan was used. Costs were recalculated to reflect pipe sizes for a zero-population growth projection. The costs for the sewer system evaluation survey and for rehabilitation of the existing combined sewer system also were used. Costs to minimize subsidence damage to the collection system, including costs for slight changes in interceptor routes, light-weight sewer pipes, flexible joints, timber cradles, and concrete supports (Section 5.2.2.1.) are not included.

2.) Costs for the mine recharge system were derived from the draft Facilities Plan, including costs for storm sewers in presently sewered areas, the drilling of additional mineholes, and the effluent recharge system. The cost of the effluent recharge system would not be greater for alternatives including expansion of the sewer service area because the proposed system would discharge effluent to the mines in both presently sewered and unsewered areas for all alternatives.

3.) Capital costs include additions, replacements, and/or modifications to the existing collection system and treatment facilities. The costs are only for liquid handling. Solids handling and disposal costs are not included.

4.) Costs for materials, construction, and operation and maintenance were updated to January 1978 price levels. Capital costs for treatment units and sewers were based on US-EPA indexes for Chicago of 292.2 and 318.5, respectively. The Engineering News Record Index for Chicago of 2,786.82 also was used.

5.) Costs for flow equalization were determined for units sized to 20% of the average design flow (2.0 mgd and 2.6 mgd).

6.) Costs for miscellaneous construction and equipment, and improvements at the treatment plant were determined by Clark, Dietz & Associates - Engineers, Inc., after inspection of the facilities (Draft EIS, Appendix F).

7.) Costs for site work, and electrical and piping costs were estimated to be 10% of the capital costs for treatment facilities.

8.) Salvage value was determined using straight-line depreciation for a planning period of 20 years. The service life of land was considered permanent. The service life of structures, including buildings, concrete process units, conveyance pipelines, etc., was assumed to be 40 years. The service life of process equipment, such as clarifier mechanisms, standby generators, etc., was assumed to be 20 years. The service life of auxiliary equipment, including instruments and control facilities, sewage pumps and electric motors, mechanical equipment such as compressors, aeration system, chlorinators, etc., was assumed to be 15 years and was given a zero salvage value for the 20-year planning period.

9.) Present worth of salvage value, operation and maintenance costs, and average annual equivalent costs were determined for 20 years using a discount rate of 6.625%.

10.) Present worth of salvage costs were determined using a single payment present worth factor of 0.2772 (salvage value X 0.277 = present worth of salvage).

11.) Present worth of O&M costs were determined using a uniform original payment series factor of 10.91 (average annual O&M cost X 10.91 = present worth of O&M).

12.) Average annual equivalent costs were determined using a capital recovery factor of 0.0917 (total present worth X 0.0917 = salvage annual equivalent cost).

Alternative 1a.

A. Collection System

Separate sanitary sewers in presently sewered and unsewered areas.

New Sanitary Sewers in Service Area

Pipe Size	Linear Feet	Cost $ (x 1,000) Capital	Salvage	O&M
8"	262,840'	11,302.0	5,651.0	13.7
10"	171,540'	824.0	412.0	1.1
12"	7,500'	442.5	221.3	.5
15"	9,000'	657.0	329.0	.6
18"	16,400'	1,541.6	770.5	15.4
	Subtotal	14,767.1	7,383.8	31.3

New Sanitary Sewers in Unsewered Areas

Pipe Size	Linear Feet	Capital	Salvage	O&M
8"	138,280'	5,946.0	2,973.0	7.2
10"	11,320'	532.0	266.0	.7
12"	6,000'	354.0	177.0	.4
15"	4,800'	350.4	175.2	.4
18"	1,600'	150.4	75.1	.2
21"	7,200'	849.6	424.8	.7
	Subtotal	8,182.4	4,091.0	9.6

B. Treatment Method

Tertiary treatment with expanded (2.6 mgd) plant capacity.

	Capital	Salvage	O&M
Preliminary Treatment (Existing)			15.1
Flow Equalization	418.5	209.3	2.9
Primary Treatment	160.0	80.0	13.0
Activated Sludge & Nitrification	536.0	134.0	85.0
Secondary Clarifiers	217.0	62.3	20.6
Chemical Treatment	25.0		48.4
Multi-media Filters	593.8	296.9	63.9
Chlorination	94.8	33.6	20.6
Misc. Construction & Equipment	20.0		
Site Work, Electrical & Piping	206.5		
Improvements	209.0		
Subtotal	2,480.6	816.1	269.5

Alternative la.

C. Recharge System

Mine discharge from old sewers and storm sewers in presently sewered area, and effluent recharge during dry-weather periods.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Storm Sewers in Service Area	3,437.2	1,718.6	111.7
Effluent Recharge System	1,077.7	538.9	16.6
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost	29,945.0	14,548.4	438.7
Service Factor (1.27; engineering, administration, and contingencies)			
Total	38,030.1		
Present Worth of Salvage Value	-4,032.8		
Net Capital Cost	33,997.3		

E. Total Present Worth 38,783.5

F. Average Annual Equivalent Cost 3,556.4

Alternative 1b.

A. Collection System

Separate sanitary sewers in presently sewered area.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	14,767.1	7,383.8	31.3

B. Treatment Method

Tertiary treatment with existing (2.0 mgd) plant capacity.

	Capital	Salvage	O&M
Existing Treatment			103.2
Flow Equalization	336.0	124.5	2.6
Nitrification	442.5	110.6	34.0
Chemical Treatment	23.0	--	38.7
Multi-media Filters	524.4	262.2	49.1
Chlorination	90.1	30.2	15.8
Misc. Construction & Equipment	20.0		
Site Work, Electrical & Piping	143.6		
Improvements	209.0		
Subtotal	1,788.6	527.5	243.4

C. Recharge System

Same as # 1a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,070.6	10,168.8	403.0
Service Factor (1.27; engineering, administration, and contingencies)			
Total	26,759.6		
Present Worth of Salvage Value	-2,818.8		
Net Capital Cost	23,940.8		

Alternative 1b.

E. <u>Total Present Worth</u> 28,337.5

F. <u>Average Annual Equivalent Cost</u> 2,598.5

Alternative 1c.

A. Collection System

Same as #1a.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	22,949.5	11,474.8	40.9

B. Treatment Method

Same as #1b.

Subtotal	1,788.6	527.5	243.4

C. Recharge System

Same as #1a.

Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost	29,253.0	14,259.8	412.6
Service Factor (1.27; engineering, administration, and contingencies)			
Total	37,151.3		
Present Worth of Salvage Value	-3,952.8		
Net Capital Cost	33,198.5		

E. Total Present Worth 37,699.9

F. Average Annual Equivalent Cost 3,457.1

Alternative 1d.

A. Collection System

Same as #1a.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	22,949.5	11,474.8	40.9

B. Treatment Method

Tertiary treatment without chemical coagulation and with expanded (2.6 mgd) plant capacity.

Subtotal	2,455.6	816.1	221.1

C. Recharge System

Same as #1a.

Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost Service Factor (1.27; engineering, administration, and contingencies)	29,920.0	14,548.4	390.3
Total	37,998.4		
Present Worth of Salvage Value	-4,032.9		
Net Capital Cost	33,965.5		

E. Total Present Worth 38,223.7

F. Average Annual Equivalent Cost 3,505.1

Alternative 1e.

A. Collection System

Same as #1b.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	14,767.1	7,383.8	31.3

B. Treatment Method

Tertiary treatment without chemical coagulation and with existing (2.0 mgd) plant capacity.

	Capital	Salvage	O&M
Subtotal	1,765.6	527.5	204.7

C. Recharge System

Same as #1a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,047.6	10,168.8	364.3
Service Factor (1.27; engineering, administration, and contingencies)			
Total	26,730.4		
Present Worth of Salvage Value	-2,818.8		
Net Capital Cost	23,884.6		

E. Total Present Worth 27,859.1

F. Average Annual Equivalent Cost 2,554.6

Alternative 1f.

A. Collection System

Same as #1a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	22,949.5	11,474.8	40.9

B. Treatment Method

Same as #1e.

	Capital	Salvage	O&M
Subtotal	1,765.6	527.5	204.7

C. Recharge System

Same as #1a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	29,230.0	14,259.8	373.9
Service Factor (1.27; engineering, administration, and contingencies)			
Total	37,122.1		
Present Worth of Salvage Value	-3,952.8		
Net Capital Cost	33,169.3		

E. Total Present Worth 37,248.5

F. Average Annual Equivalent Cost 3,415.7

Alternative 1g.

A. Collection Systems

Same as #1a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	22,949.5	11,474.8	40.9

B. Treatment Method

Existing secondary treatment with expanded (2.6 mgd) plant capacity and additional treatment in the mines.

	Capital	Salvage	O&M
Preliminary Treatment (Existing)			15.1
Primary Treatment	160.0	80.0	13.0
Activated Sludge	228.5	58.3	70.3
Secondary Clarifiers	217.0	62.3	20.6
Misc. Construction & Equipment	20.0		
Site Work Electrical & Piping	62.5		
Improvements	209.0		
Subtotal	897.0	200.6	119.0

C. Recharge System

Continuous effluent recharge, and mine discharge from old sewers.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost Service Factor (1.27; engineering, administration, and contingencies)	24,924.2	12,214.3	176.5
Total	31,653.7		
Present Worth of Salvage Value	-3,383.5		
Net Capital Cost	28,270.2		

Alternative 1g.

E. Total Present Worth 30,195.8

F. Average Annual Equivalent Cost 2,769.0

Alternative 1h.

A. Collection System

Same as #1b.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	14,767.1	7,383.8	31.3

B. Treatment Method

Existing secondary treatment with existing (2.0 mgd) plant capacity and additional treatment in the mines.

	Capital	Salvage	O&M
Subtotal	209.0	0	103.2

C. Recharge System

Same as #1g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	16,054.3	9,047.4	151.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	20,389.0		
Present Worth of Salvage Value	-2,506.2		
Net Capital Cost	17,882.8		

E. Total Present Worth 19,531.3

F. Average Annual Equivalent Cost 1,791.0

Alternative li.

A. Collection System

Same as #1a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	22,949.5	11,474.8	40.9

B. Treatment Method

Same as #1h.

	Capital	Salvage	O&M
Subtotal	209.0	0	103.2

C. Recharge System

Same as #1g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost Service Factor (1.27; engineering, administration, and contingencies)	24,236.2	12,013.7	160.7
Total	30,780.0		
Present Worth of Salvage Value	-3,327.9		
Net Capital Cost	27,452.1		

E. Total Present Worth 29,205.3

F. Average Annual Equivalent Cost 2,678.1

Alternative 2a.

A. Collection System

Combined sewer system in presently sewered area, with rehabilitation and replacement of interceptors. Sanitary sewers in presently unsewered areas.

Upgraded Combined Sewers

Pipe Size	Linear Feet	Cost $ (x 1,000) Capital	Salvage	O&M
12"	800'	47.2	23.6	.05
15"	3,600'	262.8	131.4	.3
18"	2,400'	225.6	112.8	.2
21"	800'	94.4	47.2	.1
24"	600'	74.4	37.2	.1
27"	1,200'	163.2	81.6	.3
36"	2,000'	430.0	215.0	.5
42"	6,800'	1,700.0	850.0	2.1
48"	6,800'	2,053.6	1,020.0	2.3
54"	4,000'	1,348.0	674.0	1.4
60"	4,000'	1,672.0	836.0	1.6
72"	2,800	1,352.4	676.2	1.3
		9,423.6	4,711.8	10.3
SSES[a]-Existing Sewers		260.0		
Rehabilitation		1,712.8		
New Sanitary Sewers for Unsewered Areas		8,182.4	4,091.0	9.6
	Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Flows conveyed to plant treated as in #1d. Excess combined sewer flows treated by primary (12.3 mgd) and chlorination facilities.

	Capital	Salvage	O&M
Dry-weather Flow Treatment	2,200.8	702.5	187.5
Combined Sewer Overflow Treatment			
Primary Treatment[b]	514.4	257.2	20.7
Chlorination[c]	216.1	87.5	35.0
Subtotal	2,931.3	1,047.2	243.2

[a]Sewer System Evaluation Survey

[b]Includes costs for primary treatment for dry-weather flow.

[c]Includes costs for chlorination for dry-weather flow.

Alternative 2a.

C. Recharge System

Mine discharge from combined and storm sewers in presently sewered area, and effluent recharge during dry-weather periods.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost Service Factor (1.27; engineering, administration, and contingencies)	27,025.0	12,107.5	391.4
Total	34,321.7		
Present Worth of Salvage Value	-3,356.2		
Net Capital Cost	30,965.5		

E. Total Present Worth 35,235.7

F. Average Annual Equivalent Cost 3,231.1

Alternative 2b.

A. Collection System

Combined sewer system with rehabilitation and replacement of interceptors.

	Capital	Cost $ (x 1,000) Salvage	O&M
Upgraded Combined Sewers	9,423.6	4,711.8	10.3
SSES-Existing Sewers	260.0		
Rehabilitation	1,712.8		
Subtotal	11,396.4	4,711.8	10.3

B. Treatment Method

Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #2a.

	Capital	Salvage	O&M
Subtotal	2,406.0	842.0	226.8

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	18,317.3	7,811.3	365.4
Service Factor (1.27; engineering, administration, and contingencies)			
Total	23,262.9		
Present Worth of Salvage Value	-2,165.3		
Net Capital Cost	21,097.6		

E. Total Present Worth 25,084.1

F. Average Annual Equivalent Cost 2,300.2

Alternative 2c.

A. Collection System

Same as #2a.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Same as #2b.

	Capital	Salvage	O&M
Subtotal	2,406.0	842.0	226.8

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	26,499.7	11,902.3	375.0
Service Factor (1.27; engineering, administration, and contingencies)			
Total	33,654.6		
Present Worth of Salvage Value	-3,299.3		
Net Capital Cost	30,355.3		

E. Total Present Worth 34,446.5

F. Average Annual Equivalent Cost 3,158.7

Alternative 2d.

A. Collection System

Same as #2a.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Upgraded secondary treatment with nitrification and chlorination and expanded (2.6 mgd) plant capacity. Excess combined sewer flows treated as in #2a.

	Capital	Salvage	O&M
Preliminary Treatment (Existing)			15.1
Flow Equalization	418.5	209.3	2.9
Activated Sludge & Nitrification	536.0	134.0	95.0
Secondary Clarifiers	217.0	62.3	20.6
Misc. Construction & Equipment	20.0		
Site Work, Electrical & Piping	142.6		
Improvements	209.0		
Combined Sewer Overflow Treatment[a]	730.5	344.7	55.7
Subtotal	2,273.6	750.3	189.3

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

	Capital	Salvage	O&M
D. Net Capital Cost	26,367.3	11,810.6	337.5
Capital Cost			
Service Factor (1.27; engineering, administration, and contingencies)			
Total	33,486.5		
Present Worth of Salvage Value	-3,273.9		
Net Capital Cost	30,212.6		

Alternative 2d.

E. Total Present Worth 33,894.7

F. Average Annual Equivalent Cost 3,108.1

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[a] Includes costs for primary treatment and chlorination for dry-weather flow.

Alternative 2e.

A. Collection System

Same as #2b.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	11,396.4	4,711.8	10.3

B. Treatment Method

Upgraded secondary treatment with nitrification and chlorination and existing (2.0 mgd) plant capacity. Excess combined sewer flows treated as in #2a.

	Capital	Salvage	O&M
Existing Treatment	--	--	103.2
Flow Equalization	336.0	124.5	2.6
Nitrification	442.5	110.6	34.0
Misc. Construction & Equipment	20.0		
Site Work, Electrical & Piping	79.8		
Improvements	209.0		
Combined Sewer Overflow treatment	730.5	344.7	37.9
Subtotal	1,817.8	579.8	177.7

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Costs

	Capital	Salvage	O&M
Capital Cost	17,729.1	7,549.1	316.3
Service Factor (1.27; engineering, administration, and contingencies)			
Total	22,515.9		
Present Worth of Salvage Value	-2,092.6		
Net Capital Cost	20,423.3		

Alternative 2e.

E. Total Present Worth 23,874.1

F. Average Annual Equivalent Cost 2,189.3

Alternative 2f.

A. Collection System

Same as #2a.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Same as #2e.

	Capital	Salvage	O&M
Subtotal	1,817.8	579.8	177.7

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	25,911.5	11,640.1	325.9
Service Factor (1.27; engineering, administration, and contingencies)			
Total	32,907.6		
Present Worth of Salvage Value	-3,226.6		
Net Capital Cost	29,681.0		

E. Total Present Worth 33,236.6

F. Average Annual Equivalent Cost 3,047.8

Alternative 2g.

A. Collection System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #2a.

	Capital	Salvage	O&M
Subtotal	1,467.5	465.3	141.1

C. Recharge System

Continuous effluent recharge, and mine discharge from combined sewers.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	22,124.0	9,807.0	177.6
Service Factor (1.27; engineering, administration, and contingencies)			
Total	28,097.5		
Present Worth of Salvage Value	-2,716.6		
Net Capital Cost	25,380.9		

Cost $ (x 1,000) applies to the Capital, Salvage and O&M columns.

E. Total Present Worth 27,318.5

F. Average Annual Equivalent Cost 2,505.1

Alternative 2h.

A. Collection System

Same as #2b.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	11,396.4	4,711.8	10.3

B. Treatment Method

Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #2a.

	Capital	Salvage	O&M
Subtotal	939.5	344.7	113.6

C. Recharge System

Same as #2g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	13,413.6	5,595.4	140.5
Service Factor (1.27; engineering, administration, and contingencies)			
Total	17,035.3		
Present Worth of Salvage Value	-1,550.0		
Net Capital Cost	15,485.3		

E. Total Present Worth 17,018.2

F. Average Annual Equivalent Cost 1,560.6

Alternative 2i.

A. Collection System

Same as #2a.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	19,578.8	8,802.8	19.9

B. Treatment Method

Same as #2h.

	Capital	Salvage	O&M
Subtotal	939.5	344.7	113.6

C. Recharge System

Same as #2g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,596.0	9,686.4	150.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	27,426.9		
Present Worth of Salvage Value	-2,683.2		
Net Capital Cost	24,743.7		

E. Total Present Worth 26,381.3

F. Average Annual Equivalent Cost 2,419.2

Alternative 3a.

A. Collection System

System is the same as #2a but different pipe layout to convey excess combined sewer flows to storage.

Upgraded Combined Sewers

Pipe Size	Linear Feet	Cost $ (x 1,000) Capital	Salvage	O&M
12"	800'	47.2	23.6	.1
15"	3,600'	262.8	131.4	.3
18"	2,400'	225.6	112.8	.2
21"	800'	94.4	47.2	.1
24"	600'	74.4	37.2	.1
27"	1,200'	163.2	81.6	.3
36"	2,000'	430.0	215.0	.5
42"	6,800'	1,700.0	850.0	2.1
48"	7,200'	2,174.4	1,087.2	2.4
54"	4,000'	1,348.0	674.0	1.4
60"	6,000'	2,508.0	1,254.0	2.4
		9,028.0	4,513.8	9.9
SSES-Existing Sewers		260.0		
Rehabilitation		1,712.8		
New Sanitary Sewers for Unsewered Areas		8,182.4	4,091.0	9.6
	Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant treated as in #1d. Excess combined sewer flows conveyed to storage facilities (12.3 mgd) and treated by primary (4.8 mgd) and chlorination facilities.

	Capital	Salvage	O&M
Dry-weather Flow Treatment	2,200.8	702.5	187.5
Storage (12.35 mgd)	187.0	50.0	56.4
Pumping	181.0		13.4
Combined Sewer Overflow Treatment[a]			
Primary	365.4	182.7	18.7
Chlorination	118.0	38.5	31.0
Subtotal	3,052.2	973.7	307.0

[a]Includes costs for primary treatment and chlorination for dry-weather flow.

Alternative 3a.

C. Recharge System

Same as #2a.

Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost	26,750.3	11,836.0	454.8
Service Factor (1.27; engineering, administration, and contingencies)			
Total	33,972.8		
Present Worth of Salvage Value	-3,280.9		
Net Capital Cost	30,691.9		

E. Total Present Worth 35,675.6

F. Average Annual Equivalent Cost 3,271.4

Alternative 3b.

A. Collection System

System is the same as #2b but different pipe layout to convey excess combined sewer flows to storage.

	Capital	Cost $ (x 1,000) Salvage	O&M
Upgraded Combined Sewers	9,027.2	4,513.6	10.0
SSES-Existing Sewers	260.0		
Rehabilitation	1,712.8		
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #3a.

	Capital	Salvage	O&M
Dry-weather Flow Treatment	1,675.5	497.3	188.9
Storage and Pumping	368.0	50.0	69.8
Combined Sewer Overflow Treatment	483.4	221.2	40.5
Subtotal	2,526.9	768.5	299.2

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

E. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	18,041.8	7,539.6	437.5
Service Factor (1.27; engineering, administration, and contingencies)			
Total	22,913.1		
Present Worth of Salvage Value	-2,089.9		
Net Capital Cost	20,823.2		

Alternative 3b.

E. Total Present Worth 25,596.3

F. Average Annual Equivalent Cost 2,347.2

Alternative 3c.

A. Collection System

Same as #3a.

	Cost $ (x 1,000) Capital	Salvage	O&M
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #3b.

	Capital	Salvage	O&M
Subtotal	2,526.9	768.5	299.2

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	26,225.0	11,630.8	447.0
Service Factor (1.27; engineering, administration, and contingencies)			
Total	33,305.7		
Present Worth of Salvage Value	-3,224.1		
Net Capital Cost	30,081.6		

E. Total Present Worth 34,958.4

F. Average Annual Equivalent Cost 3,205.7

Alternative 3d.

A. Collection System

Same as #3a.

	Cost $ (x 1,000) Capital	Salvage	O&M
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant and treated as in #2d. Excess combined sewer flows treated as in #3a.

	Capital	Salvage	O&M
Upgraded Secondary Treatment	1,543.1	405.6	133.6
Storage and Pumping	368.0	50.0	69.8
Combined Sewer Overflow Treatment	483.4	221.2	40.5
Subtotal	2,394.5	676.8	243.9

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	26,092.6	11,539.1	391.7
Service Factor (1.27; engineering, administration and contingencies)			
Total	33,137.6		
Present Worth of Salvage Value	-3,198.6		
Net Capital Cost	29,939.0		

E. Total Present Worth 34,212.4

F. Average Annual Equivalent Cost 3,137.2

Alternative 3e.

A. Collection System

Same as #3b.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #2e. Excess combined sewer flows treated as in #3a.

Subtotal	1,938.7	506.3	250.1

C. Recharge System

Same as #2a.

Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

Capital Cost	17,453.6	7,277.4	388.4
Service Factor (1.27; engineering, administration, and contingencies)			
Total	22,166.1		
Present Worth of Salvage Value	-2,017.1		
Net Capital Cost	20,149.0		

E. Total Present Worth 24,386.4

F. Average Annual Equivalent Cost 2,236.2

Alternative 3f.

A. Collection System

Same as #3a.

	Cost $ (x 1,000) Capital	Salvage	O&M
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #3e.

	Capital	Salvage	O&M
Subtotal	1,938.7	506.3	250.1

C. Recharge System

Same as #2a.

	Capital	Salvage	O&M
Subtotal	4,514.9	2,257.5	128.3

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	25,636.8	11,368.6	397.9
Service Factor (1.27; engineering, administration, and contingencies)			
Total	32,558.7		
Present Worth of Salvage Value	-3,151.4		
Net Capital Cost	29,407.3		

E. Total Present Worth 33,748.4

F. Average Annual Equivalent Cost 3,094.7

Alternative 3g.

A. Collection System

Same as #3a.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #3a.

	Capital	Salvage	O&M
Expanded Secondary Treatment	737.0	120.6	106.0
Storage and Pumping	368.0	50.0	69.8
Combined Sewer Overflow Treatment	483.4	221.2	40.5
Subtotal	1,588.4	391.8	216.3

C. Recharge System

Same as #2g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,849.3	9,535.5	252.4
Service Factor (1.27; engineering, administration, and contingencies)			
Total	27,748.6		
Present Worth of Salvage Value	-2,641.4		
Net Capital Cost	25,107.2		

E. Total Present Worth 27,860.9

F. Average Annual Equivalent Cost 2,554.8

Alternative 3h.

A. Collection System

Same as #3b.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #3a.

	Capital	Salvage	O&M
Secondary Treatment	209.0	0.0	91.5
Storage and Pumping	368.0	50.0	69.8
Combined Sewer Overflow Treatment	483.4	221.2	40.5
Subtotal	1,060.4	271.2	201.8

C. Recharge System

Same as #2g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	13,138.1	5,323.7	228.4
Service Factor (1.27; engineering, administration, and contingencies)			
Total	16,685.4		
Present Worth of Salvage Value	-1,474.7		
Net Capital Cost	15,210.7		

E. Total Present Worth 17,702.5

F. Average Annual Equivalent Cost 1,623.3

Alternative 3i.

A. Collection System

Same as #3a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #3h.

	Capital	Salvage	O&M
Subtotal	1,060.4	271.2	201.8

C. Recharge System

Same as #2g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,321.3	9,414.9	237.9
Service Factor (1.27; engineering, administration, and contingencies)			
Total	27,078.1		
Present Worth of Salvage Value	-2,608.0		
Net Capital Cost	24,470.1		

E. Total Present Worth 27,065.6

F. Average Annual Equivalent Cost 2,481.9

Alternative 4a.

A. Collection System

Combined sewers in presently sewered area with rehabilitation and replacement of interceptors. Sanitary sewers in presently unsewered area. (Cost same as #3a.)

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant treated as in #1d. Excess combined sewer flows conveyed to storage facilities (12.3 mgd) and pumped to recharge system at a rate of 4.8 mgd.

	Capital	Salvage	O&M
Dry-weather Flow Treatment	2,455.6	816.1	221.1
Storage and Pumping	368.0	50.0	69.8
Subtotal	2,823.6	866.1	290.9

C. Recharge System

Recharge of excess combined sewer flows, mine discharge from combined sewers, and effluent recharge during dry-weather periods.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	23,084.5	10,009.8	327.0
Service Factor (1.27; engineering, administration, and contingencies)			
Total	29,317.3		
Present Worth of Salvage Value	-2,774.7		
Net Capital Cost	26,542.6		

Alternative 4a.

E. <u>Total Present Worth</u> 30,110.2

F. <u>Average Annual Equivalent Cost</u> 2,761.1

Alternative 4b.

A. Collection System

Same as #3b.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #1e. Excess combined sewer flows treated as in #4a.

	Capital	Salvage	O&M
Dry-weather Flow Treatment	1,765.6	527.5	204.7
Storage and Pumping	368.0	50.0	69.8
Subtotal	2,133.6	577.5	274.5

C. Recharge System

Same as #4a.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	14,211.3	5,630.0	301.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	18,048.4		
Present Worth of Salvage Value	-1,560.6		
Net Capital Cost	16,487.8		

E. Total Present Worth 19,772.8

F. Average Annual Equivalent Cost 1,813.2

Alternative 4c.

A. Collection System

Same as #4a

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #4b.

Subtotal	2,133.6	577.5	274.5

C. Recharge System

Same as #4a.

Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

Capital Cost	22,394.5	9,721.2	310.6
Service Factor (1. 27; engineering, administration, and contingencies)			
Total	28,441.0		
Present Worth of Salvage Value	-2,694.7		
Net Capital Cost	25,746.3		

E. Total Present Worth 29,134.9

F. Average Annual Equivalent Cost 2,671.7

Alternative 4d.

A. Collection System

Same as #4a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant treated as in #2d. Excess combined sewer flows treated as in #4a.

	Capital	Salvage	O&M
Expanded and Upgraded Secondary Treatment	1,797.9	519.2	167.2
Storage and Pumping	368.0	50.0	69.8
Subtotal	2,165.9	569.2	237.0

C. Recharge System

Same as #4a.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	22,426.8	9,712.9	273.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	28,482.0		
Present Worth of Salvage Value	-2,692.4		
Net Capital Cost	25,789.6		

E. Total Present Worth 28,769.1

F. Average Annual Equivalent Cost 2,638.1

Alternative 4e.

A. Collection System

Same as #3b.

	Cost $ (x 1,000)		
	Capital	Salvage	O&M
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #2e. Excess combined sewer flows treated as in #4a.

Subtotal	1,545.4	315.3	225.4

C. Recharge System

Same as #4a.

Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

Capital Cost	13,623.1	5,367.8	252.0
Service Factor (1.27; engineering, administration, and contingencies)			
Total	17,301.3		
Present Worth of Salvage Value	-1,487.9		
Net Capital Cost	15,813.4		

E. Total Present Worth 18,562.7

F. Average Annual Equivalent Cost 1,702.2

Alternative 4f.

A. Collection System

Same as #4a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #4e.

	Capital	Salvage	O&M
Subtotal	1,545.4	315.3	225.4

C. Recharge System

Same as #4a.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,806.3	9,459.0	261.5
Service Factor (1.27; engineering, administration, and contingencies)			
Total	27,694.0		
Present Worth of Salvage Value	-2,622.0		
Net Capital Cost	25,072.0		

E. Total Present Worth 27.924.9

F. Average Annual Equivalent Cost 2,560.7

Alternative 4g.

A. Collection System

Same as #4a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Flows conveyed to plant treated as in #1g. Excess combined sewer flows treated as in #4a.

	Capital	Salvage	O&M
Expanded Secondary Treatment	897.0	200.6	119.0
Storage and Pumping	368.0	50.0	69.8
Subtotal	1,265.0	250.6	188.8

C. Recharge System

Continuous effluent recharge and recharge of excess combined sewer flows. Mine discharge from combined sewers.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	21,525.9	9,394.3	207.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	27,337.9		
Present Worth of Salvage Value	-2,602.3		
Net Capital Cost	24,735.6		

E. Total Present Worth 26,995.1

F. Average Annual Equivalent Cost 2,475.4

Alternative 4h.

A. Collection System

Same as #3b.

	Capital	Cost $ (x 1,000) Salvage	O&M
Subtotal	11,000.0	4,513.6	10.0

B. Treatment Method

Flows conveyed to plant treated as in #1h. Excess combined sewer flows treated as in #4a.

	Capital	Salvage	O&M
Secondary Treatment	209.0		103.2
Storage and Pumping	368.0	50.0	69.8
Subtotal	577.0	50.0	173.0

C. Recharge System

Same as #4g.

	Capital	Salvage	O&M
Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

	Capital	Salvage	O&M
Capital Cost	12,654.7	5,102.5	199.6
Service Factor (1,27; engineering, administration, and contingencies)			
Total	16,071.5		
Present Worth of Salvage Value	-1,413.4		
Net Capital Cost	14,658.1		

E. Total Present Worth 16,835.7

F. Average Annual Equivalent Cost 1,543.8

Alternative 4i.

A. Collection System

Same as #4a.

	Capital	Salvage	O&M
	Cost $ (x 1,000)		
Subtotal	19,183.2	8,604.8	19.5

B. Treatment Method

Same as #4h.

Subtotal	577.0	50.0	173.0

C. Recharge System

Same as #4g.

Subtotal	1,077.7	538.9	16.6

D. Net Capital Cost

Capital Cost	20,837.9	9,193.7	209.1
Service Factor (1.27; engineering, administration, and contingencies)			
Total	26,464.1		
Present Worth of Salvage Value	-2,546.7		
Net Capital Cost	23,917.4		

E. Total Present Worth 26,198.7

F. Average Annual Equivalent Cost 2,402.4

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