ENVIRONMENTAL IMPACT STATEMENT: SLUDGE DISPOSAL AND LAND RECLAMATION IN FULTON COUNTY, ILLINOIS

(U.S.) ENVIRONMENTAL PROTECTION AGENCY, CHICAGO, IL

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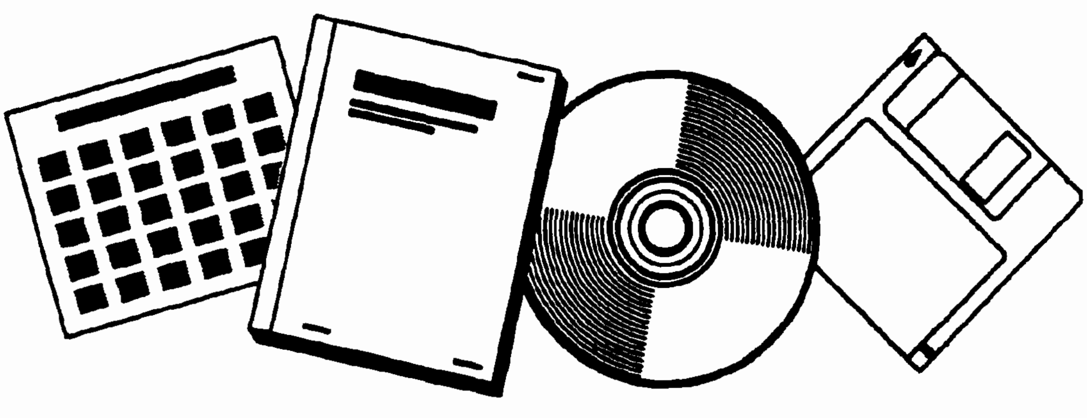

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An analysis of the methodologies utilized by the Metropolitan Sanitary District of Greater Chicago (MSDGC) for the application of sludge on strip-mined land in Fulton County, Illinois is presented. Since the project is already being implemented, this statement uniquely presents the observed and projected impacts of continued operations. Digested sludge is loaded at MSDGC's West-Southwest Treatment Plant in Stickney, Illinois and barged approximately 200 miles via the Illinois River to Liverpool. From the Liverpool dock the sludge is pumped 10 miles via underground pipeline to the project holding basins for storage. Dredge equipment is used to mix the sludge to a uniform consistency and solids content of 6 percent or less before pumping from the basins into the distribution system. Sludge is applied to land which had been previously drastically disturbed through strip-mining activities. The project began using spray application methods. However, due to odor problems and public input, the current methodology being utilized is tandem disk incorporation. Other methodologies are being explored.

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EPA

Environmental Impact Statement

Sludge Disposal and Land Reclamation in Fulton County, Illinois

FINAL ENVIRONMENTAL IMPACT STATEMENT

SLUDGE DISPOSAL AND LAND RECLAMATION

IN FULTON COUNTY, ILLINOIS

Prepared by the

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION V, CHICAGO, ILLINOIS

John McGuire
Regional Administrator
U.S. Environmental Protection Agency

January 1981

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

JAN 16 1981

REPLY TO ATTENTION OF:

TO ALL INTERESTED AGENCIES, PUBLIC GROUPS
AND CITIZENS

The Final Environmental Impact Statement (EIS) for Sludge Disposal and Land Reclamation in Fulton County, Illinois is hereby submitted for your information and review. This EIS has been prepared in compliance with the National Environmental Policy Act of 1969, and the subsequent regulations prepared by the Council on Environmental Quality and the Environmental Protection Agency. This EIS presents an analysis of the methodologies utilized by the Metropolitan Sanitary District of Greater Chicago for the application of sludge on strip-mined land in Fulton County, Illinois and concludes after prolonged study, that there are no significant adverse impacts associated with this project.

Upon publication of a notice in the Federal Register, a 30-day period will commence during which this Agency will not take any administrative action on this project.

John McGuire
Regional Administrator

SUMMARY SHEET

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(X) Final

U.S. Environmental Protection Agency
Region V, Chicago

1. (X) Administrative Action
( ) Legislative Action

2. Description of the Action

An analysis of the methodologies utilized by the Metropolitan Sanitary District of Greater Chicago (MSDGC) for the application of sludge on strip-mined land in Fulton County, Illinois is presented. Since the project is already being implemented, this statement uniquely presents the observed and projected impacts of continued operations. Digested sludge is loaded at MSDGC's West-Southwest Treatment Plant in Stickney, Illinois and barged approximately 200 miles via the Illinois River to Liverpool. From the Liverpool dock the sludge is pumped 10 miles via underground pipeline to the project holding basins for storage. Dredge equipment is used to mix the sludge to a uniform consistency and solids content of 6 percent or less before pumping from the basins into the distribution system. Sludge is applied to land which had been previously drastically disturbed through strip-mining activities. The project began using spray application methods. However, due to odor problems and public input, the current methodology being utilized is tandem disk incorporation. Other methodologies are being explored.

Fields receiving sludge have been contoured to allow collection of runoff due to storm events or application. Environmental control systems are employed to monitor surface and groundwater, soil and sediment, plants and aquatic biota, and the atmosphere.

3. Environmental Impacts

a. Water

Some contamination of surface water has occurred at the project site due to runoff from sludge application to fields and release of effluents from field retention basins. Some retention basins were found to have insufficient capacity and were therefore ineffective in removing suspended solids resulting in siltation and excess dissolved oxygen depletion in receiving waters. Observation of the site showed that the situation is being corrected. Many additional siltation basins have been added to newer fields. However, runoff from strip-mined areas and effluents from improperly maintained septic tanks and the sewage treatment plant at Canton also contribute to this pollution. Water quality is not adversely impacted by project operations. Groundwater, as sampled at wells and springs, has not been degraded by the application of sludge.

The MSDGC has been in violation of water quality standards on numerous occasions due to breaks in the surface pipeline that carries sludge to the application fields. The MSDGC has entered into a program to strengthen the pipeline in critical areas where a break would cause serious water quality problems. The primary cause of the breaks has been expansion and contraction from changes in the temperature. This program will continue as an integral part of the project operation.

b. Soils

Sludge has had a beneficial effect upon the physical properties of spoil soils. The high organic content of sludge provides a matrix for formation of a stable soil structure. Incorporation of sludge into soils by disking has decreased the chance for runoff and erosion. Increases in soil organic content and increased crop productivity have created beneficial economic and land use impacts.

c. Odors and Noise

Complaints of offensive odors have arisen from citizens within a 4 to 5 mile area surrounding the sludge application sites and holding basins during the current operations. A reduction in malodorants has occurred due to the modification of application to soil incorporation.

Noise generated at the Liverpool dock includes the noise associated with barge maneuvering and booster pumping. These activities increase the ambient noise levels around the community of Liverpool. Noise levels at the site are attributed to tractors and sludge sprayers. These noise levels can be detected at the perimeter of the project site. The noise levels are similar to existing agricultural noises in magnitude and duration.

d. Health Effects

Among all methods of sludge application, pressurized spraying offered the greatest potential for direct transfer of hazardous components to humans or animals. Inhalation of sludge aerosols, possibly containing pathogens or toxic substances, presents an opportunity for protracted and repetitive exposure. The lack of reported cases of health effects from Fulton County operations indicates that the level of risk associated with sludge application has been minimal. As the project developed, MSDGC has taken measures to avoid any potential health impact. They have abandoned pressurized spray application practices in favor of incorporating the sludge into the soil utilizing tractor drawn disking and chisel plow equipment. A distribution system and hoses allow the sludge to be placed in the furrow.

Indirect effects are caused by the consumption of plants or animals that have been contaminated by heavy metals. The interactions among sludge components and the food chain are complex and information concerning the ability of each trophic level to accumulate toxic compounds and pass them on to succeeding trophic levels is sparse and qualitative at best. The most likely suspects for potential hazard are arsenic, cadmium, lead, mercury, and selenium. Both sludge and soil at the project site are high in cadmium, especially in relation to zinc. Crop monitoring by the MSDGC should decrease the risk that contaminated crops would reach the market place. Row cropping with grain crops reduces the risk that human health would be affected. Risk could be further reduced by using grain crops to produce alcohol for gasohol. U. S. Environmental Protection Agency (USEPA) regulations 40 CFR 257.3-5 further outline a program to minimize the effect of sludge disposal upon human health where cadmium levels may be a problem.

The actual indirect hazard to humans would stem from the future use of reclaimed strip-mined land for cropping or livestock, grazing, possibly resulting in a majority of a family's food intake being contaminated by trace elements. This appears unlikely to occur due to land use constraints and availability of better-suited property. Once again, compliance with 40 CFR 257 will minimize this problem because future land owners will be aware of sludge application sites because of a stipulation in the land record or property deed.

e. Socio-economic Effects

The most obvious short-term local economic effect of the project has been to create jobs for approximately 120 skilled and unskilled laborers who average 6 to 8 months of employment yearly.

The sludge application project has also affected the local public economy by increasing future market value of the land and the tax base.

f. Land Use

Leveling and grading of strip-mined sections of the project site to prepare the sludge application fields have increased the suitability of the land for agriculture. The removal of surface rocks and leveling of steep slopes have also considerably increased the area's suitability for recreational use including playgrounds, campsites, roads and trails. The project has put former agricultural land back into productivity.

The Fulton County project has in essence reduced the area's recreational acreage by some 15,000 acres, as the District restricts access to property which was originally open for public and private recreation. This restriction is done in order to protect District equipment and pipelines.

4. Alternatives Considered

The MSDGC considered the following sludge handling systems prior to beginning operations in Fulton County. The residents of Fulton County were exploring ways to return the disturbed land back to some level of productivity. A few early attempts had been made to restore the land prior to the MSDGC project.

a. Sludge Disposal Subsystems

(1) Sanitary landfill

(2) Lagooning

(3) Ocean dumping

b. Sludge Utilization Subsystems

(1) Fertilizer production

(2) Composting

(3) Soil reclamation

c. Sludge Transportation Subsystems

(1) Truck transportation

(2) Rail transportation

(3) Barge transportation

(4) Pipeline transportation

In conclusion, sludge is applied to land which had been previously drastically disturbed through strip-mining activities. The project began using spray application methods. However, due to odor problems and public input, the current methodology being utilized is tandem disk incorporation. Fields receiving sludge have been contoured to allow collection of runoff due to storm events or application. Environmental control systems are employed to monitor surface and ground water, soil and rock, plants and aquatic biota, and the atmosphere.

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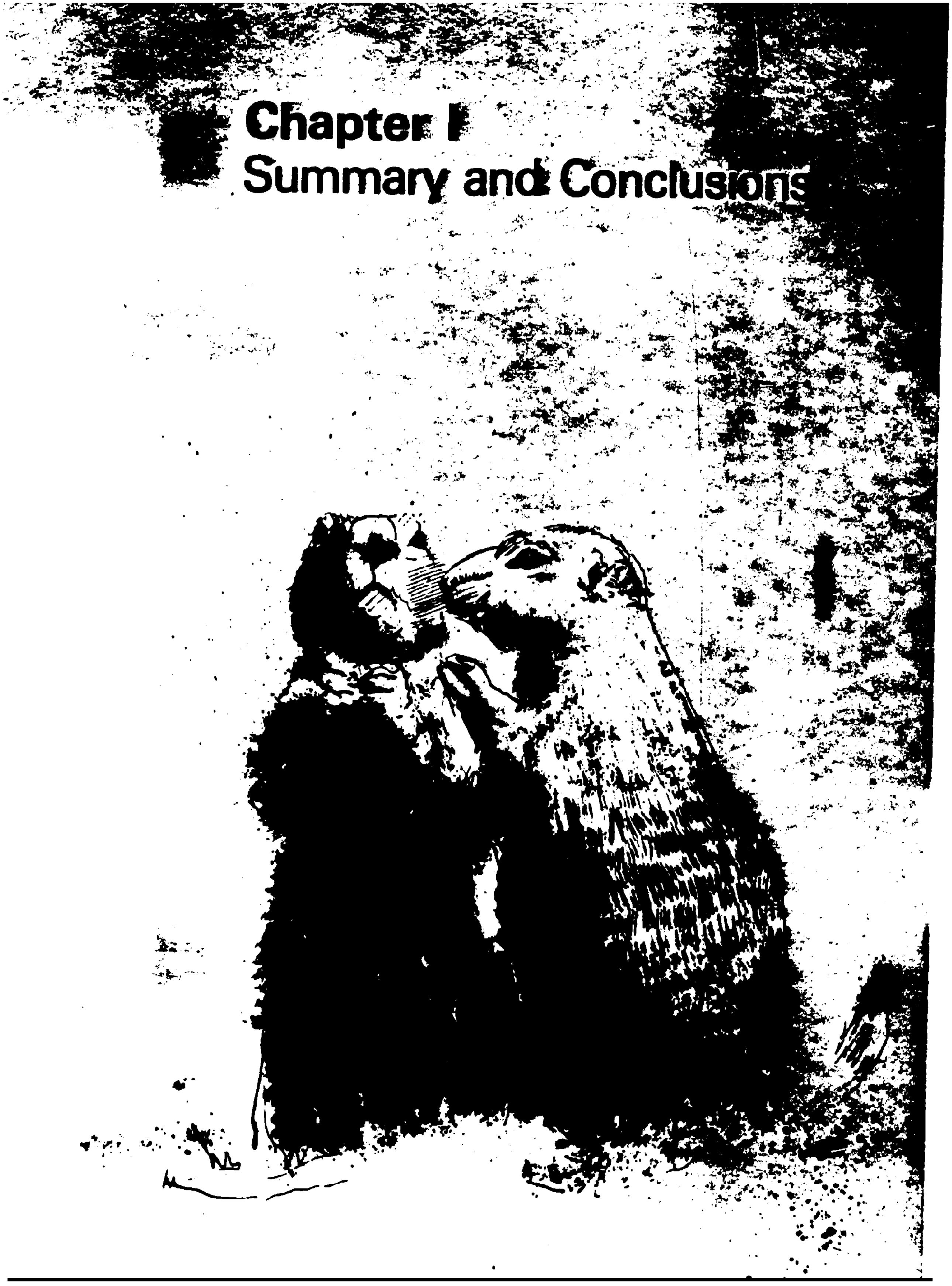
SYMBOLS AND ABBREVIATIONS

u	Mu, micro, micron
<	less than
>	greater than

TECHNICAL ABBREVIATIONS

Al	Aluminum
BOD	Biochemical oxygen demand
C	Carbon
Ca	Calcium
$CaCO_3$	Calcium carbonate
Cd	Cadmium
CEC	Cation exchange capacity
Cl	Chlorine
Cl-	Ionized chlorine
Cr	Chromium
Cu	Copper
dBa	Adjusted decibel
D.O.	Dissolved oxygen
dt/d	Dry tons per day
E.C.	Electrical conductivity
FC	Fecal coliforms
Fe	Iron
HCl	Hyrochloric acid
Hg	Mercury
K	Potassium
lb/ton	Pound per ton
meq	Milliequivalent
Mg	Magnesium
mg	milligram
MG	Million gallons
MGD	Million gallons per day
mg/l	Milligram per liter
Mn	Manganese
N	Nitrogen
N	Normality (See Glossary)
Na	Sodium
NH_3-N	Ammonia nitrogen
Ni	Nickel
NO_2 + NO_3-N	Nitrite and nitrate nitrogen
P	Phosphorus
Pb	Lead
PCB	Polychlorinated biphenyls
ppm	Parts per million
R&D	Research and development
Se	Selenium
SO_4	Sulfate ion
TDS	Total dissolved solids
TLm	Mean Tolerance Limit
TSS	Total suspended solids
TVS	Total volatile solids
Zn	Zinc

Chapter I
Summary and Conclusions



I. SUMMARY AND CONCLUSIONS

The Fulton County land reclamation project operated by the Metropolitan Sanitary District of Greater Chicago (MSDGC) is a unique and dynamic project. The project began in 1971 and continues today as an example of one major metropolitan area working with a rural, agriculturally oriented county to solve some basic environmental problems. The MSDGC has been searching for an environmentally acceptable and low cost means to utilize municipal sludge solids generated from the wastewater treatment process; while Fulton County was looking for a means of returning drastically disturbed, strip-mined land back to a productive use. The project has gone through a number of phases in land development and operational procedures which have built on both the immediate successes and failures of large-scale land application of sludge. The MSDGC has modified practices based upon public input and sponsored research projects. They have contributed enormously to the understanding of both the technical and practical aspects of municipal sludge solids utilization.

This chapter summarizes the conclusion and recommendations of the U.S. Environmental Protection Agency (USEPA) based upon several years of evaluation and field observations at the project site. It is a unique experience to prepare an Environmental Impact Statement (EIS) on an ongoing project. Due to project data collection and analysis, many impacts that would otherwise be noted as theoretical are recorded in this document as actual impacts. Several premises are used in evaluating the impact of this project.

They are:

1) MSDGC generates hundreds of tons of sludge daily;

2) there are abundant parcels of drastically disturbed lands such as the Fulton County site that would benefit from reclamation; and

3) the Clean Water Act and the Resource Conservation and Recovery Act place constraints on certain practices involved in this project.

The USEPA has taken a position that it should encourage, to the maximum extent possible, the safe utilization of municipal sludge solids on land. This recognizes that sewage sludge is not a waste product, but a resource which, when safely applied to land, benefits not only the land in soil building, but reduces the need for costly synthetic fertilizers. USEPA promulgated criteria for disposal of solid wastes, including sludge, in September 1979. The basic premises of these criteria were applied to this project during this evaluation.

Many comments received on this project have been addressed within the text. The project has been modified since the preparation of the Draft EIS in June 1976, and many comments received on former operational procedures would no longer be valid. For example, no spray operations exist at the site and the number of odor complaints received by the Fulton County Health Department have drastically diminished. Full discussions of project operations and impacts are contained in appropriate chapters and are summarized below.

A. Project History

The first collective action resulting from the long-standing concern of Fulton County citizens over the adverse effects of strip mining on the agricultural economy was taken in 1970, when the County Board of Supervisors and the States Attorney's office formed a special citizens committee to investigate the feasibility of a strip-mine landfill and leveling project in Fulton County. When it became apparent that some measures were needed to modify the inorganic mine spoil covering the landfill, the use of digested sewage sludge solids was proposed by MSDGC as a means of soil rehabilitation and crop fertilization. After many investigations, the County Board approved a resolution proposed by the Mines and Mining Committee to negotiate for a sludge utilization project.

Fulton County had over 45,000 acres of strip-mined land and was adding to this at a rate of 1,200 to 2,000 acres per year. The reclamation and productive agricultural reuse of this land proposed by the MSDGC would be accomplished at no cost to the County, and direct involvement of County government in the project from its conception would offer strong local environmental controls. Presumably, a project utilizing wastewater byproducts from an urbanized area would be tightly controlled by State and Federal agencies having the expertise and authority to ensure environmental and health safety. The County Board chose to support the Sanitary District proposal.

During the initial years—in the early seventies—of project construction and operation, some members of the local community sought injunctions against the MSDGC and damages for alleged odor nuisance. However, on February 26, 1976, the Illinois Pollution Control Board rendered its final opinion in favor of the MSDGC, removing a limitation imposed by the Illinois Environmental Protection Agency (IEPA) on the amount of sludge to be stored in the holding basins. While the outcome of the litigation is still pending, the MSDGC had discontinued aerial spraying of sludge and substituted surface incorporation using soil disking machinery. The Pollution Control Board still has the Odor issue under review.

Although the recent conversion to direct sludge incorporation into soil has largely resolved the odor issue, it also caused the reexamination of project goals for recycling sewage sludge solids through crop fertilization. While spray operations allowed application of sludge to growing crops, tandem disk operations preclude the production of crops during the year of sludge application. The normal cropping practice includes one application of sludge prior to preparing the seed bed. After cropping, the field would lie fallow during the next year allowing sludge applications of approximately 25 dry tons per acre. At six percent solids, this usually means five or six applications during the year.

Economic considerations have further altered the original thrust of the Fulton County sludge utilization project. Instead of returning all of the surplus supernatant fraction of sludge stored in the holding basins to Chicago sewage treatment plants, as in the early years of operation, most of it is now utilized on the project site by large-scale application through gated pipe to hay crops. Nitrogen is removed from the sludge application site by cropping hay. Since the sludge supernatant is very low in sludge organic solids (0.1 percent solids), it contributes considerably less to soils rehabilitation. Another modification to the initial land reclamation and crop fertilization scheme is the utilization of sludge and supernatant for reestablishing an original Illinois tallgrass prairie rather than for traditional agriculture. This effort is presently experimental, as is another activity involving reclamation of unleveled strip-mine gob and slurry piles by incorporating sludge through deep trenching and back-filling.

All project activities are under the close scrutiny of the Fulton County Steering Committee which was established in 1971 to provide public participation. The Committee is comprised of public officials, private citizens, and MSDGC personnel. Ample surveillance of project development and operations is provided through Committee membership involving public agencies responsible for environmental and health safety—the Illinois EPA and Fulton County Health Department. Organized citizens groups also participate.

B. Pre-existing Conditions

Prior to the strip-mining operations in Fulton County, the existing land use was row crop production. The site was then gently rolling with rich deep prairie soils which annually produced corn and soy bean crops. Some cattle were probably raised in small areas. Several farms were scattered within the site. The strip-mining operations destroyed these conditions. The following description of environment is based upon the drastically disturbed land that was left behind. Only part of the area was partially reclaimed prior to purchase by the MSDGC.

1. Climate

The Fulton County land reclamation project site is located in central Fulton County, which is situated in the upper region of the Spoon River watershed in west central Illinois (see Figure II-1). The climate of the project area is typically continental. The most probable weather conditions are a neutral atmosphere (Pasquill Stability Class D) and southerly winds at 10.2 miles per hour.

2. Topography

One consequence of the large-scale strip-mining operations in Fulton County is an extremely rough topography, presenting a large challenge to full land reclamation and reuse. Strip mining has left steeply sloping spoil mounds which may increase the capacity of storm runoff to carry suspended solids into receiving waters. Mining has also resulted in a number of long, narrow lakes, which probably have altered the distribution of thermal energy at the site and, therefore, the microclimate. One early attempt at reclamation was carried out by Mr. William Gale. He bulldozed several hundreds of acres of land in an effort to run a cattle ranch. Another effort was made to grow trees on the unreclaimed spoils; neither of these operations greatly modified the strip-mined land. At the western perimeter of the current site a number of gob and slurry piles were left by the United Electric Company at the termination of mining operations. This area is the only area where acid mine drainage occurs.

3. Geology and Soils

During surface mining, the overburden soils and cap rock were removed. The subsurface of strip-mined areas consists of cohesive fine-grained soils with pockets and discontinuous zones of boulder-size rock. The rearranged and redistributed overburden soils have extremely low permeability, minimizing the potential for groundwater contamination from leaching of surface pollutants, but increasing surface runoff and the potential for surface water contamination. Nevertheless, some zones or layers may consist of broken shale and sandstone or blocks arranged in a way that increases permeability to a rate as high as 10-1 centimeter per second. Although such zones are seldom continuous for more than short distances, they are considered important near reservoirs.

In areas where strip-mining has occurred, the glacial soils are covered by loess. This material has low permeability and is subject to erosion, depending on vegetative cover and other conservation practices. Decomposition of mineral deposits such as black shale, which are exposed by strip mining, create high background levels of trace elements, complicating the assessment of water pollution from sludge.

While most strip-mined areas are characterized by acidic soils and surface waters, Fulton County's calcareous soils are near-neutral to alkaline. This characteristic is highly significant because it leads to the immobilization of many hazardous metals that might otherwise be available for plant uptake in an acidic environment. This is true both for heavy metals existing in the place land or mine spoil and for those added when sludge is applied.

4. Hydrology and Water Quality

Most of the surface water at the project site is drained by Big Creek and Slug Run to the Spoon River, a tributary of the Illinois River. Steep slopes, sparse vegetative cover and poor soil permeability create high runoff volume and velocity, promoting erosion and stream or lake siltation which can adversely affect aquatic biota.

Determinations of baseline surface water quality before the sludge utilization project began show the overwhelming influence of strip mining on the quality of water in streams and reservoirs at the site. Pre-project levels of sulfate, copper, lead, iron and manganese in streams and reservoirs, which violated State standards, reflect the composition of runoff over strip-mined land. High concentration of ammonia nitrogen and fecal coliforms in Big Creek before the project began, often in violation of Illinois standards, illustrate the strong influence of pollutant sources upstream from the project site, including effluent from the Canton sewage treatment plant.

Groundwater quality reports for the project area before the project began operations indicated that concentrations of chromium, copper, iron, lead, manganese, and nickel were within ranges found elsewhere in the United States. Baseline ranges of pH and zinc concentrations were close to national values, but those of chloride, sulfate, calcium, magnesium, and sodium were higher, indicating high dissolved solids or salt concentrations, at least with reference to standards for groundwater used as a water supply. The chemical composition of groundwater was influenced by the geochemical characteristics of abandoned strip mines, such as heavy metals in exposed black shale. It is important to add that most municipal groundwater supplies in the project vicinity are obtained from deep wells unaffected by surface land disturbance. Also, low soil permeability makes groundwater resources much less vulnerable to sludge leachate.

5. Land use and Economic Conditions

According to present trends, demand for farmland in Fulton County has remained high. Local agriculture is changing in composition. Dairy, winter wheat and poultry production is declining, while corn, soybean, swine and beef cattle production have increased. Thus, future land use in the project area will probably be centered more on forage crops, pasture and feedlots than on plant or animal produce.

Suitability of strip-mined land in the project area for various uses is affected by topography, soils, and drainage. Problems of settlement with unconsolidated soils in the strip-mined sections of the project site could make it more difficult to build hard-surface roads, underground utilities, and residential or industrial structures. Nearby developments on similar mined land, however, demonstrate the feasibility of construction on the MSDGC property. Current levels of available plant nutrients and organic matter make these soils unsuitable for intensive agriculture. Without land reclamation utilizing sewage sludge, any row-crop production on formerly strip-mined fields would depend on liberal use of costly chemical fertilizers, extensive soil conditioning, and rigorous conservation practices. Steep slopes and severe problems of access in unreclaimed strip-mining areas have caused failure of previous attempts to manage timber crops in Fulton County.

The recreation potential of the project area has been limited by poor accessibility (at least until the proposed Interstate Highway is completed) and competition from the diverse attractions in nearby Spoon River Valley, along the Illinois River, at Dickson Mounds State Park, and in the numerous former strip-mined areas where recreation uses are of particular interest. Some hunting and fishing activities have occurred. One area in particular contained potholes which attracted migratory waterfowl. Recreational potential for nearly all the MSDGC property is limited by the existence of an extensive above-ground sludge pipeline system which is subject to vandalism. That vandalism has prompted the MSDGC to close all of their property other than the "Fulton County Conservation Area" to public access.

Large tracts of equally available and suitable land in Fulton County are expected to keep land values low in the project area. According to tax assessment records, reclaimed strip-mined lands which are used productively have been valued only 25 percent more than unreclaimed lands.

C. Existing Project Operations

Project construction began in January 1971. Approximately 4,344 acres of the 15,529-acre project site (August 1977) have been recontoured and graded to create 43 fields suitable for sludge application and row crop agriculture.

Sixty-one retention basins were constructed to contain stormwater and erosion including sludge runoff from application fields. Four large holding basins having a combined capacity of 8 million cubic yards were constructed to provide for the interim storage of liquid sludge and sludge supernatant.

To protect against environmental degradation possibly resulting from the project, sludge holding basins were lined to prevent seepage to groundwater, control berms and retention basins were installed on sludge application fields to contain all field runoff and control basin effluent quality, and the fields were graded and provided with siltation basins to reduce runoff velocity, erosion and sedimentation. The effectiveness of environmental control systems and the environmental soundness of project operations are monitored intensively by the State of Illinois and the County. Each step of the project is monitored to assess impacts on the environment.

The operations begin when anaerobically digested sewage sludge from the MSDGC West-Southwest Treatment Plant or aged sludge from the Lawndale lagoons, or a mixture, is barged approximately 180 miles from Chicago down the Illinois River to the dock at Liverpool in Fulton County. In 1977, shipments averaged 200 dry tons per day or one-third of the entire MSDGC sludge output. The sludge is pumped out of barges and relayed 10 miles by booster pumps to the project holding basins for storage. Dredging equipment is used to withdraw sludge from the basins. The withdrawn sludge is pumped and distributed to the application fields at an average rate of 23 dry tons per acre (1977), using a modular pipe network installed on the ground surface. The pumped mixture usually has a solids content of approximately 5 percent. A major portion of the sludge supernatant previously was barged back to the head end of the West-Southwest Treatment Plant or to the Chicago Lawndale lagoons. In 1976, the MSDGC modified its procedures providing for the large-scale application of supernatant to 17 additional fields at the project site, comprising 1,334 acres. Maximum permitted rate of supernatant application is 117,000 gallons per acre per year, which provides 120 pounds of available nitrogen. In practice, the soil hydraulic capacity has been a more limiting factor.

Sludge that is shipped to Fulton County must meet standards set by the Fulton County Health Department. Prior to November 8, 1975, the following standards applied:

1. Volatile acids--no more than five 24-hour composite samples taken in a 30-day period shall exceed 300 milligrams per liter

2. Alkalinity--no more than 5 percent of the 24-hour composite samples taken in a 30-day period shall be lower than 2,500 milligram per liter

3. Volatile solids--no 24-hour composite sample shall be more than 62 percent of total solids

4. pH--no 24-hour composite sample shall be less than 6.9.

As of May 1975, sludge from the Lawndale lagoons complied with all standards except for alkalinity, which was deficient 9.5 percent of the time. Sludge from the West-Southwest plant complied with the volatile acids standards, but was deficient 3.9 percent of the time for total volatile solids, 1.4 percent of the time for alkalinity, and 1.3 percent of the time for pH.

By November 1975, the Fulton County Health Department recognized that sludge storage for long periods of time results in volatilization of ammonia and consequent decreases in alkalinity, and existing regulations were perhaps too stringent in view of the fact that some sludge shipped to Fulton County had been in storage in the Lawndale lagoons for periods ranging up to 15 years. At that time, therefore, the volatile acids and alkalinity standards were changed to the following.

* If volatile acids are less than 100 milligrams per liter then the alkalinity cannot be less than 1,500 milligrams per liter
* If volatile acids exceed 100 milligrams per liter then the alkalinity cannot be less than 2,500 milligrams per liter.

Since the standards were amended, there have been no violations. Sludge quality has actually improved since 1974; alkalinity standards had not been violated since December 1, 1974; pH has never been deficient since November 26, 1973; and the standard for total volatile solids has been met since November 14, 1973.

The Fulton County Board repealed their ordinance on Sludge Handling in July 1980 and no longer has any type of controls over sludge handling or sludge quality.

The sludge is applied to the soil by a tractor-drawn tandem disk incorporator. The disk incorporator applies sludge to the entire plow layer of the soil, using a disking machine with a distribution manifold that directs sludge to each disk while tilling the soil.

Supernatant is applied through a gated irrigation pipe. With the gated irrigation pipe, the pipe is laid on high ground and sludge supernatant is pumped through the slots, forming a downslope sheet flow across the application field. Harvesting three hay crops during the primary growing season removes excess nitrogen.

Annual sludge application rates were originally proposed to be 75 dry tons per acre in the first year of project operations, tapering down to 25 dry tons per acre by the fifth year and continuing at that rate. The actual average rate of sludge application has increased from 2.7 dry tons per acre in 1972 to 23 dry tons per acre in 1977.

In some instances, sludge has been applied to original place land at reclamation rather than agronomic rates. The Illinois Environmental Protection Agency (IEPA) defines agronomic rates to be approximately 5-12 dry tons per acre per year. This practice is permitted by the IEPA where there is adequate environmental monitoring. On application fields previously strip mined, annual rates of application reached 60 dry tons per acre in 1976. By late 1977, only one application field designed to utilize sludge supernatant was in use; supernatant is required to be applied at the nitrogen agronomic rate for the hay crops harvested.

A sludge analysis program is designed to ensure adequate treatment of sludge before shipment to the holding basins. The water monitoring system includes sampling from 26 wells, 1 spring, 11 stream stations, 10 reservoir stations, and 61 runoff retention basins. The soil monitoring program includes sampling of the plow layer (0-6 inches) and soil boring to bedrock taken and analyzed for physical and chemical parameters. Sampling of aquatic biota as well as crop leaves, grain, and tissues of livestock test herds is being conducted to determine effects of sewage sludge application. In addition, a portable meteorological station was set up close to the holding basins to measure air temperature, wind speed and direction, relative humidity, and rainfall.

Beginning in 1971 through the present, project operations have been performed pursuant to permits issued by the Illinois Environmental Protection Agency and the Fulton County Health Department.

The Fulton County Planning Commission reviews all land use plans and requests modifications or gives approval.

D. Alternatives to the Project

The sludge processing and disposal methods practiced by the MSDGC represents nearly the full spectrum of system alternatives. Ten system options were derived by the MSDGC from various combinations of subsystems, for sludge dewatering, stabilization, disposal, utilization, and transportation. The ten systems chosen for analysis are presented in a cursory manner in Figure I-1 because they are only peripherally related to actual impacts at the site. They do provide information concerning options and relative risks.

The cost-effectiveness of a system represents a balance between capital, operating and maintenance costs, system reliability, environmental impacts, and costs for measures to prevent or mitigate potential environmental hazards or impacts. The only component in this balance for which actual values can be assigned is total annual costs. Environmental impacts can be assessed only in terms of relative potential impacts from each system alternative, as the state of the art has not progressed to the point of reliably assigning monetary or other exact values to environmental effects.

While either incineration and sanitary landfill of ash or direct sanitary landfill of dewatered sludge might appear to be attractive alternatives to land application, several overriding considerations are not highlighted here. The high energy requirements for incineration and potential emissions of volatilized hazardous substances such as cadmium tend to outweigh the lower costs; also, this alternative is effectively unavailable in the Chicago region due to fuel and air quality restrictions. New sanitary landfill sites in the Chicago region are practically unobtainable, and they waste the nutri-nutrients in sludge which can be recycled safely and efficiently in a well-designed, well-managed land utilization project.

E. Existing polices and recommendation of Federal Agencies

1. Food and Drug Administration

The Food and Drug Administration (FDA) of the U. S. Department of Agriculture

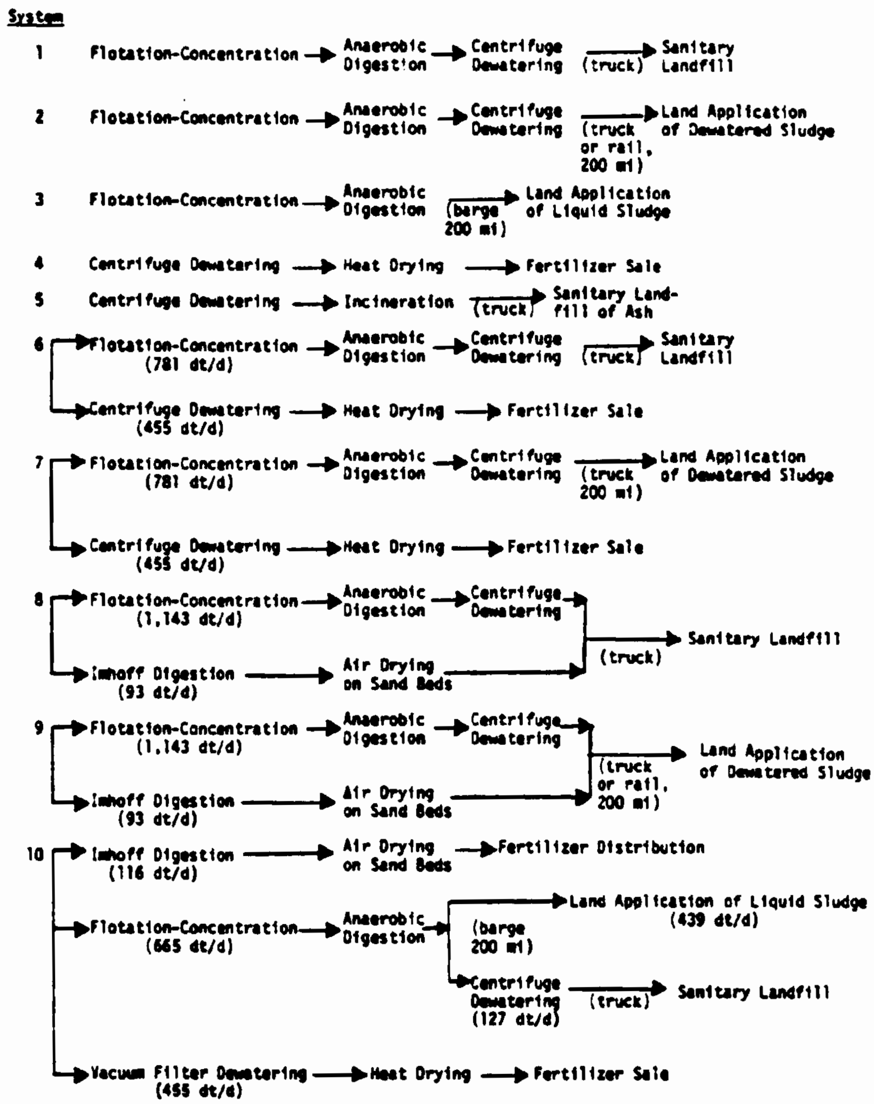


Figure I-1. System Operations and Sludge Flows (MSDGC 1975a) has primary responsibility for ensuring the safety and wholesomeness of the nation's food supply. Specific FDA research is directed at preventing levels of sludge contaminants in soils and foods from becoming sufficiently high to subject consumers to unnecessary risks or necessitate large withdrawls of land from food production. Specific FDA concerns and recommendations are summarized below.

The FDA has assigned first priority in its heavy metals program to mercury, lead, cadmium, arsenic, selenium, and zinc in foods. The FDA presently regards cadmium and lead as the metals of greatest concern, while more information is needed on the content of mercury, arsenic, and selenium in sludge and food to properly assess their hazard.

Repeated application of cadmium-containing sludge causes a build-up of cadmium in the soil, according to the FDA, and many crops, including the grains, take up cadmium from the soil. Because approximately 23 percent of the total cadmium intake in the diet comes from grain and cereal products, the FDA believes that an increase of cadmium in grains could lead to a significant increase in the cadmium burden from our food supply.

With regard to pathogens as a possible hazard, the FDA believes that the development of a cycle with ascarid eggs (intestinal worms) in sludge is a potential problem. Such a cycle would begin with increased intake of ascarid eggs by a community ingesting food grown on sludge-amended soils, increased pathogens discharged into the sewage system, and increased numbers of eggs surviving sewage treatment and re-entering the food chain through application of sludge to agricultural land. The FDA also states that Salmonella, other bacteria, and pathogenic viruses, are a cause for concern with sludge-treated soils and crops.

2. U.S. Department of Agriculture

The U.S. Department of Agriculture (USDA) states that the application of sludge to agricultural land which may be used for crop production, must be accomplished so that cropland resources are protected and harmful contaminants do not accumulate in the human food chain. Specific suggestions of the USDA have been incorporated in the development of the USEPA Technical Bulletin on Municipal Sludge Management. This was published in final form on November 2, 1979 and its recommendations are presented below. Limits are based on experiments directed at the determination of heavy metal levels toxic to plants or absorbed by plants. These levels may not constitute appropriate levels for human intake and should be subject to revision as new information becomes available. Levels of metal additions apply only to soils that are adjusted to pH 6.5 or greater when sludge is applied, and managed at pH 6.2 or greater thereafter (soil pH determined by 1:1 water, or equivalent method).

> Sludges having cadmium contents greater than 25 milligrams per kilogram or 25 parts per million (dry weight) should not be applied to privately owned land unless their proportions of cadmium to zinc are less than or equal to 1.5 percent. This safeguard is designed so that visible damage to plants from zinc toxicity would serve

as a warning of, or deterrent to, excess accumulation of cadmium. Sludge having a greater proportion of cadmium as compared to zinc should not be applied on a continuing basis unless there is an abatement program to reduce concentrations in the sludge to acceptable levels.

Annual sludge application rates on privately owned land should be the lower of the nitrogen requirement of the crop (inorganic nitrogen + 20 percent organic nitrogen), defined as 100 percent of the crop requirement when sludge is incorporated into the soil and 150 percent of the crop requirement when applied to the soil surface or the cadmium loadings on land, which should not exceed 1 kilogram/hectare/year from liquid sludge or 2 kilograms/hectare/year from dewatered sludge.

No greater amounts of sludge-borne metals may be applied to privately owned land than those shown in the following table.

Table I-1. Maximum Cumulative Sludge Metal Applications for Privately Owned Land (kilogram per hectare)

	Soil Cation Exchange Capacity (meq/100g)*		
Metal	0-5	5-15	15
Lead	500	1,000	2,000
Zinc	250	500	1,000
Copper	125	250	500
Nickel	50	100	200
Cadmium	5	10	20

*Determined on unsludged soil by the method utilizing pH 7 ammonium acetate for a weighted average to a depth of 50 centimeters (milliequivalents per 100 grams)

On land dedicated to sludge application (such as publicly owned or leased land, up to five times the amounts of sludge is mixed into the 0-15 centimeter layer of surface soil. Where deeper incorporation is practiced, proportionally higher total metal applications may be made. If the sludge metal application rates on land dedicated to sludge application exceed those maxima recommended for privately owned land, metal analysis should be provided to purchasers of marketed products grown there.

Growing leafy vegetables on sludge-treated land is not recommended without monitoring the metal contents of the crop.

Sludge should not be applied to privately owned land having soils with less than 50 centimeters of depth.

3. U.S. Environmental Protection Agency

As stated earlier, on November 2, 1977, the USEPA published the final version of "Municipal Sludge Management: Environmental Factors." This document is a Technical Bulletin for use in the USEPA Construction Grants Program and is to be used in an advisory manner.

Recommendations relevant to indirect health effects are summarized as follows:

> Although absolute numerical limitations on heavy metals are not appropriate, the project should conform to any limitations established by the FDA or USDA. If the sludge is relatively high in heavy metals, it is prudent to pretreat the contributing industrial wastewaters, maintain a pH above 6.5 in the combined soil and sludge, grow grain crops as opposed to leafy vegetables, and intensify heavy metals monitoring in the sludge, soil and plant tissues.
>
> Sludge application rates should be controlled so that the total amount of nitrogen added and available to plants is no greater than twice their nitrogen requirements for growth, including that mineralized from the soil, the inorganic sludge nitrogen, and organic sludge nitrogen based on a mineralization rate of 15 to 20 percent for the first growing season, and 3 percent of the residual sludge nitrogen for three subsequent growing seasons (volatilization of ammonia from surface-applied sludge should be taken into account).
>
> When sludge is used for agricultural purposes, it is necessary to achieve pathogen reduction beyond that attained by stabilization. Methods reported as successful include pasteurization for 30 minutes at 70 degrees Centigrade (C); high pH treatment, typically with lime, at a pH greater than 12 for 3 hours; storage of liquid digested sludge for 60 days at 20 degrees C or 120 days at 4 degrees C; complete composting at temperatures about 55 degrees C as a result of oxidative bacterial action and curing in a stockpile for at least 30 days.
>
> Because specific organisms may survive in the soil for extended periods, sludge-treated land should not be used for growing human food crops to be eaten raw before three years after the last sludge application. For orchard crops eaten raw, heat-

dried sludge can be used provided the project is approved by the FDA.

If direct contact occurs between sludge and a growing crop, sludge should be negative for Salmonella and Ascaris ova if the crop, although normally cooked in the home before consumption, is to be marketed without processing which is lethal to pathogenic microorganisms and parasites.

Forage and pasture crops should not be consumed by animals while these crops are physically contaminated by sludge. Grazing animals should not be permitted on pastures before thorough removal of sludge, by rain or some other means. When there is a risk of direct ingestion of the sludge by grazing animals, the lead content of the sludge should not exceed 1,000 milligrams per kilogram (dry basis) and the cadmium content should not exceed 20 milligrams per kilogram (dry basis).

New regulations addressing Cadmium loading rates, PCB concentrations, pathogen levels, and public health considerations were published September 13, 1979. Entitled "Criteria for the Classification of Solid Waste Disposal Facilities and Practices", these regulations superseded the above-mentioned recommendations in the categories that it addresses. These regulations set forth the requirements and criteria for applying municipal sludge to land for agricultural purposes. Compliance with these criteria is mandatory under Section 405 of the Clean Water Act. It should be noted that those portions of the regulations dealing with sludge application are designated as interim-final regulations. This means that they are legally binding but subject to change based upon additional public comment.

A summary of these regulations as they pertain to the land application of sludge is presented below.

40 CFR 257 - Criteria for Classification of Solid Waste Disposal Facilities and Practices

a. Cadmium - The regulations put forth two approaches to cadmium control.

(1) This approach involves disposal site management controls and standards governing cadmium applications. It requires that the soil/sludge mixture pH be 6.5 or greater at the time of each sludge application. There is no pH requirement if the sludge contains concentrations of cadmium 2 milligrams per kilogram (dry rate) or less. For application of sludge to soils that will be used for the production of tobacco, leafy vegetables, or root crops grown for human consumption, a mass loading limit of 0.5 kilograms cadmium per hectare may not be exceeded.

For all other food chain crops the annual cadmium application rate may not exceed:

TIME	ANNUAL CADMIUM APPLICATION RATE (KILOGRAMS PER HECTARE)
Present to June 30, 1984	2.0
July 1, 1984 to December 31, 1986	1.25
Beginning January 1, 1987	0.5

Limitation on cumulative sludge cadmium applications are as follows: 5 kilograms per hectare, where soil cation and exchange capacity (CEC) is less than 5 milliequivalents (meq) per 100 grams; 10 kilograms per hectare where CEC is between 5 and 15 meq/100 grams and 20 kilograms per hectare where CEC exceeds 15 meq/100 grams. If background soil pH is less than 6.5, cumulative sludge cadmium limit is 5 kilograms per hectare regardless of cation exchange capacity unless the pH is adjusted to and maintained at 6.5 or greater whenever food chain crops are grown.

(2) The second approach involving cadmium limits is known as the "control site" or "dedicated site". This concept is analogous to the Fulton County project that is under the direction of the Metropolitan Sanitary District of Greater Chicago. Under this management scheme, there is no cadmium mass loading limit. However, the owner or operator must maintain sludge/soil pH of 6.5 or greater when the sludge is applied or when crop is planted, whichever is later; this pH level must be maintained whenever food chain crops are grown. Also, the owner or operator of the site must develop a facility operating plan which shows how animal feed will be distributed to prevent ingestion by humans and describes measures to be taken to safeguard against possible health hazards from cadmium in the food chain which may result from alternative land uses. This latter aspect is basically a requirement that future property owners are notified by a stipulation in the land record or property deed stating that the property has received sludge at high cadmium application rates, and that food chain crops should not be grown.

b. Polychlorinated Biphenyls (PCB's) - For municipal sludges containing PCB's in concentrations greater than 10 milligrams per kilogram (dry weight), the regulations require that such sludge be incorporated into the soil. Incorporation into the soil is not required if assurance can be given that the PCB content in the animal feed grown is less than 0.2 milligrams per kilogram or that milk from animals grazed on land that has been amended with sludge has less than 1.5 milligram per kilogram of PCB.

c. Pathogen Levels - There are two land application approaches outlined in this portion of the regulation, depending on the type of crops grown.

(1) Septage (solids from septic tanks) may be applied directly to agricultural land provided that public access is restricted for 12 months and that grazing by animals whose products are consumed by humans is prevented for at least one month. Similarly, sewage sludge that has achieved a level of

pathogen reduction comparable to anaerobic digestion, may be applied directly to agricultural land, provided that public access is controlled for at least 12 months and grazing is prevented for at least one month.

(2) If sewage sludge or septage is applied to land that is used for crops directly consumed by humans, a stabilization process equivalent to heat drying or thermophilic aerobic digestion must have been used. This level of treatment is not required if there is no contact between the solid waste and the edible portion of the crop.

d. Other Criteria - It is important to remember that all of the criteria and regulations found within 40 CFR 257 will apply to land application programs. The additional criteria describe performance standards and/or operating techniques to protect air and water quality, sensitive land and biological resources, and public health and safety. For example, in flood plains, the criteria would prohibit land application of sludge which would restrict the flow of the base (100 year) flood plain, reduce temporary water storage capacity, or result in a washout of sludge that would threaten human life, wildlife, or land or water resources. The criteria also address endangered species, pollutant discharges, underground sources of drinking water, and open burning.

4. Council for Agricultural Science and Technology

As an aid in addressing questions concerning heavy metals arising from the USEPA proposed Technical Bulletin, the USEPA requested that the Council for Agricultural Science and Technology (CAST) create a task force to review recent research on the application of sludge to cropland and to prepare a consensus statement on the potential of hazards of heavy metals in sludge to plants and animals. A report was prepared by a group of 30 scientists, most of whom have been actively engaged in research on the application of sewage sludge to agricultural land. Conclusions and recommendations concerning specific metals evaluated in this report are summarized below.

> Manganese, iron, aluminum, chromium, arsenic, selenium, antimony, lead, and mercury produce relatively little plant accumulation or hazard to crop production when sludge is applied to the soil because all either have low solubility in slightly acid or neutral, well aerated soils or, as with selenium, are present in such small amounts that their concentration in soils is quite low. The availability of these elements to plants is relatively low, and little uptake by plants occurs.
>
> Cadmium, copper, molybdenum, nickel, and zinc can accumulate in plants and may pose a hazard to plants, animals, or humans under certain circumstances.
>
> In general, the increase in metal contents of plants is greater from the initial sludge application than from subsequent applications.

CAST recommendations are as follows:

> To limit cadmium accumulation in food supply from sludge treated land to a relatively low level, maintain soil pH at or above 6.5, grow crops which tend to exclude cadmium from the whole plant or from reproductive tissue, apply low annual rates of cadmium and use sludges which have a low cadmium concentration, and/or grow non-edible crops.
>
> Maintaining soil pH at 6.5 or greater should also prevent zinc and nickel from posing a threat to plants and/or the food supply. While this results in greater solubility and availability of molybdenum than would occur at lower pH values, sludges are usually very low in molybdenum and that element would probably not pose a serious hazard to the health of grazing animals.
>
> The long-term impact of repeated applications of sludge on metal concentrations in the food supply could be reduced substantially by growing corn and other selected crops harvested for their edible seeds or fruits in place of forages or leafy vegetables.

The USEPA recognizes that these recommendations are based upon applications to agricultural lands which have not been strip mined. In the case of Fulton County, where two goals are being addressed, land application and reclamation, the USEPA proposes that the land application program be consistent with the Criteria for Classification of Solid Waste Disposal Facilities and Practices to the fullest extent possible. Should occasional variances occur, access to land should be controlled and both the site and crops monitored to detect potential adverse impacts. Compliance with the alternate cadmium control procedures would be required.

F. Environmental Impacts

1. Land

The effect of sludge application to the spoil soils of Fulton County in conjunction with leveling operations has a beneficial impact. The positive effects to the soil result mainly from the high content of organic matter in the sludge.

Increased aggregate stability resulting from the addition of organic matter results in decreased erosion potential. Organic matter also provides a matrix for ionic loading and water absorption, and plant nutrients for increased agricultural productivity.

Although increased soil organic matter reduces erosion potential, the degree of soil erosion depends to a greater extent on the contour of the land. Early designs based upon spray operation required convex shaped fields which promoted runoff, especially along field perimeters. Redesign and operational modifications have rectified the initial deficiencies. Also, spray irrigation is no longer used.

The MSDGC has been constructing supplemental siltation basins to retain silt-laden runoff. However, a lack of vegetation on control berms, in properly structured drainage channels and basin dikes has contributed to severe gully erosion, accelerating siltation and thereby reducing this added capacity for controlling soil loss and sedimentation in runoff retention basins. Available records indicate only sporadic cleaning of siltation basins; it is difficult to determine whether this reflects poor maintenance or poor record-keeping. MSDGC records are also sparse in documenting repairs to drainage pipes, which have on occasion become damaged or clogged, obstructing discharge from siltation basins into run-off retention basins.

High rates of disk incorporation of sludge contribute to soil erosion by necessitating multiple passes of the incorporator during the primary growing season, obviating the possibility of growing a crop. In alternate years, when a field lies fallow without even a cover crop and sludge is applied, soil erosion will increase considerably.

It is uncertain as to what proportion of accumulated toxic metals are actually available and therefore detrimental to crops. Monitoring at Fulton County has shown that metal uptake by crops presently corresponds more to the amounts of sludge applied in the current growing season than to the amounts accumulated from previous years. Because the MSDGC no longer produces a crop in the alternate years of sludge application, the availability of metals for uptake should be reduced considerably in the intervening years when crops are grown.

2. Water

Pre-project investigations show that surface water quality was exceedingly poor as a result of runoff and leachate from strip-mine spoil and, in Big Creek, upstream pollution sources including effluent from the Canton sewage treatment plant.

High background concentrations of metals and nutrients, which are not attributable to MSDGC operations, may allow small contributions of sludge constituents to be masked and thereby go undetected. At the same time, poor upstream water quality vastly decreases the likelihood of such contributions resulting in the further deterioration of water quality.

a. Surface water impacts - Surface water quality is monitored at stream and reservoir stations as well as runoff retention basins. A comparison of Illinois water quality standards to the quality of stream and reservoir samples during earlier and more recent stages of the project shows that surface water quality has not significantly deteriorated.

The downstream station located on Big Creek demonstrates better overall water quality than the station located upstream on Big Creek before it enters the project area. This indicates that dilution and instream purification occur in this stretch of Big Creek. Although increased levels of sulfate and total dissolved solids occurs at S2, this has been attributed to previous strip mining operations performed at the site. These operations brought in new soil materials, including pyrite, shale, and limestone to the surface.

Observations at the site indicate that the greatest shortcoming of the runoff basins is their inability to contain storm runoff and intermittent rainfall of approximately one to two inches per day which may occur daily over a period of about a week. These conditions lead to hydraulic soil saturation, during which time the soil cannot accommodate recycled runoff basin contents. This circumstance has sometimes led to emergency releases of runoff basin effluents that could not meet effluent standards.

Examination of the logs of runoff basin discharges reveals faulty operating procedures. Basin discharge gates that have been left open during prolonged periods of heavy rainfall, allowing the free flow of runoff, sometimes result in substandard effluents entering surrounding surface waters. Records produce no mention of backpumping retained runoff onto application fields, although this procedure was intended in the project design and backpumping records were required by the initial IEPA operating permit.

Effects resulting from underdesigned and poorly maintained runoff basins are probably highly localized and confined within the project site. Project operations through 1977 do not appear to have made any significant impact on surface water quality.

b. Groundwater impacts - Trend analyses were made for nitrate and nitrate nitrogen, ammonia nitrogen and iron in four wells selected to represent background groundwater quality ("without the project"). Data were examined to investigate possible seepage from the sludge holding basins and possible groundwater contamination from sludge application. The data were found to indicate increasing nitrite and nitrate levels in one well only, and this was not attributable to project operations.

Fecal coliforms, trace elements and other chemical concentrations in wells remain close to the pre-project conditions. The variations in groundwater quality at most stations are comparable and are probably influenced by the geochemical characteristics of abandoned strip mines. Groundwater quality has apparently remained unaffected at this stage of the project. Therefore, soils appear to be functioning well as a biochemical filter for removal, conversion, and fixation of sludge.

3. Air

Impacts on air quality may result from aerosolization and volatilization of sludge constituents, possibly presenting odor problems. This section summarizes odor complaint data and the relative odor potential of the sludge holding basins and alternative application techniques.

Since project initiation, complaints of offensive odors have arisen from citizens near the project site. The Midwest Research Institute (MRI), under contract with Fulton County Health Department, designed a program to verify the origin of these complaints. The frequency of odor complaints has been found to be decreasing each year. Although some localized odors can be detected under special conditions, modified application techniques may have reduced the incidence of odor generation. This can be attributed to the elimination of the spraying operations.

4. Health

Stabilized sludge contains potentially toxic substances such as heavy metals and pesticides, and may also contain human and animal pathogens and parasites, although usually in very low concentrations.

The presence of animal virus downwind of the sludge spraying source during active application periods was found not to be independent of background conditions. There is evidence which indicates that the spray application was not the only source of virus. Bacteria concentrations decreased exponentially with distance from the spray source. Wind velocity, temperature and relative humidity seemed to have little influence on downwind concentrations of bacteria (USEPA, March 1979).

The spraying operations terminated in 1976, except for one research field run by the University of Illinois. Therefore, this source of potentially harmful pathogens has been substantially reduced. Probably the best barometer of health effects is lack of health-related problems associated with project operators and local citizens within the county.

A major concern with the application of sewage sludge to land is the possibility of heavy metals being transferred indirectly to the public through the consumption of contaminated vegetables and meat. No indirect health effects are evident at this time. The nature of the project itself precludes the direct human ingestion of crops grown on site. Hay, corn, soybean and sorghum are sold on the open market. They represent a small fraction of the total crop produced in Fulton County and receive even greater dilution in larger markets. There is no evidence that crops are directly consumed by humans. Crops fed to animals consumed by humans add little to the existing burden.

On September 13, 1979, USEPA adopted criteria for regulating land disposal of solid waste designed to control annual and cumulative additions of cadmium to the soil. Because of the extensive monitoring available in Fulton County, the MSDGC project qualifies under the suggested alternative, which calls for analysis of cadmium comparable to levels present in similar crops or livestock produced locally where sludge has not been applied to land. The alternative criterion does not define "comparable" in a statistical sense, nor does it present an approach to determining what levels are locally representative.

Due to some severe land use constraints to build roads and housing on the present land, many potential health-related impacts will probably not occur. The current land is used where possible for row crops, not root crops or leafy vegetables. If the land is committed to this current usage, the relative risks of the project are very acceptable.

Further development of buffer zones and maturing vegetation will reduce not only some of the visual impacts but reduce further the potential risks due to runoff or erosion. Most of the site resembles typical farm lands with associated practices or modifications of the former strip-mined land.

Housing developments in the area apparently have not been adversely impacted by water quality associated with the strip-mining activities, but indeed have created their own pollution problems in non-project reservoirs (algae blooms due to contamination from septic fields).

5. Noise

Sources of noise related to the project include pumps and tractors. Three pumping or sludge distribution stations are located within project property, and one booster station is situated at the Liverpool dock. The pumping stations on the project site are situated at least one mile from the nearest farm. The booster station at the Liverpool dock and barge pumps are within 1/2-mile radius of Liverpool. Tractors and trucks are mobile noise sources that will be detected only when in operation near the boundary of project property.

Considering the one-mile buffer distance and further dissipation of noise by buildings, vegetation and topography, the noise level of pumps is acceptable for residential areas as recommended by the U.S. Department of Housing and Urban Development. Noise generated from pumps at the Liverpool dock and by barge pumps will somewhat increase the ambient noise level around the community of Liverpool, but not significantly.

6. Land Use

Leveling and grading of strip-mined sections of the project site to prepare the sludge application fields, and the removal of large rock fragments from the surface, have increased the suitability of the land for a number of uses. Beyond the obvious benefits to agriculture, leveling has made it possible to use farm machinery to control tree growth, instead of employing hand labor which is prohibitive in cost.

The removal of surface rocks and leveling of steep slopes have also considerably increased suitability for recreational use, including playgrounds, campsites, recreation building sites, roads, and trails.

7. Economics

The most obvious short-term local economic effect of the project has been to create jobs for approximately 120 skilled and unskilled contract laborers who average 6 to 8 months of employment yearly. In 1975, the MSDGC paid approximately $890,000 to their contract employees and $300,000 to their full-time staff of 23.

The sludge application project has also affected the local economy by increasing the future market value of the land and the tax base. In 1973, the MSDGC paid to Fulton County about $102,000 in real estate taxes, which amounted to 1.3 percent of total tax revenues, and $34,000 in personal property taxes which amounted to 3.4 percent of the total. Land reclamation and reuse could theoretically add about $280,000 to the market value of the 4,344 project acres of strip-mined land scheduled for sludge application.

Future uses of land will not be economically intensive and would generate little on-site employment and income. Income due to tourist-related retail and service enterprises has occurred in the recent past. Agricultural reuse, especially grazing, would have a small multiplier effect on local employment and income. Feedlots could contribute to the expansion of nearby meat packing firms. Full reclamation and agricultural reuse could theoretically add $100,000 to $200,000 per year (1970 dollars) to the ultimate value of agricultural output.

G. Mitigative Measures Needed to Ensure Environmental Compatibility

1. Land Management Measures

MSDGC should develop a Facilities Operating Plan as outlined in 40 CFR 257.3-5 (H)(1)(e). As promulgated, this cadmium management approach sets forth requirements which will serve to minimize the potential for many pollutants reaching the aquatic environment or the human food chain. This approach is more fully discussed on page VII-5. To further reduce the potential for contaminants entering the food chain it is recommended that the crops grown on fields used for sludge application be sold to alcohol producers and used for gasohol production.

The MSDGC should evaluate the optimum sludge application rate where soil erosion and siltation basin maintenance can be held to a minimum but land requirements do not get too large. Tradeoffs should be evaluated to keep soil compaction at a minimum and common agricultural techniques used to reduce associated problems. Chisel plowing and dry discing could be utilized to reduce soil compaction.

Where feasible, fields that are graded to drain laterally across the principal slope into ditches along the perimeter should be upgraded with a broad, shallow depression and retention dike at the base of the slope to add backup runoff retention capacity on the field itself, thus eliminating high velocity runoff, scouring, and gully erosion at the edge of the field.

Terraces constructed across long slopes and maintained in permanent vegetation should be provided, when practicable, for greater erosion control; drainage channels or ditches, dikes, and berms should be permanently grassed to stabilize the soil.

Cover crops to stabilize surface soil should be established and maintained on fallow fields immediately following seasonal sludge applications. MSDGC has indicated that they currently plant winter wheat to help satisfy this condition.

Breached dikes or berms should be repaired promptly; carriers of rock, hay bales or other material should be placed in ditches or runoff channels containing high velocity flow to reduce scouring and gully erosion.

Application fields should not be worked with sludge incorporation machinery when fields are muddy and ponding of sludge is most likely to occur. Often the "pull" on the incorporation hose by the tractor is the limiting factor to working in muddy fields, but ponding should be avoided where possible.

The effectiveness of past soil conservation practices should be carefully evaluated, and technical assistance should be sought from the Soil Conservation Service through the Fulton County Soil and Water Conservation District in planning the needed conservation practices to assure that soil loss does not exceed tolerable limits as defined by the Universal Soil Loss Equation.

It is essential that combined soil and sludge pH in all fields be maintained at or above 6.5 continuously.

The MSDGC should extend the current practice of building supplemental siltation basins, especially where soil loss and siltation of retention basins is severe and runoff retention capacity is marginal; also, there should be more frequent cleanout of full siltation basins and mowing of overgrown basins to preserve their function.

The prescribed practice of pumping from partially or nearly filled runoff retention basins back onto application fields should be employed where necessary to avoid emergency releases of substandard effluent; such recycling of runoff should occur before fields are saturated from rainfall and sludge application combined.

Discharge control gates should be kept closed during a period of runoff from a storm; prolonged periods when gates remain open should be carefully avoided.

A refined water quality monitoring scheme is required to differentiate the pollutant contributions from project point sources (retention basin discharges), community point sources (Canton sewage treatment plant), and non-point sources (runoff over mine spoil). Stream monitoring stations in particular are too few to enable segregating these contributions, and community pollution of Big Creek, where most stream monitoring occurs, tends to mask the possible pollution of minor contributions from project operations.

Quality of runoff retention basin effluents must be upgraded and should be monitored by analysis of 24-hour composite samples or by averaging the values of samples taken at several intervals instead of using a single grab sample. This is to say that during a release event MSDGC should take a series of grab samples over time, instead of one grab sample. Several mobile composite samples could be utilized by staggering release events. The current Illinois EPA requirement, which assumes relatively stable concentrations of biochemical oxygen demand, total suspended solids and fecal coliforms, has been ineffective in preventing occasional release of contaminants whose concentration can fluctuate widely in 24 hours. The IEPA should ensure that discharges do not cause a violation of instream water quality standards as required in 40 CFR 257.3-3(a). The sampling scheme should be agreed upon with IEPA.

2. Air Quality Management Measures

Periodic regrading to remove depressions due to subsidence of unconsolidated subsoil or mine spoil should be performed as necessary to prevent ponding of freshly applied sludge which presents a potential for odor emissions. Occasional unavoidable ponding should prompt measures to control odor generation. The MSDGC has applied an odor control product to ponded areas, and this practice should be continued.

The use of wind barriers such as tall, dense hedgerows around the holding basin berms, could reduce surface turbulence and wave action which intensify odor emissions. The present requirement of a 4-foot freeboard from the sludge surface to the top of the berm provides wind baffling only for a short distance downwind. A reduction in the overall size of the holding basins is a good measure for reducing the basin odors.

3. Health Management Measures

Potential hazards to human health will greatly depend on the types of crops grown on the project fields. Crops should be selected carefully to avoid those which favor the accumulation of metals in edible plant tissues. In general, grain crops present a lesser heavy-metal hazard to the food supply than do forages, pasturage, and leafy vegetable (CAST, 1976).

Crops which may be eaten raw should not be planted within three years of the last sludge application (EPA, 1976).

The efficiency of wastewater treatment and improved industrial pre-treatment as required should reduce the concentrations of potentially toxic substances, especially heavy metals, in MSDGC sludge.

4. Plans and Records

Steps should be taken to ensure that all project maintenance activities are recorded on a regular basis in accessible documents. Items to be recorded should include dates, locations and descriptions of repairs to fields and basins, berms, dikes, drainage ditches and pipes, as well as significant reseeding, fertilizing and mowing. Observations of conditions requiring correction, such as soil subsidence and gully erosion, accelerated siltation, overtopping or breaching of embankments, and overgrown or sparse vegetation should also be recorded. Where necessary, maps or diagrams should be provided to reference the locations of planned or completed activities.

Operations records also require improvement. For example, present records concerning the operation of runoff retention basins should be augmented to include periodic reporting of the stage or level of all basins, discharging or not, so that available capacity may be determined in the event of a storm. All emergency discharges from retention basins should be recorded along with the results of a water quality analysis of the discharged effluent. Recycling of substandard effluent by pumping back onto the fields, if practiced at all, should be recorded in times and amounts.

Chapter II
Background and Information

II. BACKGROUND AND INTRODUCTION

A. Project Background and Overview

Sewage sludge disposal is a problem associated with the sewage treatment process of most large cities. In some cases, accumulation of large amounts can pose severe problems for ultimate disposal, given economic and land use constraints. In recent years, land application of sludge, when properly managed, has proven to be an economic and environmentally acceptable method of ultimate disposal. Land application, if properly practiced, has the benefit of turning the waste product of sludge into a resource of fertilizer by utilizing the nutrient content. Any successful program must recognize the environmental limitations of land application as well as the needs and problems of both the urban and agricultural communities. Sewage sludge, when applied at an agronomic rate, will supply nutrients to the plants as well as improve soil properties. This soil improvement capability has the potential to renovate depleted or barren land. Benefits and problems associated with the application of sewage sludge on agricultural and old strip-mined land are discussed.

1. Benefits

a. Characteristics of Metropolitan Sanitary District of Greater Chicago (MSDGC) Sludge - The term "sludge", as applied to this project, refers to an anaerobically stabilized byproduct of sewage treatment. Liquid sludge contains dissolved, colloidal, and suspended solids. Purely domestic waste is often quite acceptable for land application programs. However, in a large metropolitan area, such as Chicago, the sludge characteristics are altered by the types of industries contributing to the wastewater. Most sludges contain 2-5 percent solids as they finish the treatment process. The solid portion is composed of approximately equal amounts of inorganic and organic materials. The inorganic portion is largely fine particles having the texture of silt and clay, and contains mainly nitrogen, phosphorus, sulfur, chlorine, carbonates, and metal salts. The organic portion is a complex mixture of constituents comprising organic carbon, nitrogen, phosphorus, and sulfur.

Table II-I gives a range of the chemical composition of sludge and specifications for a "typical" liquid, digested sewage sludge as it flows from the digester. The composition of different batches of sludge can vary appreciably from the values shown; these are given only as a general guideline. Not all of the nitrogen in sewage sludge is available to crops during the year of application. Some may be lost by volatilization or leaching, and the remaining organic nitrogen must be mineralized before it can be assimilated by crops. Also, nearly all of the minor and trace elements can be toxic at some concentration; their availability to plants depends on soil properties, crop varieties, and many other factors (University of Illinois, 1976).

b. Application Method and Rates - A sludge containing about 6 percent solids or less can be handled as a liquid; i.e., through pipes, carried in tank trucks, barges and special pumps may be used to achieve the transfer. Generally, liquid manure spreading equipment can be used. When sludge contains more than 10 percent solids, special equipment is needed. Also, dewatered sludge may be handled as a solid.

Table II-1

Composition of Fresh, Anaerobically Digested Sewage Sludge (University of Illinois, 1976)

Element	Concentration Range (%)	Typical Sludge (dry basis) Concentration (%)	Typical Sludge (dry basis) Amount (lb/ton)
Elements essential for plants			
Nitrogen-organic	2 to 5	3	60
Nitrogen-ammonium	1 to 3	2	40
(Nitrogen-total)	(1 to 6)	(5)	(100)
Phosphorus-as P	0.8 to 6	3	60
(Phosphorus as P O		(6.8)	(137)
Potassium-as K	0.1 to 0.7	0.4	8
(Potassium as K O		(0.5)	(10)
Calcium	1 to 8	3	60
Magnesium	0.5 to 2	0.9	20
Sulfur	0.3 to 1.5	0.9	18
Iron	0.1 to 5	4	80
	ppm*	ppm*	
Sodium	800 to 4,000	2,000	4
Zinc	50 to 50,000	5,000	10
Copper	200 to 17,000	1,000	2
Manganese	100 to 800	500	1
Boron	15 to 1,000	100	0.2
Elements not essential for plants			
Cadmium	3 to 3,000	150	0.3
Lead	100 to 10,000	1,000	2
Mercury	1 to 100	3	trace
Chromium	50 to 30,000	3,000	6
Nickel	25 to 8,000	400	0.8

*ppm - Parts per million

Note: Values varying according to source, treatment and other factors. Sludges held in storage lagoons for long periods may be considerably lower in nitrogen content.

Although not a recommended practice, liquid sludge can be sprayed through large diameter irrigation nozzles. Sludge and supernatant also can be allowed to flow down furrows over a graded field. Land application of sludge is not a substitute for irrigation if a problem of insufficient rainfall exists.

In some present operations in Illinois, sludge is pumped through a flexible hose to an injection plow traveling through the field. At the plow, sludge flows through a manifold which connects with outlets at each plowshare or disk. Sludge can thus be incorporated immediately into the soil. It is necessary that caution be exercised in applying sludge to sloping land to ensure that resulting runoff does not contaminate streams and other bodies of water.

Application rates are expressed in terms of inches of liquid per acre, tons of liquid per acre, or tons of dry solids per acre. A layer of liquid sludge one inch deep amounts to about 27,000 gallons (100 tons) on each acre covered.

In determining the correct application rate to satisfy crop requirements for nutrients, many variables must be taken into consideration. For example, the percentages of specific nutrient concentrations that are in a form available for plant uptake, the loss of elements from leaching through the soil, and the mineralization or immobilization of elements after application must be determined. An application rate that is suitable for one constituent of sludge might be unsuitable for another, causing either nutrient deficiency or toxicity. In addition, the contribution of trace elements, especially heavy metals, may limit the long-range utilization or disposal of sludge on agricultural lands (University of Illinois, 1976).

Application rates must be specified according to the analysis of sludge being used, and sufficient sampling must be done to measure variability in composition over a reasonable period of time. The University of Illinois has done sufficient research to indicate favorable crop response and increases in soil organic content when sludge is applied to agricultural and strip-mined land. (University of Illinois, 1976).

c. Value of sludge application - Sludge provides a source of organic matter that may be beneficial in many soils, particularly those low in organic matter such as sandy soils or previously strip-mined lands. Improved structure and water-holding characteristics result from an increase in soil organic matter when it is at a low level (under 3 percent) (University of Illinois, 1976).

2. Potential Problems

Potential problems that must be taken into consideration when planning a land application program include:

a. Odors from sludge application methods can be minimized by incorporating the liquid sludge. Storage basin odors have caused the most complaints in the past. The upper layer sometimes has a high ammonia content. Odor can be reduced by minimizing surface area and length of time needed for storage.

b. Many concerns about long-term sludge application have centered around trace metals in the sludge. The elements of most concern include nickel, zinc, cadmium, and copper but such concern extends to mercury, lead, boron, chromium, cobalt selenium, and molybdenum. The fear is that these substances may accumulate to cause toxic concentrations in the crops. The University of Illinois has traced the movements of heavy metals in the food chain. Studies have indicated that there is no indication of high levels of toxic metals in the soils or plants where municipal sludges are applied at agronomic rates. (University of Illinois, 1976).

c. There has been serious concern that sewage sludge might contain pathogens and that animal and human health problems might result from sludge utilization. However, specific studies have shown that viruses are unlikely to survive a period of 15 days in a heated anaerobic digester, at least in a condition capable of causing an infection. Much the same situation was found for several kinds of parasites.

d. In regard to nutrients, it was found that both the rate of nitrogen transformed to nitrate and the movement through soil are the same, regardless of the source. Phosphorus poses somewhat more of a problem in that phosphorus added to soils as a sludge constituent appears to be highly available to crops. Hence, it is possible for available phosphorus to accumulate in soils to levels toxic to sensitive crops if sludge application rates are high. Also, the levels of phosphorus in drainage water may possibly increase to the point of posing a eutrophication threat when drainage water is returned to non-flowing surface waters. However, these problems are not expected to result as long as agronomic rates of sludge application are not exceeded (University of Illinois, 1976).

B. Project History and Issues

1. History and Policy Matters

Fulton County citizens have been concerned about the after effects of strip mining in the County for years. The first collective action was taken in 1970, when the County Board of Supervisors and the State Attorney's Office formed a special citizens committee. This group directed the State Attorney to investigate the feasibility of a land application project in Fulton County.

It was apparent from other studies that although the mined area could be effectively leveled, some measures would have to be taken to modify the poor inorganic mine spoil material of the area. It was then that the use of sewage sludge was proposed.

The MSDGC was invited to make a presentation to the Fulton County officials on September 11, 1970. Several administrative approaches to the project were discussed, but MSDGC purchased about 15,000 acres of mined land which was being used for pasture. It was the intent of the MSDGC to grade the land in order to control runoff, increase the organic content of the soil by large additions of sludge and restore the land to full agricultural productivity.

2. Environmental Litigation

Several court cases were brought against MSDGC. Also, MSDGC filed several cases against the Illinois Environmental Protection Agency (IEPA). A summary follows:

a. IEPA vs. MSDGC - charged air pollution violations against MSDGC.

b. MSDGC vs. IEPA - a permit appeal. The decision was in favor of IEPA. All permits "stayed" until a decision in the above case was reached.

c. MSDGC vs. IEPA - a mandamus action brought by the district to compel the issuance of the Fulton County permits.

C. Related Activities

1. The Big Bluestem Program and Recreational Benefits

One reclamation program called for returning a 3,000-acre segment of land to original tall grass prairie vegetation. The principle is that a tall grass prairie may prove even better than crops and pasture in recycling and reclamation. The prairie plants offer new possibilities for both agriculture and land reclamation. The idea of reintroducing wildlife and attracting tourists was discussed.

2. The Fulton County Steering Committee

This committee was established to provide local public participation for the Prairie restoration program. The committee was composed of public officials, private citizens, and MSDGC staff personnel.

3. Recreational areas

Areas will be established and certain pothole areas preserved.

D. The Study Area

1. Basis for the Study Area

The study of socioeconomic and land use impacts employs three areas of focus. The largest area of study is regional, covering Fulton County and any influences of Peoria. An area of more intensified study contains land surrounding the project site and includes Canton. The smallest area of study is confined within the boundaries of the project site (see Figure II-1).

The study of environmental effects of the project includes odor and noise nuisance, potential contamination of surface and groundwater and soil, possible health effects of airborne pathogens, and potential biomagnification of toxic materials in food chains via crop and livestock production and consumption. No definite geographic boundary can be assigned to accommodate all effects. For example, problems associated with odors and airborne pathogens, which can travel great distances, require a larger study area. Related climatological features must be examined not only locally but also regionally.

Generally speaking, the study area is extended to at least five miles from the boundaries of the project property. This area includes the communities of Canton, Cuba, St. David, Bryant, and Lewiston (see Figure II-1). All environmental and health effects resulting from the project are evaluated against the applicable standards as discussed in the following section and confirmed with findings from similar studies in published and unpublished literature.

2. Pollution Control Standards

The MSDGC must comply with four basic sets of regulations to construct and operate the Fulton County land reclamation project. There are effluent standards, as stated in the Illinois EPA Water Pollution Control Permit, which reflect the water pollution regulations of Illinois Rule 404, governing the concentrations

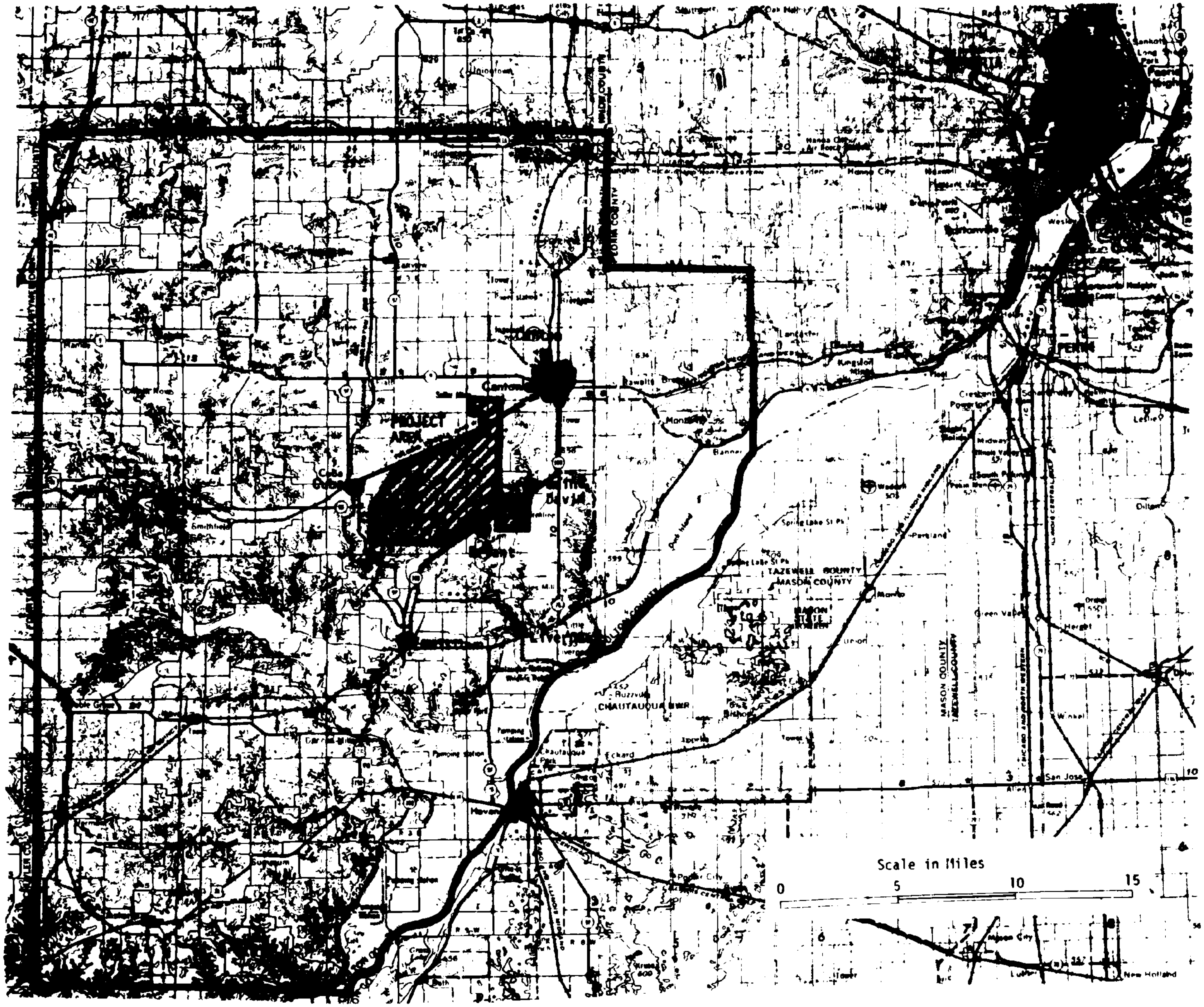


Figure II-1. Project Site and Surroundings of total dissolved solids, biochemical oxygen demand (BOD), and fecal coliforms. The MSDGC must construct, operate and maintain the project so as to maintain the General Water Quality Standards for the State of Illinois. In addition, the Fulton County Board of Health requires a permit for any sewage sludge operation; it contains standards for the chemical composition, transportation, storage, use and disposal of digested and undigested sewage sludge. The USEPA regulations pertaining to land application are published in the Federal Register under 40 CFR 257. These separate sets of standards are examined in turn in this section. Miscellaneous standards and special standards applying to gated-pipe application of supernatant liquid and deep trench incorporation of sludge to specific properties are also covered.

a. Water Quality Standards - The water quality standards for the State of Illinois are designed to protect Illinois waters for aquatic life, agricultural and industrial uses, and primary and secondary contact (for recreation), and to insure the aesthetic quality for the environment. All waters of the State must meet the water quality standards defined in Table II-2. In addition, the following standards must be met:

Any substance toxic to aquatic life shall not exceed 1/10 of the 48-hour median tolerance limit (48-hour TLm) for native fish or essential fish food organisms.

All State waters must be free from unnatural sludge or bottom deposits, floating debris, visible oil, odor, unnatural plant or algal growth, unnatural color or turbidity, or matter in concentrations or combinations toxic or harmful to human, animal, plant, or aquatic life of other than natural origin.

There shall be no artificially induced temperature changes that may adversely affect aquatic life, that may disturb the normal daily and seasonal temperature fluctuations, or that may cause the temperature to rise more than 5 degrees Fahrenheit (F) above natural temperature.

b. Effluent standards - To construct and/or operate any water pollution control facility in the State of Illinois, a permit from the Illinois Environmental Protection Agency (IEPA) is required. Each permit is comprised of standard conditions common to all such permits and a number of special conditions based on the specific case. The Comprehensive Operating Permit issued to the MSDGC contains 15 Special Conditions. (see appendix).

According to Special Condition #9, effluent discharged from any runoff retention basin must meet the applicable effluent requirements for discharge to the waters of the State as established by the Illinois Pollution Control Board Rules and Regulations. The point of discharge is considered to be the overflow structure of each of the retention basins.

Special Condition #10 states that certain contaminant concentrations are to be considered background values, and that the effluent standards are met when the sum of the background concentration and the allowable regulatory concentration is greater than the measured concentrations for the respective parameter. The regulatory concentrations applicable to the Fulton County site are defined in Chapter 3 of the Water Pollution Regulations of Illinois, Rule 404(f), which describes State effluent standards for streams with less than 1:1 dilution, based

Table II-2. Water Quality Standards for the State of Illinois

Parameter	Standard (mg/l)
Ammonia nitrogen (as N)	1.5
Arsenic	1.0
Barium	5.0
Boron	1.0
Cadmium	0.05
Chloride	500.0
Chromium (total hexavalent)	0.05
Chromium (total trivalent)	1.0
Copper	0.02
Cyanide	0.025
Dissolved Oxygen	
minimum for 16 out of 24 hours	6.0
minimum at any time	5.0
Fluoride	1.4
Iron	1.0
Lead	0.1
Manganese	1.0
Mercury	0.0005
Nickel	1.0
Phenols	0.1
Phosphorus (as P)*	0.05
Selenium	1.0
Silver	0.005
Sulfate	500.0
Total Dissolved Solids	1000.0
Zinc	1.0
Acidity-alkalinity	6.5-9.0
	per 100 ml
Fecal coliforms**	
Geometric mean	200
Maximum for 10% of samples	400
	pCi/l***
Radioacitivity	
Beta	100
Radium 226	1
Strontium 90	2

*In any reservoir or lake, or in any stream at the point of entry to any reservoir or lake

**Based on a minimum of five samples taken over not more than a 30-day period

***Pico curies per liter

based on the 7-day, 10-year low flow. These allowable regulatory concentrations were defined to be the requirements for secondarily treated wastewater. The numerical values of these standards are presented in Table II-3. After negotiation between IEPA and MSDGC these discharge standards were relaxed to be consistent with the requirements for a secondarily treated wastewater discharge. (Table II-3a)

c. Sludge standards - The Fulton County Board of Health Sewage Sludge Rules and Regulations require that any transportation, storage, use, or disposal of sewage sludge or digested sewage sludge requires a valid permit from the Board of Health. All sewage sludge transported for storage or applied to land must be digested.

Tests must be performed by the permit holder on a 24-hour composite sample of digested sewage sludge to be transported for storage in Fulton County. Weekly results are to be submitted to the Fulton County Board of Health, which retains the right to independently sample the sewage sludge of any permit holder in Fulton County.

As of November 18, 1975, the Volatile acids and alkalinity standards were changed to the following:

If volatile acids are less than 100 milligrams per liter, then the alkalinity cannot be less than 2,000 milligrams per liter.

The Fulton County Health Department took into account the fact that some of the sludge shipped to Fulton County had been in storage in the Chicago Lawndale lagoons for periods ranging up to 15 years. Exceedingly long storage periods result in volatilization of ammonia and consequent decreases in alkalinity.

d. Solid Waste Disposal Criteria - Criteria for the classification of Solid Waste Disposal Facilities Practices (40 CFR 257) includes the latest requirements to ensure a safe sludge disposal operation. These were published in the September 21, 1979 Federal Register.

e. Miscellaneous requirements - According to the Fulton County Board of Health Sewage Sludge Rules and Regulations, the use and disposal of digested sludge must comply with the following standards:

Cropping practices shall be such that soil loss does not exceed tolerable limits as defined by the Universal Soil Loss Equation for the soil type.

Underground aquifers shall not be contaminated with digested sewage absorbed into all soils

Spray applications shall be done so as to contain the material within the land-application area designated in the permit

In addition, sewage sludge shall not be applied:

Within 100 feet of a stream, lake, well, or any potable water supply

Within 200 feet of a dwelling unit

On root crops for human consumption

Table II-3
Effluent Standards for Retention Basin
Discharge in the State of Illinois

Parameter	Total Suspended Solids (mg/l)	BOD (mg/l)	Fecal Coliforms (mg/l)
Background Arithmetic Mean	61.7	2.75	—
Background Geometric Mean	—	—	94.3
Water Pollution Regulations of Illinois Rule 404(f) (Regulatory concentration)	5.0	4.0	400.0
Effluent Standard (Total concentration)	66.7	6.75	494.0

mg/l = Milligrams per liter

Table II-3a
Effluent Standards for Retention Basin
Discharge in the State of Illinois, Revised

Parameter	Total Suspended Solids (mg/l)	BOD (mg/l)	Fecal Coliforms (mg/l)
Background Arithmetic Mean	61.7	2.75	—
Background Geometric Mean	—		94.3
Water Pollution Regulations of Illinois Rule 404(f) (Regulatory concentration)	37	30	400.0
Effluent Standard (Total concentration)	99	33	494.0

In a flood plain, unless adequate pollution control mechanisms are available

To frozen or snow-covered land

Outside of the land-application area

f. Discharge Limitations - Water Pollution Control Permits from the IEPA were issued on June 19, 1975, for sludge distribution on various project areas. The permits are presented in Appendix A. Agronomic rates of application, avoiding steep sloping land, avoiding ponding, trying to avoid rainstorms, and not applying on snow and ice were some of the conditions placed on the distribution process.

E. Description of MSDGC Treatment Systems

1. MSDGC Sewage Treatment Plants

The MSDGC has seven wastewater treatment plants. The West-Southwest (WSW), Calumet and Northside plants are secondary treatment works, while Hanover, Streamwood, Lemont, and John E. Egan provide tertiary treatment. The John E. Egan water reclamation plant has been operating since December 1975. The Streamwood Plant was retired in September 1977. The new O'Hare Water Reclamation plant began operation in mid 1980.

Presently, only the West-Southwest and Northside facilities produce sludge to be shipped to Fulton County for land reclamation (MSDGC, 1975). As operations progress at the O'Hare plant the possibility exists that some sludge from the facility may be shipped to the Fulton County Site. The Northside facility has no sludge stabilization, recycling or disposal systems. After concentration, sludge at approximately 1.3 percent solids is pumped to the West-Southwest facility via pipeline. In 1975, the Northside plant pumped 2.5 million gallons per day (133 dry tons per day) of primary and secondary sludge to the West-Southwest plant (MSDGC, 1976m). Summary performance data from the MSDGC plants are presented in Table II-4.

2. West-Southwest Treatment Plant

The WSW plant is comprised of the West Side Treatment Works, which is an Imhoff facility, and the Southwest Side Treatment Works, an activated sludge facility. The facilities of both treatment works can be divided conveniently into two groups: sewage treatment systems and sludge processing systems. The sewage treatment systems are briefly discussed below, followed by a detailed description of the sludge processing systems.

The West Side Treatment Works consist of a grit chamber and screen house, skimming tanks, Imhoff tanks for sewage treatment and sludge stabilization, and drying beds for sludge dewatering. There are 108 Imhoff tanks arranged in three batteries of 36 tanks each. Digested Imhoff sludge is dried on 12 underdrained sand beds 80 feet wide and sludge is scraped from the beds and hauled to a dump 3 miles west of the plant. Dried Imhoff sludge was given away as "Nu-Earth". In recent years the "Nu-Earth" program has been curtailed. As an option, Imhoff sludge may be screened prior to either lagooning or heated anaerobic digestion.

The Southwest Treatment Works include aerated grit chambers, grit dewatering build-

Table II-4. Performance of MSDGC Plants (MSDGC, 1976 m)

	West-Southwest	Northside	Calumet	Hanover	Lemont	Streamwood	Egan
Degree of Treatment	Secondary	Secondary	Secondary	Tertiary	Tertiary	Tertiary	Tertiary
Capacity (MGD)	1200	333	220	6.0	1.2	3.0	30
Flow Ranges in 1975 (MGD)							
Average Daily	847.0	330.0	220.0	5.7	0.8	2.4	-
Lowest Daily	744.0	235.0	160.0	2.6	0.4	1.2	-
Highest Daily	1446.0	401.0	330.0	11.7	2.3	5.5	-
Average Effluent Concentrations (ppm) and Percent Reduction in 1975							
BOD_5	7 (94%)	12 (87%)	25 (88%)	5 (97%)	4 (98%)	4 (96%)	-
TSS	7 (97%)	9 (91%)	27 (90%)	5 (97%)	9 (95%)	5 (97%)	
Ammonia	5.4	4.0	11.9	1.5	2.4	1.4	-

(1) Plant expanded to handle increased flow in May of 1975.
(2) Plant operational December 1975.

ing, preliminary settling tanks, aeration tanks for the activated sludge process, and final settling tanks for sewage treatment heat drying and heated anaerobic digestion are the two sludge processes used at the Southwest Treatment Works. The wet air oxidation process has been discontinued due to operating problems, adverse effects from recycled streams, and safety considerations.

The heat drying process includes screening of sludge by bar screens and grinding the screenings by hammer mills and sludge dewatering by 93 vacuum filters. The sludge produced is sold as fertilizer base material.

3. Sludge Processing and Disposal

In 1975, the MSDGC produced approximately 625 dry tons per day (dt/d) of sewage sludge. The MSDGC has a number of systems available for sludge handling, stabilization and disposal, and is developing others. (These are presented in Figure II-2) Detailed discussions on the systems related to this study are discussed later. The sludge processing systems at the WSW plant are summarized in Table II-5, which gives the types of systems utilized in 1975 and their capacities in dry tons per day.

In summary the following four sludge handling, stabilization, and disposal schemes are utilized.

1. Heat drying and fertilizer sale
2. Heated anaerobic digestion and lagooning
3. Heated anaerobic digestion and land application in Fulton County
4. Imhoff digestion followed by air drying on sand beds and subsequent distribution as "Nu-Earth".

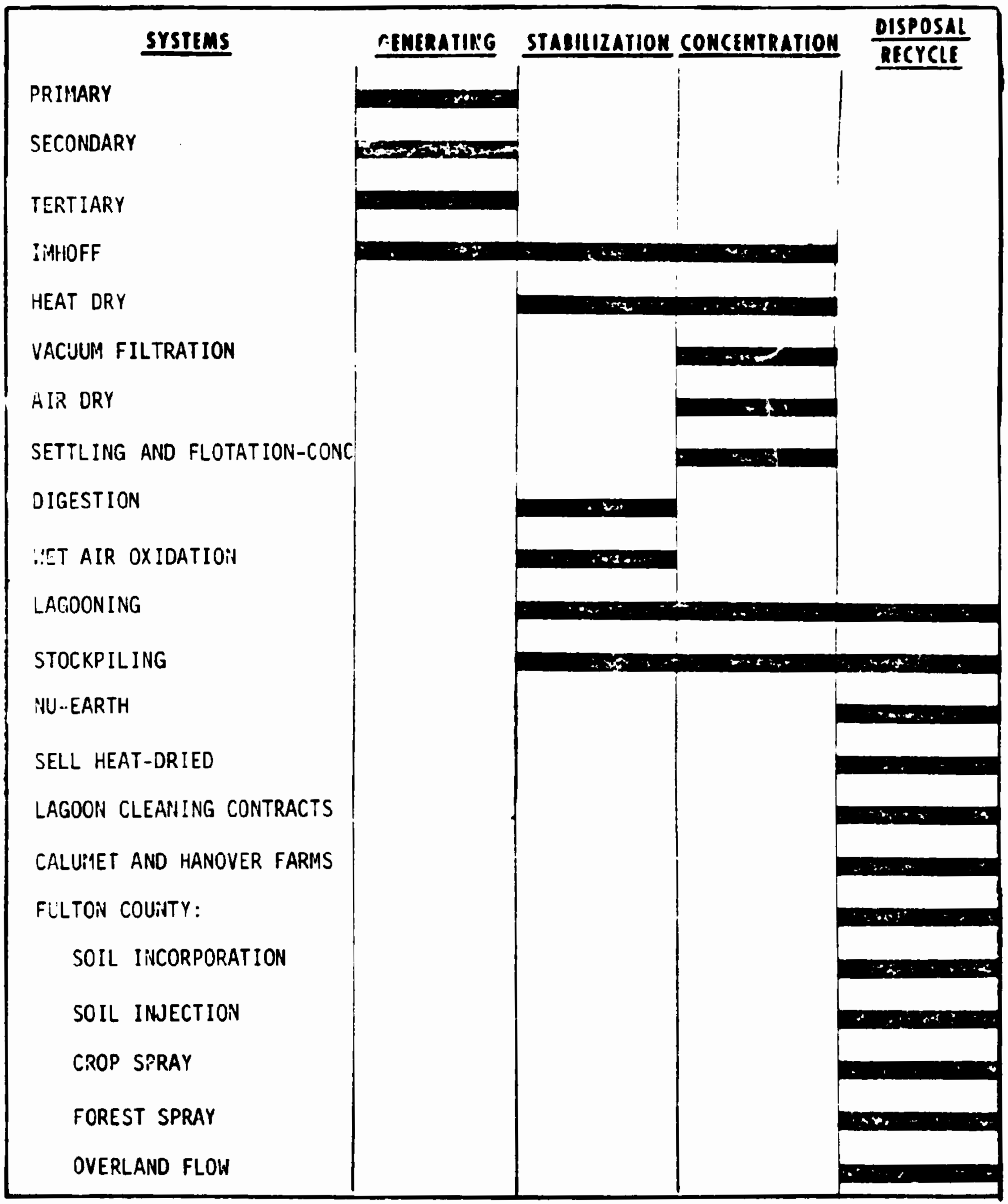


Figure II-2 Available MSDGC Solids Systems (MSDGC)

Table II-5
West-Southwest Sludge Processing Systems,
1973 (MSDGC, 1976m)

System	Type	Capacity (dt/d)
Imhoff Digestion, Air Drying on Sand Beds, and Storage	Stabilization and Recycling	100
Heat Drying	Stabilization and Recycling	380
Heated Anaerobic Digestion	Stabilization	300
Wet Air Oxidation Process (on standby basis only)	Stabilization	190
Land Reclamation (based on land available for application for 1975 season and a 20 dt/d/A loading rate)	Recycling	110
Lagoons (requiring periodic cleaning; no long-term disposal capacity available)	Stabilization and Storage	0

dt/d/A: dry tons per day per acre
dt/d: dry tons per day

Chapter III
Existing Conditions

III. EXISTING CONDITIONS

This chapter provides a description of baseline information concerning climate, topography, geology, soils, hydrology, water quality, biology and ecosystems. Past and projected trends in local population and the economy are presented along with the established and forecasted land patterns and land development potential. The chapter concludes with a discussion of natural and cultural resources in Fulton County that are particularly sensitive to planned project operations.

A. Climate And Topography

Past and present climatic conditions and local meteorology must be determined in order to predict the most probable and worst conditions affecting project operations. Potential air quality problems, and particularly odor transmission are considered. The area climate, which is represented by a record of numerous atmospheric events, is defined by weather elements such as temperature, wind, cloud cover, solar radiation, humidity, precipitation, and atmospheric stability. Climatic data from two weather stations are used for analysis. Weather station #14842 is located at the Greater Peoria Airport approximately 25 miles east-northeast of the project site (National Climatic Center, 1974a). The second weather station was set up by the MSDGC at the project site (MSDGC, 1975b).

In addition to climate, local topography is summarized in terms of land-form characteristics which could influence the microclimate and create susceptibility to impacts on air and water quality.

1. General Meteorology

The climate of this area is typically continental, as is evidenced by the changeable weather and wide range of temperature extremes. Meteorological characteristics of the project area are discussed in the following sections.

a. Temperature and precipitation - According to 40-year observations at the Peoria Airport station, the average monthly temperature varies from 25 degrees F to 75 degrees F, with an annual average of 51.1 degrees F. Sub-freezing minimim temperatures generally do not occur from late March through mid-November. Using a baseline of 65 degrees F, there is an average of 6,200 annual heating degree days and 943 cooling degree days (National Climatic Center, 1974a).

The annual rainfall, as recorded at Peoria Airport, averages 34.99 inches, with a maximum of 50.27 inches and minimum of 23.99 inches. Variations in monthly mean, maximum and minimum precipitation are shown in Figure III-1. The monthly maximum and minimum rainfalls are displayed for the Peoria Airport station, while the monthly means measured at both Peoria Airport and the project site are shown for overlapping observation periods. In spite of the 25-mile distance between these two stations, the precipitation pattern is quite uniform. The maximum amount of rainfall occurring in any 24-hour period was 5.52 inches in May 1927. The predicted 24-hour rainfall patterns for Fulton County at four recurrence intervals (1-year, 5-year, 25-year and 100-year) are presented in Table III-1. The cumulative amount of rainfall is estimated to be 6.53 inches for a 24-hour, 100-year rainstorm.

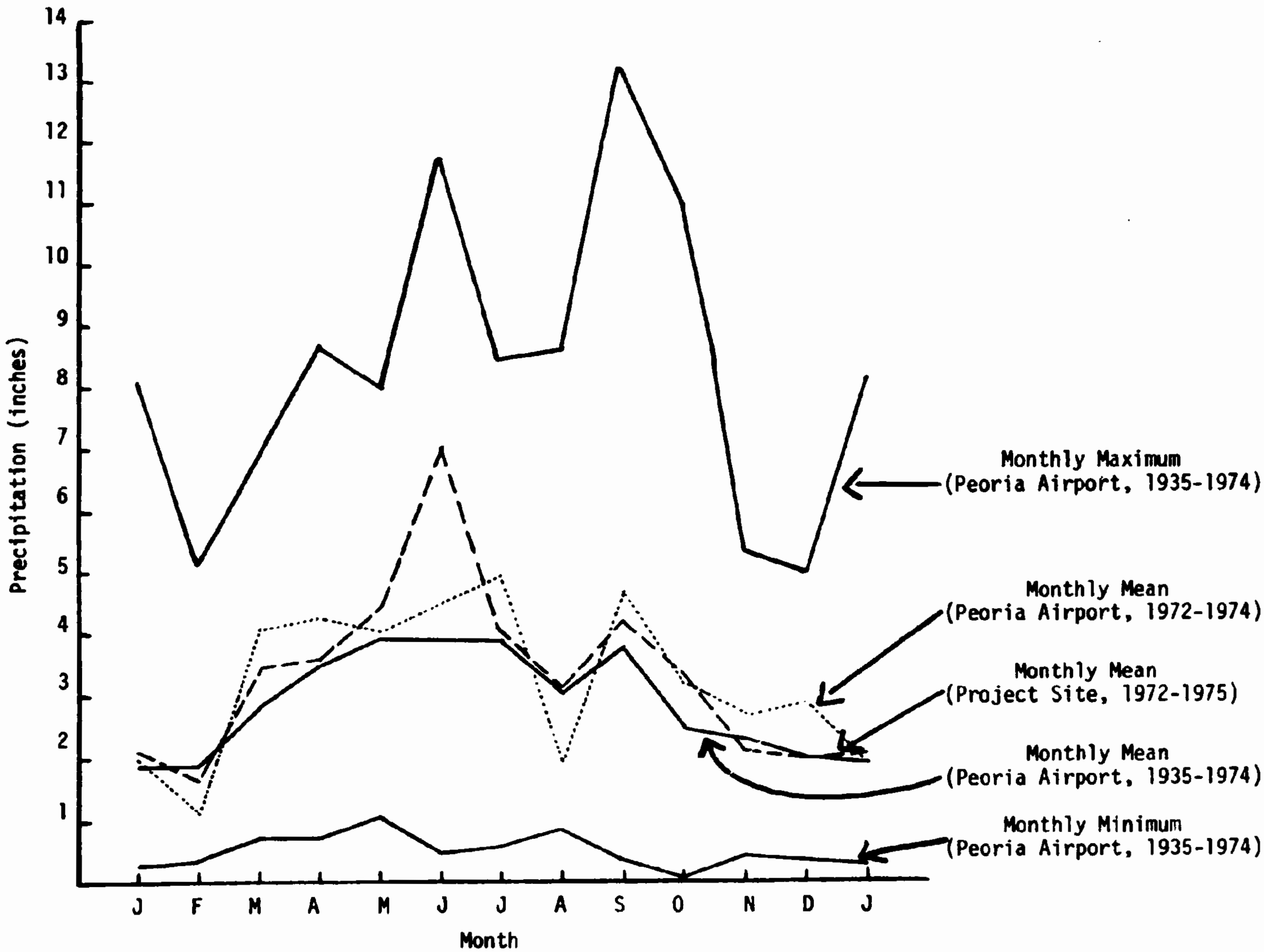


Figure III-1 Variations in Monthly Mean, Maximum, and Minimum Precipitation at Peoria Airport Station (National Climatic Center, 1974b)

Table III-1 Predicted 24-Hour Storm Pattern for Fulton County (MSDGC, 1975a)

Inches of Rain for 24-Hour Storm

Recurrence Interval	Hour 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
100 years	.07	.07	.08	.09	.1	.11	.13	.14	.18	.23	.65	3.03	.36	.28	.16	.15	.12	.11	.1	.09	.08	.08	.07	.05
25 years	.035	.046	.046	.046	.058	.058	.081	.092	.138	.173	.58	2.74	.311	.219	.115	.104	.07	.07	.058	.046	.046	.046	.035	.035
5 years	.035	.035	.035	.035	.047	.047	.059	.07	.11	.129	.445	2.13	.246	.176	.094	.082	.059	.059	.047	.035	.035	.035	.00234	.0234
1 year	.02	.02	.02	.025	.03	.03	.04	.05	.07	.09	.29	1.39	.96	.11	.06	.05	.04	.03	.03	.03	.02	.02	.02	.02

The average annual snowfall is normally 23.1 inches, with a maximum of 42.3 inches and a minimum of 7.8 inches. Significant snowfall usually begins in mid-October and ends in mid-April. Mid-December through February are freezing months during which snow accumulation is at a maximum.

b. Wind vectors - Wind data are recorded for direction and speed. By dividing the number of recorded wind vectors within a given sector of wind direction and interval of wind speed by the total number of observations, the frequency of winds in that vector interval can be established. Normally 16 wind directions 22.5 degrees apart are chosen for this type of analysis, along with four wind speed intervals (0-3, 3.1-6, 6.1-10, and 10.1 mph or higher). The average wind vector frequencies at Greater Peoria Airport between 1964 and 1973 are given in Table III-2. Calm periods normally occur during 2.83 percent of the year.

The vector frequencies presented in Table III-2 were used to construct a wind "rose" as shown in Figure III-2. The vectors in this figure indicate wind directions and contain four segments, each representing a wind speed interval with the lowest wind speeds beginning at the core of the rose. The frequency of wind in a given wind speed interval and wind direction is proportional to the length of its representative segment. This wind rose indicates that southerly winds prevail in this general area for all wind velocities. Winds from other sectors are rather uniformly distributed. A wind rose representing conditions at the sludge holding basins on the project site was constructed and is shown in Figure III-3. Data were available for approximately ? years only; therefore, the level of statistical confidence in this case is not as high. At the project site, there is a strong southerly wind component as there is at Peoria Airport. However, at the site, winds from the southwest and west-northwest sectors are similarly important. The difficulties between the wind roses are believed to be due to differences in local terrain.

c. Atmospheric stability - In air pollution studies concerning the dispersion of airborne materials, atmospheric stability, which is a measure of the mixing capacity of the atmosphere, is of major interest. A stable atmosphere has a limited mixing ability and provides little capacity for the dilution of air pollutants. Pasquill introduced a system for the classification of atmospheric stability (Turner, 1964). Parameters considered in this system include net solar insolation, solar altitude, cloud cover and ceiling height, wind speed, and the presence of urbanization. There are seven stability classes: Class A, extremely unstable; Class B, unstable; Class C, slightly unstable; Class D, neutral; Class E, slightly stable; Class F, stable; and Class G, extremely stable. Based on data collected at the Greater Peoria Airport station, the annual and seasonal percentages of occurrence for each stability class are summarized in Table III-3. The predominant atmospheric condition in the area is Pasquill Stability Class D, a neutral atmosphere, with an annual frequency of 57.75 percent, or 211 days per year.

d. Typical weather conditions - Climatic conditions in the Peoria area are summarized in Table III-4. The annual prevailing wind is southerly with a mean velocity of 10.3 mph. Relative humidity is seldom below 50 percent, ranging between 62 and 83 percent annually. The average number of days with heavy fog or visibility equal to or less than 1/4 mile ranges from 1 to 3 days per month and peaks during winter. Nighttime radiational loss is believed to be the major fac-

Table III-2. Average Annual Frequencies of Wind Vectors by Percentage, Greater Peoria Airport, January 1964 through December 1973 (National Climatic Center, 1974a)

Wind Direction	Wind Speed (mph) 0-3.0	3.1-6.0	6.1-10.0	>10.1	All 4 Wind Speed Intervals for Given Wind Direction
North	0.63	1.80	2.44	1.87	6.74
North-Northeast	0.41	1.04	1.15	0.57	3.17
Northeast	0.38	1.03	1.58	1.14	4.13
East-Northeast	-.45	1.33	1.91	1.27	4.96
East	0.46	1.46	2.26	1.16	5.34
East-Southeast	0.41	1.13	1.41	0.68	3.63
Southeast	0.46	1.47	2.02	1.18	5.13
South-Southeast	0.48	1.86	2.40	2.08	6.82
South	1.33	4.51	7.20	5.44	18.48
South-Southwest	0.58	1.63	1.84	1.35	5.40
Southwest	0.59	1.50	1.92	1.28	5.29
West-Southwest	0.63	1.40	1.61	1.18	4.82
West	0.66	1.55	2.16	2.95	7.33
West-Northwest	0.53	1.44	2.02	3.86	7.85
Northwest	0.44	1.29	2.24	2.43	6.40
North-Northwest	0.41	1.16	1.78	1.16	4.51
All 16 Wind Directions for Given Wind Speed Interval	8.85*	25.60	35.95	29.60	100.00

*Calm periods account for 2.83% annually.

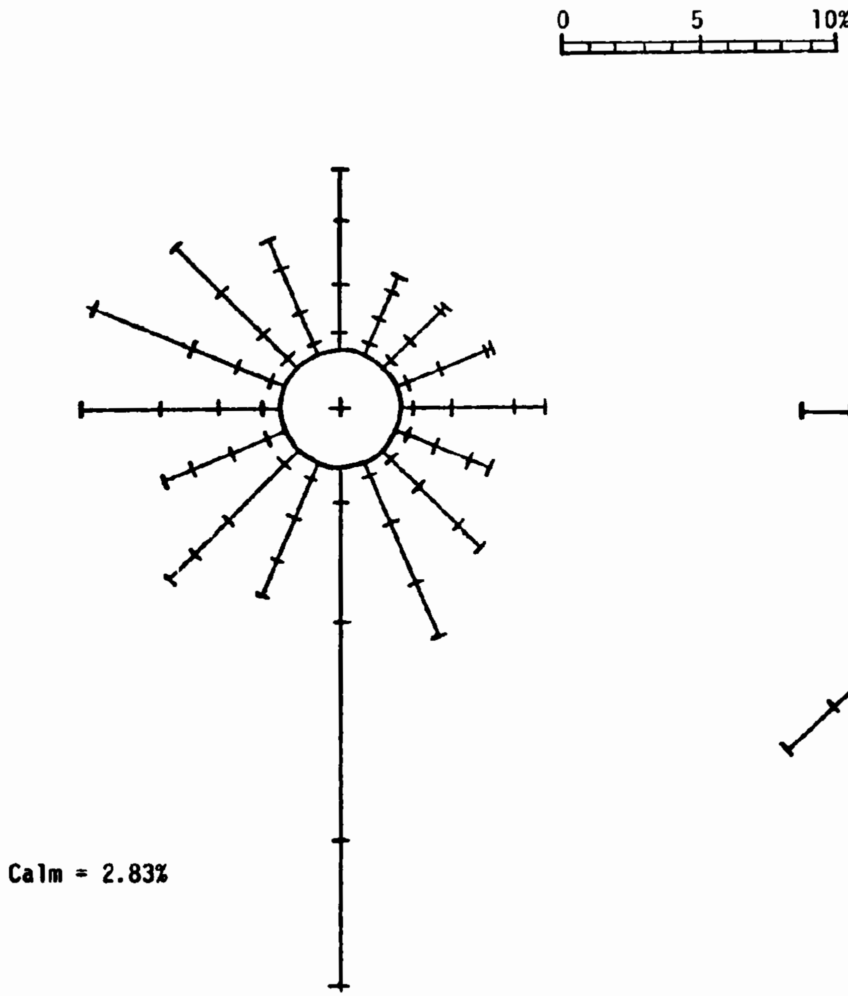


Figure III-2 Wind Rose at Meteorological Station #14842, Peoria, Illinois, January 1964 through December 1973 (National Climatic Center, 1974a)

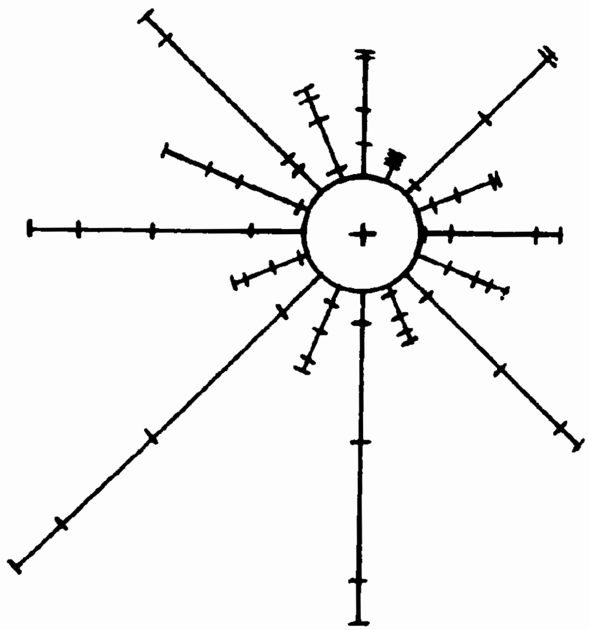


Figure III-3 Wind Rose at Storage Basins, MSDGC Fulton County Project Site (MSDGC, 1975b)

Table III-3. Average Seasonal Atmospheric Stability by Percentage, Greater Peoria Airport (National Climatic Center, 1974)

Period	Pasquill Stability Class						
	A Extremely Unstable	B Unstable	C Slightly Unstable	D Neutral	E Slightly Stable	F Stable	G Extremely Stable
SPRING: (March, April, & May)	0.24	3.51	8.97	65.26	11.30	7.95	2.77
SUMMER: (June, July, & August)	1.01	10.53	18.01	38.93	11.36	13.56	6.60
FALL: (September, October, & November)	0.04	2.57	8.81	54.71	14.70	13.76	5.40
WINTER: December, January, & February)	0.01	0.42	5.04	72.38	11.71	8.07	2.38
ANNUAL	0.33	4.28	10.24	57.74	12.26	10.84	4.30

Table III-4 Summary of Climatic Conditions in the Area of Peoria, Illinois (National Climatic Center, 1974a, 1974b, 1975)

Period		Prevailing Wind Direction	Prevailing Wind Speed (mph)	Range of Relative Humidity (%)	Average Number of Days with Heavy Fog or Visibility of 1/4 Mile or Less	Percent of Time Each Year: Ceiling Height Equal to or Less than 400 ft.	Percent of Time Each Year: Light Winds	Percent of Time Each Year: Joint Frequency of Height and Light Winds
SPRING	March	WNW	12.3	64-81	2	0.37	0.25	0.0116
	April	S	12.3	56-78	1	0.09	0.28	0.0032
	May	S	10.5	57-81	1	0.20	0.79	0.0187
SUMMER	June	S	9.2	56-81	1	0	0.52	0
	July	S	8.0	59-86	1	0	0.93	0
	August	S	7.8	59-87	1	0.12	0.76	0.0102
FALL	September	S	8.8	65-88	1	0.16	0.40	0.0094
	October	S	9.5	58-85	2	0.35	0.70	0.0292
	November	S	11.2	66-83	2	0.54	0.21	0.0137
WINTER	December	S	10.9	73-83	3	1.06	0.39	0.0532
	January	S	11.2	68-78	3	1.03	0.57	0.0739
	February	WNW	11.6	66-77	3	0.58	0.92	0.0447
YEAR		S	10.3	62-83	21	--	--	0.2678
LENGTH OF RECORD (years)		31		15	31	2	2	2

tor contributing to poor visibility. Ground fog normally occurs during the night and at dawn. Periods of low ceiling height and light wind can lead to severe conditions during which air pollutants accumulate at ground level. The annual joint frequency of low ceiling height and light wind is 0.27 percent which is equivalent to only 24-hours in a year.

2. General Topography

Strip-mining activities in the project area have left steeply sloping spoil mounds and a number of long, narrow lakes with abruptly sloping shorelines scattered about the project site. Uneven settling of unconsolidated and clayey soils within the mined sections has produced an almost undulating surface. In addition, the project area is covered with rocks and potholes. The application fields have been prepared for agricultural use by leveling and grading, filling potholes and removing rocks. As a result, the application fields themselves have a level to gently sloping topography.

The capacity of storm runoff to carry solids such as silt or spoil fines may have been increased by the steepened slopes resulting from coal stripping and piled, abandoned spoil. This is evidenced by several spoil downwashes on the project site. The leveling and grading accomplished for site preparation should have significantly reduced the erosion problem. Site areas not developed as sludge application fields may continue to erode, causing water quality problems.

B. Geology And Soils

Environmental impacts such as erosion or groundwater contamination, and socio-economic factors such as land development potential, will depend to a great degree upon the geological and soil characteristics. This section contains a discussion of past and present geological conditions and a description of soil characteristics in the vicinity of Fulton County.

1. Geological Characteristics

The land surface is covered with unconsolidated Pleistocene soil deposits in this general area which nearly obscure the bedrock except near the valleys of major drainage channels. A brief discussion of the bedrock and Pleistocene stratigraphy is presented in this section, concluding in a description of the characteristics of mine spoil.

Outcrops of bedrock reveal that the geological formation consists of shales and sandstones, of the Pennsylvanian Age Carbondale Formation containing several strata of coal and limestone beds. Figure III-4 shows a typical stratigraphic profile. A soft gray shale known as Canton Shale, approximately 40 to 60 feet thick, lies immediately beneath the surface soil deposits. This shale is underlain by 1 to 2 feet of gray, fossiliferous limestone known as Saint David Limestone. Beneath this stratum are 4 to 6 feet of black shale, which merges into a high-quality coal designated as No. 5 or Springfield coal. This coal seam has a thickness of 4 1/2 to 5 feet and is located near elevation 580. The relatively shallow depth and high quality of this coal has led to considerable strip and shaft mining throughout the general area. The coal is underlain by soft clay to shale and several other thin strata of limestone and shale. These layers have a total thickness of approximately

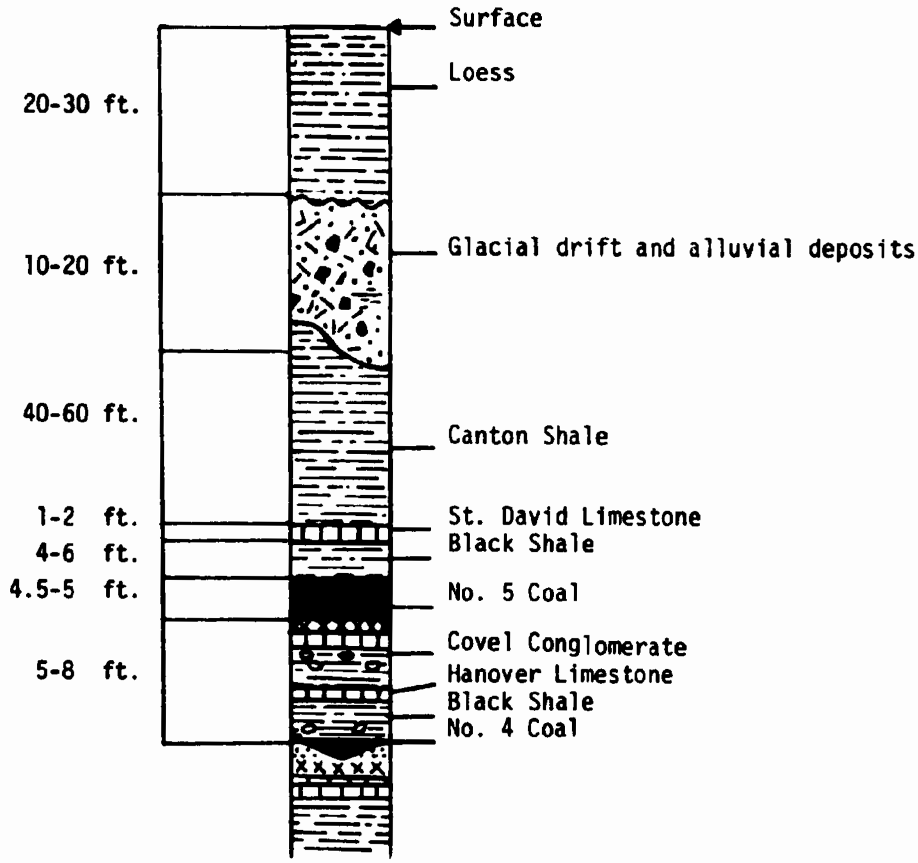


Figure III-4 Typical Stratigraphic Profile in the Project Area (A&H Engineering Corporation, 1971)

5 to 8 feet.

The bedrock surface is covered by a 30 to 50-foot mantle of glacial drift or drift-related deposits. The bottom layer is composed of a silty clay to clayey silt matrix resulting from glacial till during the Illinois Glacial Era. Illinoisan glacial till is topped by a windblown silt material known as loess, which often reaches thicknesses of 20 to 30 feet in this general area. Soil borings on the project site indicate a thickness ranging from 3 to 40 feet, averaging about 20 feet. Past coal mining operations have modified this stratigraphic profile. The uppermost bedrock strata and the unconsolidated sediments have been removed and remolded into a generally similar but locally variable soil mass (A&H Engineering Corporation, 1971).

2. Soil Characteristics

A study of the project site to identify areas with basically similar soil and groundwater characteristics was conducted L. T. Hooper (1971).

According to Hooper, the project site can be divided into three basic areas:

- Area 1 — completely strip-mined land
- Area 2 — virgin or place land with a cover of loess over glacial till
- Area 3 — alluvial land within major stream beds, affected by mining activities.

The spatial distribution of these soil areas is presented in Figure III-5.

During surface mining operations, the overburden soils and cap rock in Area 1 were removed from the entire area to obtain coal. Therefore, the subsurface of Area 1 consists of a heterogenous landfill which is composed of cohesive fine-grained soils with pockets and discontinuous zones of boulder-size rock. These rearranged and redistributed overburden soils are rather impervious. Numerous depressions were created, most of which have no drainage outlet. Large lakes maintain nearly uniform levels which are controlled by culverts. Mining activities have resulted in slightly different features in parts of Area 1. A subclassification of Area 1 and its description can be found in the Subsurface Investigation and Evaluation - Final Report (Hooper, 1971).

Area 2 is the area in which no strip-mining activities have been undertaken. Approximately 3 to 40 feet (averaging 20 feet) of loess, which is comprised of 50 percent clay and 50 percent silt-sized particles, covers the glacial soils. These materials have low permeability and, depending on vegetative cover and conservation practices, are subject to erosion. A groundwater table at a depth of approximately 15 feet is normal throughout the area with the exception of slopes leading down to stream valleys. It is known that much of Area 2 has been mined underground by tunneling methods (Hooper, 1971).

Area 3 consists of alluvial soils within major stream beds, and defines most of the continuous drainage channels. These soils are relatively impervious to perco-

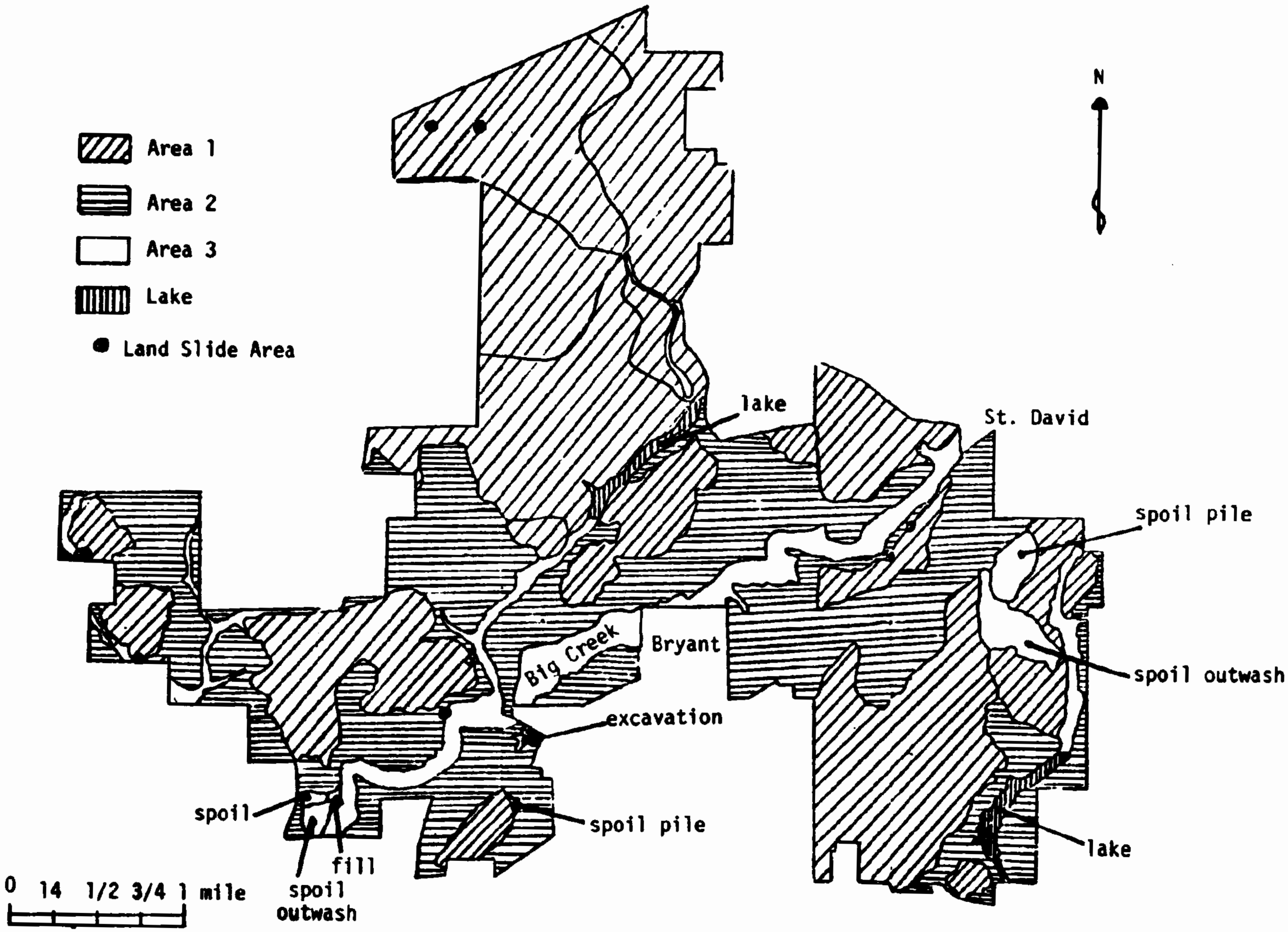


Figure III-5 Spatial Distribution of Soil Areas (Hooper, 1971) lation water, but are moderately permeable to horizontal flow. A high groundwater table is normal here.

Based on field pumping tests, laboratory tests, and analysis of existing groundwater conditions, the permeability of the overall mass of mine spoil is estimated to be in the range of 10-3 to 10-5 centimeters per second (cm/sec). The vertical permeability of soils was estimated by laboratory tests to be from 10-5 to 10-9 cm/sec. According to Casagrande's classification of soils by permeability, these soils are impervious, non-draining or poorly draining (Casagrande, 1948). However, some zones or layers may consist of broken shale and sandstone slabs or blocks arranged in a way that provides a rapid path for water (A&H Engineering Corporation, 1971). Such areas may possess a permeability as high as 10-1 cm/sec. Although they are seldom continuous for more than short distances, these zones are considered important in reservoir areas.

There are no published Soil Conservation Service soil surveys available for Fulton County. However, the Fulton County Soil Conservation Agent at Lewistown provided highly useful information concerning the agricultural capability of local soils (see Section F. 3. of this chapter).

Over 52 soil borings were made to bedrock to determine the background characteristics of soil and rocks. Physical soil characteristics, such as permeability, were used to examine potential groundwater contamination from the project.

The chemical composition of both mining spoils and place land sampled from a 0-6 inch depth is summarized in Table III-5. Included are the mean, maximum and minimum values of exchangeable calcium, organic carbon, and hydrochloric acid-extractable metals such as aluminum, cadmium, copper, chromium, lead, manganese, nickel, and zinc. In general, the spoil material and place land have approximately equal concentrations. The mining spoils, however, contain significantly higher levels of cadmium and copper. Increased Cadmium and Copper concentrations in spoil material probably arise from the black shale above the coal seam which is now dispersed throughout the overburden spoil materials. The spoils also contain more exchangeable calcium but less organic carbon than place land. The higher organic carbon content of the place land indicates that it is more fertile. .

The characteristics of the calcareous mine spoil material have been analyzed separately and are presented in Table III-6. Clay species in the clay fraction of the soil were investigated by the potash content, surface area, and X-ray diffraction patterns of the soil particles. Illite is the dominant mineral and accounts for 54 percent of the total clay. Kaolinite was estimated at 27 percent, and chlorite at 8 percent, vermiculite at 11 percent of the total.

C. Hydrology And Water Quality

This section describes the hydrological and water quality characteristics of the project area. The purposes of this review are to define local hydrological patterns, establish baseline water quality information, and define their interrelationships. Moreover, the background quality of ground and surface waters and their respective flows will determine their vulnerability to project operations.

Table III-5 Metals, Exchangeable Calcium and Organic Content of Spoil Material and Place Lands in Fulton County Prior to the Application of Digested Sludge (MSDGC, Spring 1972)

	0.1N HCl Extractable Metals (ug/g of Oven Dry Soil)								Exchangeable	Organic
	Mn	Zn	Cu	Cd	Cr	Ni	Pb	Al	Ca (%)	Carbon (%)
Mean	509	154	31.7	6.7	4.79	3.52	1.22	0.2	0.83	0.61
Minimum	384	79	11.1	3.2	1.90	0	0	0	0.63	0.24
Maximum	620	208	69.4	10.0	19.1	8.50	3.40	1.36	1.12	1.56
Mean	540	146.1	31.4	7.5	2.62	4.55	1.23	0.08	0.36	1.64
Minimum	317	92.0	10.3	3.2	1.48	2.23	0.30	.0	0.20	0.92
Maximum	741	258.6	68.7	12.7	3.73	7.94	3.17	0.66	0.72	4.55

THREE SUCCESSIVE 5-MINUTE EXTRACTIONS OF 1.5 GRAMS OF SOIL WITH 15 MILLILITERS OF ACID

Table III-6 Selected Characteristics of the Fulton County Calcareous Mine Spoil Material (MSDGC, 1974)

Parameter and Unit	Quantity
Spoil Material	
pH	7.8
E.C. umhos/cm	0.46
1/3 bar water (%)	26.72
15 bar water (%)	12.49
Cation exchange capacity (meq/100 g)	14.8
Ammonium fixation capacity (meq/100 g)	5.2
Silt content (%)	64
Clay content (%)	28
Sand content (%)	8
Clay Fraction Only	
Illite (%)	54
Kaolinite (%)	27
Vermiculite (%)	11
Chlorite (%)	8
Surface area (m^2/g)	138
K_2O (%)	4.47
MgO (%)	2.29
CaO (%)	1.15
Na_2O (%)	0.82

1. Surface Water Hydrology

The project site is located within the Illinois River Basin. Most of the surface water is drained by Big Creek and Slug Run, a branch of Big Creek, to Spoon River, a tributary of the Illinois River. The tributaries associated with the project site, on a regional scale, are shown in Figure III-6. The flows of Big Creek and Spoon River have been monitored at three USGS gage stations. Two stations are located on Big Creek at St. David and near Bryant, and the third on the Spoon River at Seville. The daily average, maximum and mimimum discharges at these stations in 1972 and 1973 are shown in Table III-7. (The detailed drainage pattern near the project site is depicted in Figure III-7).

Table III-7 Daily Discharges at USGS Gage Stations (USGS, 1972 and 1973)

	1972			1973		
Gage Stations	Daily Discharge (cfs)*			Daily Discharge (cfs)		
	Mean	Maximum	Minimum	Mean	Maximum	Minimum
Big Creek at St. David (USGS Station 05570350)	16.9	137	1.9	39.4	700	7.6
Big Creek near Bryant (USGS Station 05570370)	28.3	259	6.7	56.4	803	11.0
Spoon River at Seville (USGS Station 05570000)	625.0	5150	37.0	—	—	—

*cubic feet per second

Based on a soil permeability of 10-5 cm/sec (as discussed in Section III-B), the vertical infiltration rate ranges from 1.2 X 10-6 inches per hour for a rainfall intensity of 1.01 inches per hour. The amount of rainwater infiltrating the soil surface is relatively insignificant when compared to surface runoff. This poor soil drainage forces most rain water to be discharged to creeks or streams as surface runoff. Flood hazards are generally confined to the flood plains.

2. Groundwater Hydrology

Migration or drainage of groundwater is much more difficult to define than for surface water. With the aid of well-water elevations and river water levels, the groundwater flow in the general area has been interpreted qualitatively. The water elevations in 22 wells within and around the project site have been observed monthly by MSDGC personnel. After some data reduction, all observations are expressed as an average value, accompanied by its standard deviation and range

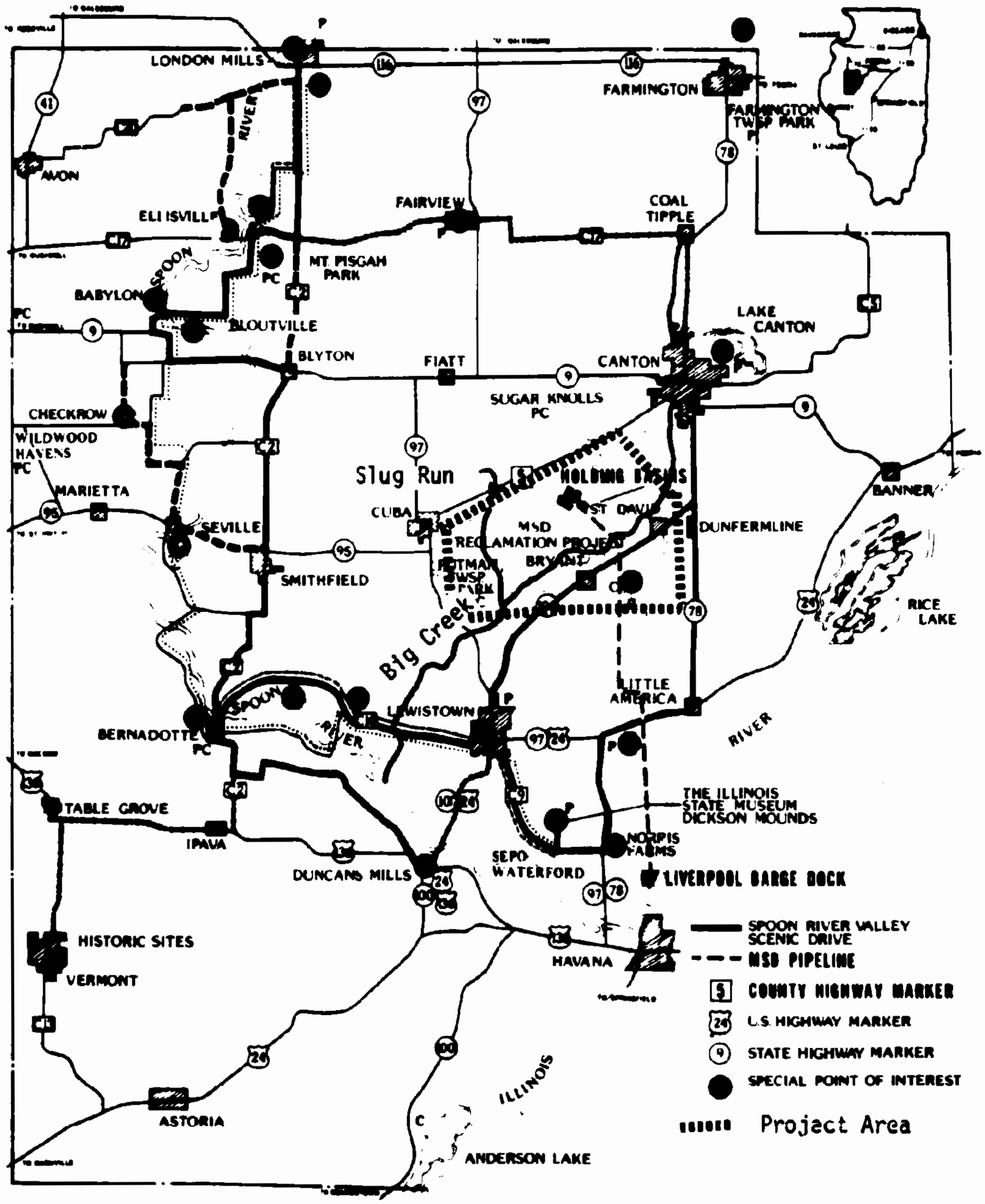


Figure III-6. Illinois River and Tributaries Associated with the Project Site

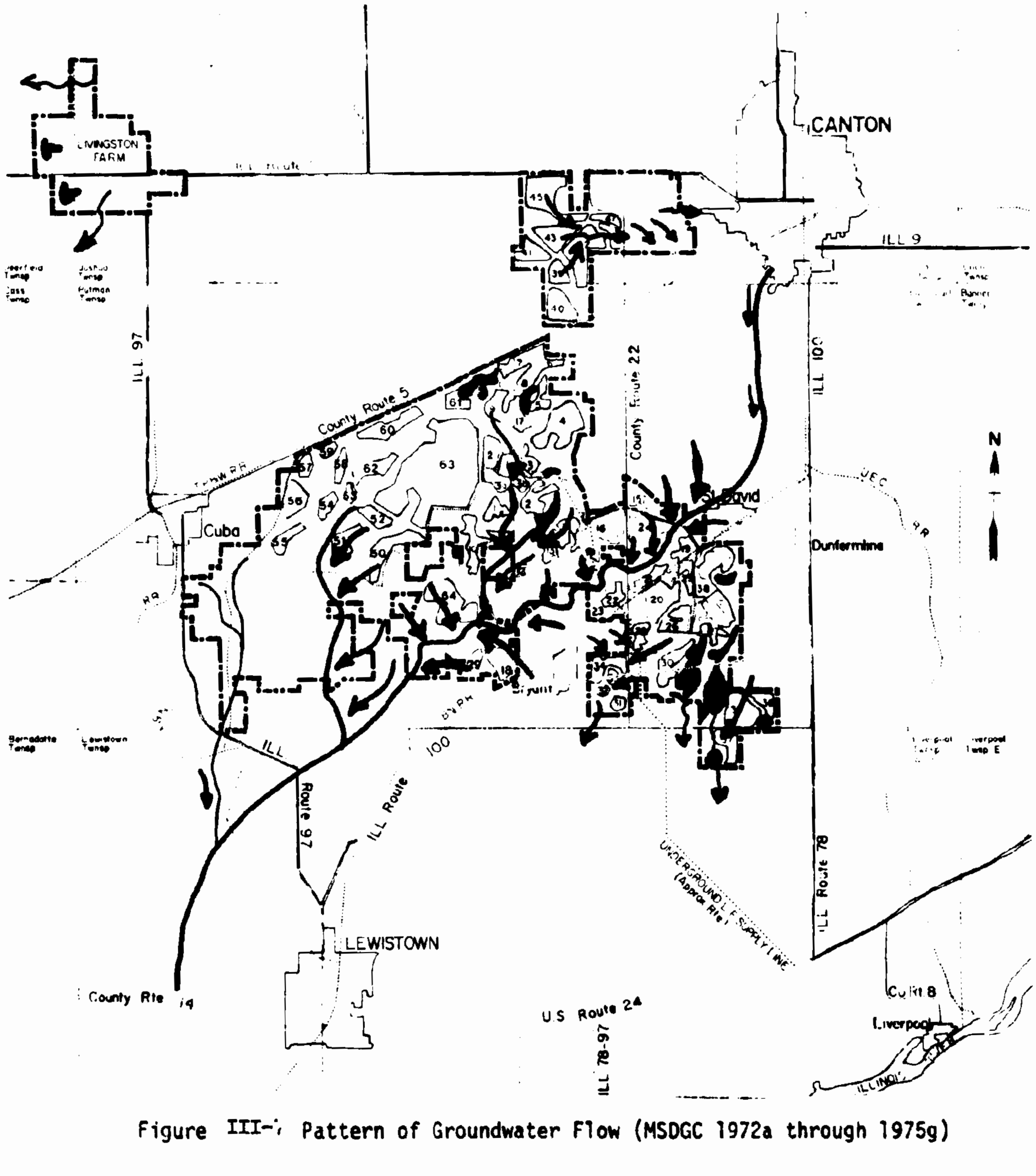


Figure III-7 Pattern of Groundwater Flow (MSDGC 1972a through 1975g) of variation throughout the observation periods. The results are summarized in Table III-8. (All water elevations are based on USGS mean sea level with the 1929 adjustment.) Utilizing well water and stream water levels, the pattern of groundwater flow can be approximated by the "streamline" method. This pattern is displayed in Figure III-7.

The interactions between groundwater and surface water systems cannot be attributed solely to soil percolation or trans-migration because soils in this area are relatively impermeable. Therefore, surface water flow is generally derived from upstream tributary flow, storm runoff, and snow melt. Paths of rapid flow between ground and surface waters may furnish the mechanism for groundwater depletion.

3. <u>Water Quality</u>

To assess possible impact on water quality from project operations, surface and groundwater quality prior to project implementation must be established. Using 1971 as the baseline year, stream water quality at monitoring stations S1, S2, and S3 (see Figure V-4) is summarized in Table III-9. These measurements were then compared to standards for the State of Illinois which are presented in Chapter II. The 1971 pH values and the chloride, cadmium, chromium, manganese, mercury, nickel, and zinc concentrations were generally in conformance with water quality standards. Average concentrations of sulfate ions (SO_4), copper and lead were within or marginally close to standards, although the standards were violated occasionally, as evidenced by the 1971 maximum concentrations which were all higher than allowed. Ammonia nitrogen (NH_3 -N), irons, and fecal coliform concentrations violated standards on numerous occasions, indicating pollution in Big Creek. These violations were not caused by the sludge application project.

Stations S1 and S2 on Big Creek constitute an upstream-downstream pair relative to the project site. Poor water quality at upstream station S1, which cannot be affected by the project, is attributable to sewage effluent from the Canton sewage treatment plant and other sources of pollution upstream from S1. Generally, the stream at station S1 was lower in quality than at the downstream station S2 with respect to ammonia nitrogen, chlorine, sulfate ions, copper and fecal coliforms. This indicates that cleansing and dilution occurred along the approximately 6.5-mile stream reach between the two stations. Levels of cadmium, iron, nickel, and zinc remained relatively constant at both stations. Surface runoff and leachates originating in the strip-mined area along this segment of Big Creek may contribute to increased levels of chromium, lead and manganese in the downstream direction.

Groundwater samples were collected from a number of wells and one spring. The measured ranges of all groundwater quality parameters reported in 1971 and 1972, prior to project operations, are presented in Table III-10. In this table, the well associated with maximum reading of a given parameter is designated by parentheses. Wells W2, W4, W9, W11, W12, and W13 indicated high degrees of contamination. Variations in concentrations of nitrite and nitrate nitrogen (NH_2+NH_3-N) and ammonia nitrogen at all monitoring stations are summarized in Table III-11 for 1972.

Table III-8 Elevations of Well Water (MSDGC 1972 a through 1975 g)

Well	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Mean Elevation (ft. msl)	--	--	--	--	--	617.9	608.8	622.2	593.6	621.3	624.5	628.1	601.6	638.4
Standard Deviation (ft.)	--	--	--	--	--	7.8	2.0	3.7	2.1	6.4	1.4	1.7	0.9	1.5
Range of Variation (ft.)	--	--	--	--	--	24.0	6.0	9.9	6.0	20.2	4.0	4.0	3.0	5.0
Observations	0	0	0	0	0	18	20	11	18	18	9	19	13	16

Well	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24	W25	W26	W27
Mean Elevation (ft. msl)	656.7	614.8	625.3	632.0	608.0	600.0	572.0	571.4	601.2	675.7	647.7	659.8	673.8
Standard Deviation (ft.)	0.4	0.6	3.7	1.2	16.2	--	--	1.3	3.2	2.4	9.3	1.9	6.2
Range of Variation (ft.)	0.7	2.0	12.0	3.3	61.1	--	--	4.0	10.0	8.0	25.0	4.0	21.0
Observations	4	10	16	5	14	1	1	10	20	21	20	7	19

Table III-9 Surface Water Quality in 1971 (MSDGC, 1971)

Parameter and Unit		Monitoring Station S1	S2	S3
pH	mean	7.9	8.1	8.0
	max.	8.8	8.7	8.3
	min.	7.3	7.1	7.5
Cl^- (mg/l)	mean	53	28	10
	max.	120	72	15
	min.	24	4	6
SO_4^{-2} (mg/l)	mean	389	381	606
	max.	1,250	879	743
	min.	120	80	424
NH_3-N (mg/l)	mean	2.6	1.8	0.4
	max.	8.1	6.6	0.7
	min.	0.3	0.1	0.1
Cd (mg/l)	mean	0	0	0
	max.	0	0.06	0.04
	min.	0	0	0
Cu (mg/l)	mean	0.02	0.02	0.01
	max.	0.13	0.06	0.03
	min.	0	0	0
Cr (mg/l)	mean	0	0.02	0.02
	max.	0.18	0.28	0.12
	min.	0	0	0

Parameter and Unit		Monitoring Station S1	S2	S3
Fe (mg/l)	mean	1.5	1.3	0.3
	max.	4.8	4.5	0.6
	min.	0	0.1	0.1
Pb (mg/l)	mean	0.05	0.09	0.08
	max.	0.2	0.28	0.2
	min.	0	0	0
Mn (mg/l)	mean	0.7	0.86	0.47
	max.	0.98	1.31	0.96
	min.	0.06	0.60	0.24
Hg (μg/l)	mean	0.05	0	0.2
	max.	0.2	0.2	0.6
	min.	0	0	0
Ni (mg/l)	mean	0	0	0
	max.	0.35	0.33	0.31
	min.	0	0	0
Zn (mg/l)	mean	0	0	0
	max.	0.2	0.2	0
	min.	0	0	0
Fecal Coliforms (1/100 ml)	mean	7,500	1,700	920
	max.	34,000	3,800	4,000
	min.	270	20	80

Table III-10. Ranges of Various Water Quality Parameters in Well Water, 1971 and 1972, and U.S. Averages (MSDGC, 1972a through 1975 g; Durfor and Becker, 1964)

Parameter and unit		1971	1972	Range in Quality of Groundwater Used for Water Supplies in 17 U.S. Study Areas
pH		6.6-9.0	6.5-9.2	6.7-8.7
Total P	mg/l	0.6.0 (W9)	0-0.54 (W2)	--
Cl^{-1}	mg/l	2-500 (W4)	2-488 (W4)	2.0-92
$SO_4^{=2}$	mg/l	1-500 (W4)	3-1,812 (W14)	0.8-572
Alkalinity ($CaCO_3$)	mg/l	4-1,650 (W11)	100-1,000 (W11)	--
Conductivity	µmho	90-1,050 (W17)	200-4,000 (W4)	108-1,660
Al	mg/l	--	--	2.9-83
Cd	mg/l	33-495 (W12)	38.5-883 (W1)	3.2-121
Ca	mg/l	0-0.1 (W6)	0-0.22 (W2)	--
Cr	mg/l	0-0.39 (W6)	0-0.05 (W13; W18)	ND-1.1
Cu	mg/l	0-0.5 (W2)	0-1.82 (W2)	<0.8-15
Fe	mg/l	0-118.7 (W9)	0-182.6 (W13)	1.1-6,600
Pb	mg/l	0-1.0 (W19)	0-2.2 (W2)	ND-38
Mg	mg/l	21-390 (W12)	23-410 (W14)	0.3-120
Mn	mg/l	0-12.7 (W9)	0-8.3 (W12)	ND-340
Hg	µg/l	0-20 (W19)	0-2.8 (W7)	--
Ni	mg/l	0-0.42 (W10)	0-0.3	ND-<15
K	mg/l	0.1-24.9 (W4)	0-19.4 (W4)	0.4-30
Na	mg/l	11.7-310 (W8)	7-646 (W11)	6.1-129
Zn	mg/l	0-390 (W12)	0-140 (W10)	ND-<470
Fecal Coliforms	1/100 ml	0-<100	0-120 (W7)	--

ND = not detected.

Table III-11 Levels of Nitrite and Nitrate Nitrogen and Ammonia Nitrogen in Well Waters in 1972 (MSDGC, 1972a through 1975g)

	NO_2+NO_3-N (mg/l)			NH_3-N (mg/l)		
Well	Mean	Max.	Min.	Mean	Max.	Min.
W1	0.03	0.11	0	0.40	0.70	0
W2	0.03	0.11	0	0.80	4.10	0
W4	0.29	1.51	0	1.1	1.9	0
W5	0.04	0.27	0	0.2	0.6	0
W7	0.16	0.28	0.04	0.5	1.1	0.1
W8	0.01	0.05	0	1.8	4.3	0
W9	0.02	0.09	0	1.0	1.7	0
W10	0.02	0.09	0	0.8	1.6	0.4
W11	0	0.02	0	1.8	2.1	1.4
W12	0.03	0.13	0	0.8	1.3	0.2
W13	0.08	0.21	0	0.6	0.8	0.3
W14	0.01	0.07	0	0.6	1.3	0.1
W15	0.06	0.28	0	1.1	1.9	0.3
W17	0.81	2.50	0	0.5	2.2	0.1
W18	0.03	0.11	0	1.8	2.7	1.3
W19	0.03	0.13	0	0.99	2.0	0.0

The U.S. Department of Interior conducted a survey of water quality from wells and infiltration galleries in more than 17 study areas throughout the United States. The range in quality of groundwater used for water supply is summarized in Table III-10 (Durfor and Becker, 1964). Comparison of the baseline groundwater in the project area with that from the Department of the Interior study indicates that concentrations of Chromium, copper, iron, lead, manganese and nickel in the project area were within the range found elsewhere in the United States; the ranges of pH and zinc concentration were close to the national values. Concentrations of chlorine, sulfate ion, calcium, magnesium, and sodium were higher than those found nationwide, indicating that dissolved solids or salt concentrations were relatively high in the project area, at least with reference to standards for groundwater used as a water supply.

The recommended maximum level of nitrate nitrogen for drinking water is 10 milligrams per liter (mg/l) as nitrogen (U.S. Department of Public Health Service, 1962 and 1969). If all ammonia nitrogen were oxidized to nitrite or nitrate, the range of nitrite and nitrate nitrogen concentrations in the project area would fall between zero and 5.2 mg/l. This range falls within the lower one-third of the national range of 0 to 17 mg/l as reported by Durfor and Becker (1964). The maximum nitrite and nitrate concentration of 5.21 mg/l, recorded at well W4 in the community of Cuba, was well within the recommended drinking water standard. The baseline quality of groundwater in the area of the project appears to be compatible with use for public water supply. However, the high overall concentration of dissolved minerals, approximately three times the the U.S. standard of 500 ppm could necessitate extensive hardness removal. Most municipal groundwater supplies in the project vicinity are obtained from deep wells unaffected by surface land disturbance.

D. Biology And Ecosystems

The following discussion of biology and ecosystems is divided into two sections: fish and wildlife, and natural vegetation. Within each of these are discussed major species, both past and present, and the rare and endangered species possibly inhabiting the project area.

1. Fish and Wildlife

Fish abound in most of the local lakes, and are the most numerous vertebrates in the study area. The predominant fish are bluegill, green and redear sunfish, black crappie, yellow and black bullheads, large-mouth bass, and catfish.

A great diversity of wildlife currently inhabits the project area. Turtles, frogs, water insects, and crustaceans are abundant in Lake Evelyn. There are also some black snakes and signs of beaver activity. The steep-sided lakes formed by strip mining have fewer crustaceans and water insects, but muskrats and frogs are abundant. Land animals include dear, fox, raccoon, skunk, opossum, rabbit, coyote, badger, groundhog, and weasel. Water fowl include ducks, geese (especially the giant Canada goose), swans and an occasional great blue heron. Other birds include crows, hawks, warblers, robins, starlings, sparrows, red-winged blackbirds, bluejays, and finches.

Within historic times, other animals have populated Fulton County. These prairie animals included populations of elk, buffalo, trumpeter swans, sandhill cranes, and the prairie chicken, as well as large predators like the cougar, bear, and wolf. Big Bluestem, a project aimed at re-creating a native prairie on part of the MSDGC property (the 2,972-acre former Gale Farm) is planned to create habitat opportunities for a number of original prairie animals.

Six rare and endangered animal species are listed for the region containing Illinois. Fish species are the longjaw cisco and the blue pike. Endangered birds are the arctic peregrine falcon and Kirtland's warbler, and mammals are the Indiana bat and the eastern timber wolf. However, the probability of any of these species being present in the project area is extremely remote, and should therefore not present a problem.

2. Natural Vegetation

The two types of vegetation in the project area consist of cultivated monocultures (predominantly corn) in the sludge application fields, and the area's natural vegetation. The following is a discussion of this natural vegetation and the locally rare and endangered plant species which might occur.

The predominant grasses are brome, alfalfa, and reed canary grass. Trees are those generally propagated by wind-blown seeds, including elm, cottonwood, and willow. Most of the lakes in the project area were formed from the end cuts of strip-mining operations, and have steeply sloping sides and a small littoral zone. This zone supports some growth of Chara and Nitella. Diatoms are the predominant planktonic species. No cattails or reeds are present.

A few lakes have gently sloping sides and a relatively large littoral zone. These lakes have an abundance of lake cattails and reeds. Diatoms and lesser amounts of green algae are the major planktonic species. Submerged aquatic vegetation includes stoneworts, Chara, Nitella, Elodea, Vallesenaria, and some of the Potomogetons. Considerable numbers of currant, raspberry, and blackberry bushes grow along the banks.

There are three endangered plant species which may exist in the project area (Federal Register, July 1, 1975). One, an endangered woodland species, is Aster chasei, a woodland aster. Two endangered prairie species are Lespedeza leptostachya, a bush clover found on dry prairie, and Petalostemum foliosum, a prairie clover found near river banks.

E. Population And Economics

This section is a description and interpretation of the baseline data needed for the assessment of the socio-economic and land use impacts of the project. What is presented here is a selective representation of a broad data collection effort and contains only those data which are relevant to the prediction of impacts. The two main topics discussed in this section are demographic and economic characteristics.

1. Demographic Characteristics

Population will be a major factor in determining the types of land use for which there will be a demand in the project area. The following paragraphs discuss historic and recent demographic trends in Fulton County, and give population projections developed from analysis of trends. The section concludes with a discussion of family income in the County.

a. Population trends - Table III-12 shows historic population trends in Fulton County. The County's population decreased from approximately 50,000 persons in 1910 to about 42,000 in 1970. Slight increases in the populations of Canton, Lewistown and Farmington slowed the decline in total population to 6.1 percent between 1940 and 1970. However, an increase from 41,000 in April 1970, to 42,000 in July 1974, indicates that past declines may be reversed by new factors which could lead to future population growth. The general demographic trend prior to 1970 was one of declining rural population, only partially balanced by increase in local town populations. Approximately 80 percent of the population was rural in 1910, declining to less than 30 percent in 1970 (U.S. Bureau of the Census, 1930 to 1970; Enviro Control, Inc., 1975). Rural population decrease has been caused largely by national decline in the labor intensiveness of farm production.

Township population data (1960-1970) show that growth is occurring along a corridor of townships which cross the County from Canton and Orion Townships on the east to Vermont Township on the west (see Figure III-8). On both sides of this corridor, township population is declining. It is noteworthy that these declining areas are largely agricultural. The heavily strip-mined Townships of Putman, Canton and Orion show significant population increase. Thus, in terms of population growth, economic development tends to coincide with mining activities. During this same period the communities of the County showed a pattern of population change consisting of three components:

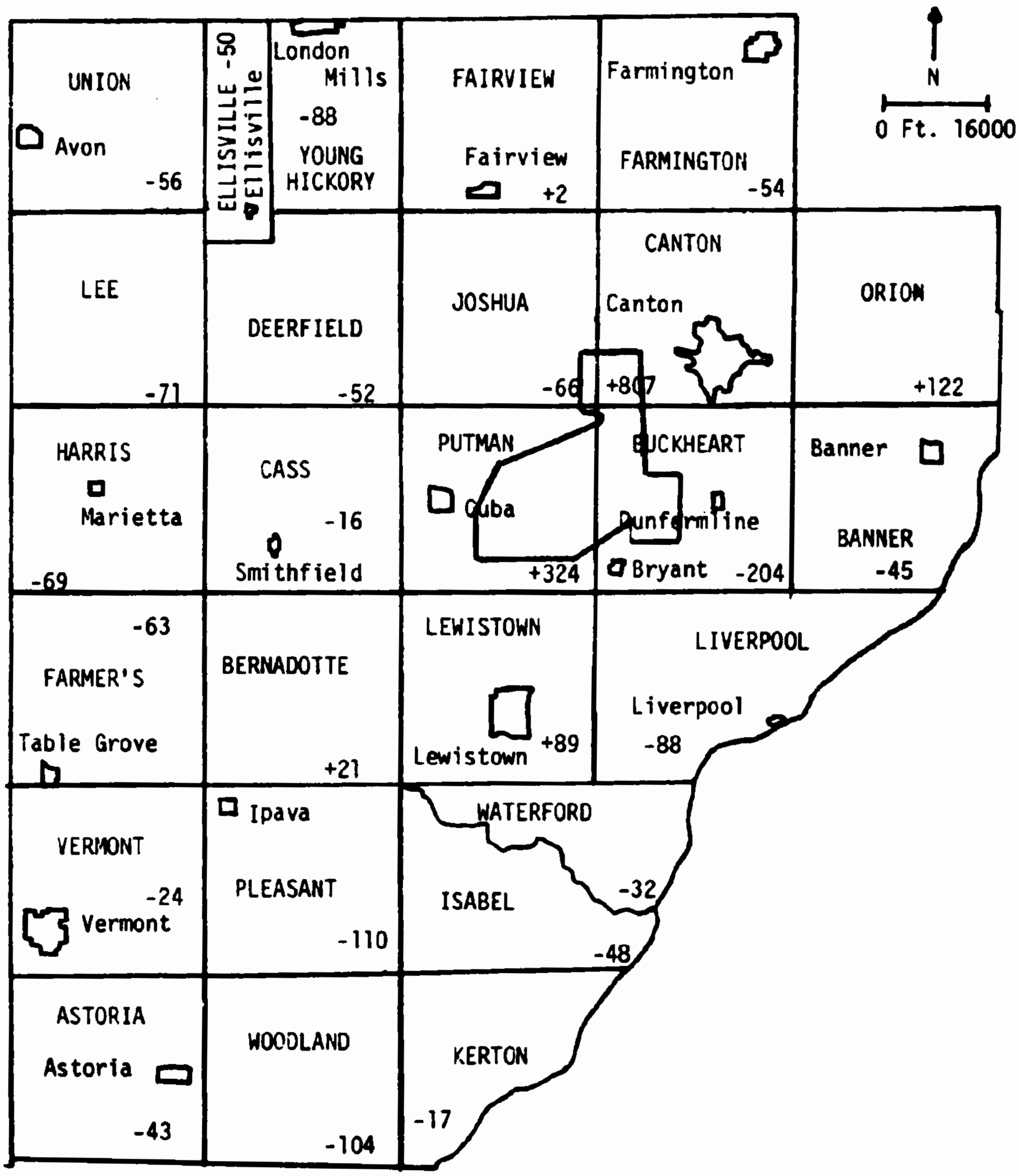
- Major communities (Canton, Cuba, Lewistown, and Farmington) increased significantly
- Communities in the predominantly agricultural western part of the County (Ellisville, Ipava, Marietta, and Smithfield) declined.
- Other communities grew slowly

b. Population projections - Future population growth is predicted in the most recent projections describing Fulton County and its surrounding water resources sub-region. The 1972-E OBERS Projections predict a 43 percent population increase between 1970 and 2020 for the 29-county water resources sub-area containing Fulton County. The basis given is the expected expansion of manufacturing. Increased opportunities in industry would facilitate the maintenance of the existing population, and would encourage population in-migration to the areas near new industrial plants. Consistent with the 1972-E OBERS Projections are population projections for Fulton County which have been released recently by the State of Illinois (see Table III-13 below). These 1975 projections by the Bureau of the Budget, State of Illinois, predict a 29 percent increase in Fulton County's population between 1970 and 2020.

Table III-12 Historical Population Trends in Fulton County (U.S. Census of Population)

Township	Land Area*	1970	1960	1950	1940	1930
Astoria	36.6	1,738	1,781	1,976	1,953	1,997
Banner	33.7	694	739	756	690	617
Bernadotte	37.7	333	362	369	671	643
Buckheart	35.1	1,770	1,974	2,257	2,320	2,589
Canton	35.7	15,837	15,080	15,056	14,162	13,937
Cass	38.7	819	835	948	1,018	987
Deerfield	34.8	424	476	528	560	630
Ellisville	13.8	230	280	319	423	331
Fairview	36.4	923	921	1,029	1,065	1,113
Farmers	35.7	498	561	617	967	976
Farmington	36.2	3,998	4,052	3,950	3,937	3,941
Harris	33.8	520	589	680	903	813
Isabel	29.5	300	348	387	507	460
Joshua	35.8	641	707	813	857	874
Kerton	27.3	178	195	283	370	338
Lee	37.2	404	475	496	594	627
Lewistown	35.7	3,252	3,163	3,237	2,943	2,884
Liverpool	42.2	844	932	1,057	1,071	955
Orion	36.5	898	776	789	900	781
Pleasant	37.9	1,018	1,128	1,199	1,299	1,333
Putman	34.8	2,115	1,791	2,025	2,169	2,123
Union	36.7	1,387	1,443	1,340	1,370	1,355
Vermont	36.7	1,399	1,423	1,490	1,590	1,602
Waterford	21.3	238	266	346	352	303
Woodland	38.7	596	700	843	976	976
Young Hickory	24.3	869	957	906	940	798
Community						
Astoria		1,281	1,206	1,308	1,292	1,189
Bryant		326	346	395	387	442
St. David		773	862	812	859	977
Canton		14,217	13,588	11,927	11,577	11,718
Norris		359	307	319	339	329
Smithfield		318	329	355	359	315
Ellisville		137	140	157	216	164
Fairview		601	544	568	528	522
Table Grove		469	400	481	480	463
Farmington		2,959	2,831	2,651	2,225	2,269
Marietta		169	201	178	193	202
Lewistown		2,706	2,603	2,630	2,335	2,249
Ipava		608	623	667	629	635
Cuba		1,581	1,380	1,482	1,620	1,479
Avon		1,013	996	870	803	799
Vermont		947	903	940	945	948
London Mills		612	-	-	-	432
Banner		235	247	215	172	-
Dunfermline		282	284	292	-	-
Liverpool		218	184	-	-	-

* Acres



Township Population Change, Plus (+) or Minus (-)

Figure III-8 Fulton County Township Population Change, 1960-1970 (U.S. Census of Populati

Table III-13 Population Projections for Fulton County (Illinois Population Projections, 1975)

1970 Census	1975	1980	1985	1990	2000	2020
41,883	41,308	42,031	43,196	44,691	49,454	54,048

c. Family income - Median family income in Fulton County is relatively high when compared to other predominantly rural counties (Griffin and Chicoine, 1974). Principal causes for higher income are the availability of nearby manufacturing employment and historic labor-intensive modes of agricultural and strip-mine production. Much of the manufacturing employment pays high union wages. Many other, less well-paid members of the work force are able to supplement their income by working shifts at the factories. Fewer people work on farms or at strip mines at present, but the skills required to operate increasingly sophisticated equipment enable them to command higher salaries.

Table III-14 shows that the median family income has been increasing at approximately the same rate in Fulton County as in the entire country.

Table III-14 Trends in Median Family Income (in 1967 dollars) (County and City Data Book, 1972, 1967, 1956; Statistical Abstract of the United States, 1974, 1977)

Geographic Unit	1949	1959	1969	1970
Fulton County	$4,235	$5,981	$7,852	$8,619
United States	$4,603	$6,334	$8,486	$9,586

2. Economic Characteristics

A number of local economic conditions will influence the overall impacts of the project. These conditions are described in the following section in terms of historic trends and current and probable future conditions. The analysis is divided into two major topics. The first consists of employment and governmental finances, including land values in relation to tax base. These factors create a framework for an ensuing description of the agricultural, mining and manufacturing and the retail and wholesale trade sectors of the local economy, which is the second topic.

a. Employment and fiscal trends - Table III-15 summarizes a detailed history of employment in Fulton County. Several general trends are apparent in these data. Large declines in employment have occurred in the agricultural and mining sectors; little change has occurred in services and wholesale trade; manufacturing has fluctuated; and slight increases have occurred in retail trade.

F. Land Use And Development

Land use is one physical manifestation of social and economic values. In the following section, data describing past and current land use, as well as projected social and economic trends, are used to project future land use.

1. Established Uses of Land

The following discussion of land use is divided into two major categories:

- Land use patterns
- Use of strip-mined land.

a. Land use pattern - A county-wide inventory of land use was made in 1968 (Harland Bartholomew and Associates, 1969). Recent low rates of social and economic change in Fulton County indicate that 1968 data reliably approximate current conditions. According to these data, most of the land in Fulton County is devoted to unintensive use. Approximately 88 percent of the land is either covered by forest or water, used for agriculture, or is vacant. Fallow strip-mined land covers nearly 7 percent of the area. Public and semi-public areas, mostly unintensively used, cover over 3 percent of the county. Only the 2 percent of remaining land is used intensively. Intensive uses amount to a little over 1 percent residential, less than 0.5 percent commercial, and about 0.7 percent industrial.

While quantitative estimates of past land use are generally unavailable, some estimates of agricultural and strip-mining acreage were obtained. Data from the Census of Agriculture (see Table III-16) show that the percent of land in the County devoted to agriculture decreased from 87.5 percent in 1945 to 82.7 percent in 1959. This change was accompanied, from 1945 to 1969, by a decrease of 60,000 acres of pasture and an increase of 32,000 acres of cropland. By 1974 approximately 5,000 acres of strip-mined land had been added to the 1959 county-wide total of 40,000 acres (Sandberg, 1973). Due to recently increased requirements for land reclamation, this added acreage has been reclaimed to a degree much closer to its original state than were most of the 40,000 acres.

The relationship of the project site to neighboring areas of importance is provided in Figure III-9. This map shows the strong orientation of intensive uses to Canton and, to a lesser extent, Lewistown. Wee-Ma-Tuk Hills and Spoon River College are the major intensively developed sites near the project area; both

Table III-15 Employment Structure in Fulton County, Illinois (U.S. Census, County Business Patterns and Census of Government)

COMPONENT	Years			
	1950	1959	1964	1969
Agriculture[1]	430[2]	384[2]	392[2]	123[1]

	1953	1959	1964	1967	1972
Manufacturing	2,601	919	2,683	3,605	2,551
Trade-Retail	1,726	612	1,715	1,898	2,004
Trade-Wholesale	276	185	180	227	221
Services	467	195	828	1,024	1,273
Mining	1,268	--	837	1,004	699
Contract Construction	133	265	134	127	192
Forestry & Other	7	20	10	--	--

	1957	1962	1967	1972
Government[3]	1,317	1,359	2,177	1,913
Education[3]				
Total	390	295	505	955
(Teachers)		(229)	(375)	(673)

[1]For Class 1-5 farms for worker by number of days worked -- 150 days or more.

[2]Workers by number of days worked -- 150 days or more.

[3]Local government employment and payroll in individual city areas.

Table III-16 Historical Agricultural Trends in Fulton County, Illinois (U.S. Census of Agriculture)

	1940	1945	1950	1959	1969
Farms	3,199	2,892	2,780	2,314	1,772
Land in Farms (acres)	501,867	489,318	489,919	496,427	464,314
Average Size of Farms (acres)	156.9	169.2	169.2	214.5	262.0
Land in Farms (%)	89.7	87.5	87.6	88.7	82.7
Farm Population	NA	10,614	NA	NA	5,890
Farm Operators on Farms	2,885	2,709	2,621	1,925	1,323
Hired Workers	739	376	842[1]	680[1]	NA
Absentee Farm Operators	165	173	131	176	311
Total Cropland (acres)	251,635	269,964	261,894	293,928	302,083
Total Pastureland (acres)[2]		189,129	183,518	164,126	129,482
Corn (acres)	106,985	132,621	128,421	148,893	145,884
Sorghums (acres)	63	48	41	365	380
Oats (acres)	35,334	29,264	45,678	27,795	
Winter Wheat (acres)	33,832	13,348	13,348	19,071	12,578
Soybeans (acres)	24,916	46,783	31,037	39,451	56,302
Cattle and Calves	41,789	54,109	47,836	61,933	55,674
Cow Milked	12,395	11,762	9,953	4,002	902
Hogs and Pigs	79,753	122,229	161,982	204,669	120,332
Chickens	209,967	252,613	187,980	125,604	59,770
Value of All Products (1967 dollars)	$12,646,440	$23,988,145	$23,826,590	$26,523,367	$31,483,785

[1] Number of farms reporting the use of hired help.

[2] For class 1-5 farms (greater than $2,500 sales).

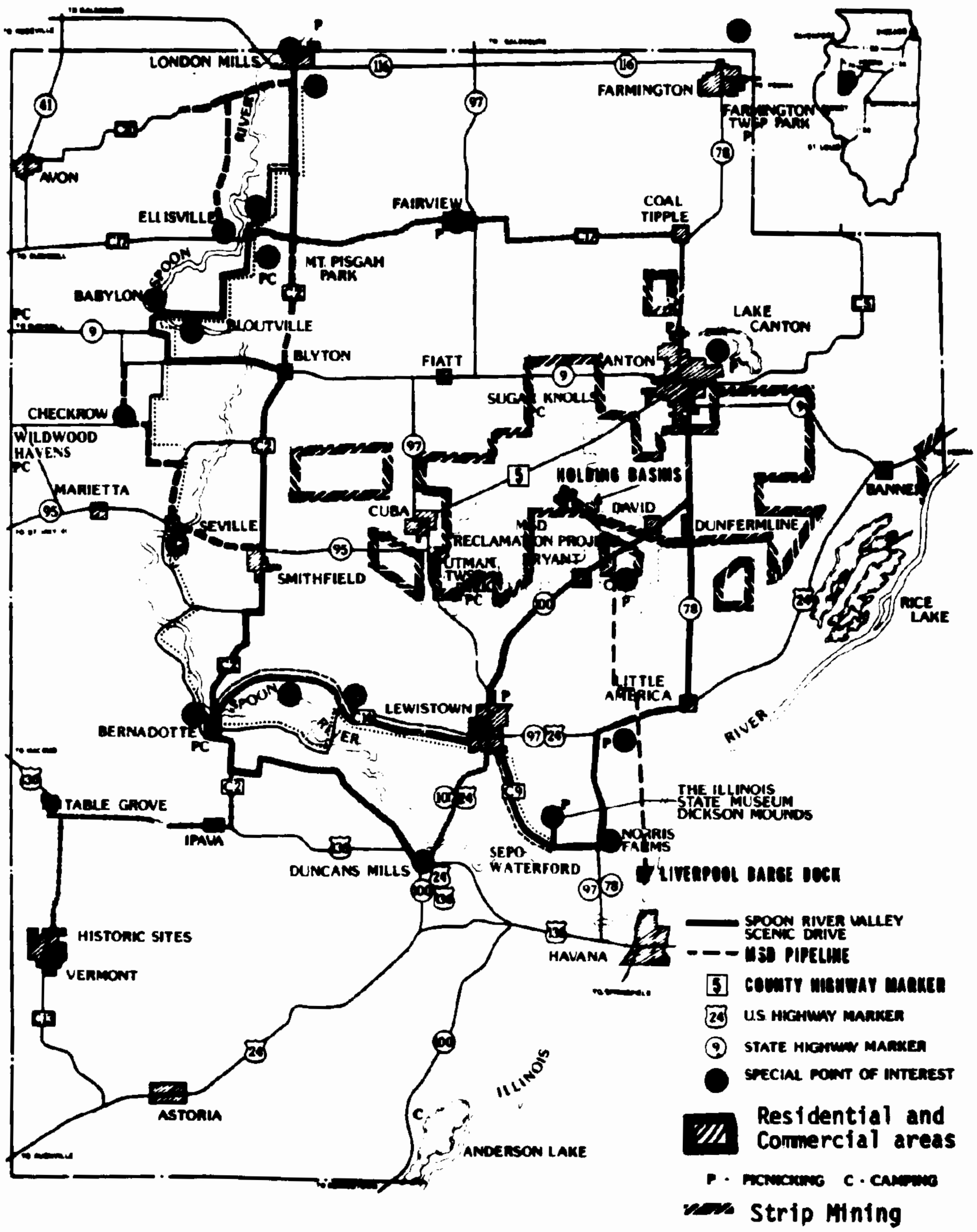


Figure III-9 Fulton County Land Use, 1968
(Harland Bartholomew and Associates, 1969)

exhibit potential for future growth.

The predominant urban land use is residential, accounting for almost 38 percent of the total urban area (Harland, Bartholomew and Associates, 1969). Most industrial activities are located in or adjacent to urban areas; remaining rural industrial operations are mostly agriculturally oriented. Strip-mining activities are located in the central, northeastern, and southwestern sections of the County. Agricultural activities are located throughout the County.

Substantial, widely scattered forests are located along streams and in areas where steep slopes have limited the use of the land. Major conservation districts are located along the Illinois River. Parks and private recreation clubs occupy many other scattered areas. Hunting, fishing, and camping are the primary recreational activities. Most recreation is seasonal and requires an extensive amount of land per user. Most regional recreation is concentrated at Dickson Mounds State Park and throughout the Spoon River Valley. Parks are planned for several sites near the Spoon River (Bordner, 1975).

The major land holders in Fulton County are the mining companies, incorporated farms and owners of a number of large farms, as well as MSDGC. Land holdings as of 1973 are detailed in Table III-17, indicating that large portions of the County are owned by relatively few individuals and corporations. The existence of large tracts of land makes it relatively easy to buy land for recreation, conservation, industrial development, or strip mining.

Table III-17. Major Land Holders in Fulton County, 1973
(Fulton County Plat Book, 1973)

Land Holders	Acres	Percent
Total County Land	561,152.00	100.00
Mining companies	41,716.58	7.43
Incorporated Farms (9 companies)	25,382.90	4.52
Other Major Farms (18 owners)	12,576.05	2.24
MSDGC	9,711.31*	1.73
State of Illinois	4,266.33	0.76
Private Recreation	2,912.28	0.51
Banks	1,998.90	0.35
Major Developers	1,676.44	0.29
Industrial Firms	832.40	0.14
Total	101,073.19	18.01

* Acreage was 15,528 as of August 1975

b. Use of strip-mined land - A 1973 survey identified land use in currently and formerly strip-mined areas (Sandberg, 1973). Table III-18 summarizes the existing use of reclaimed and unreclaimed strip-mined lands. Unreclaimed lands were defined as areas where no attempt has been made to reclaim stripped land to a productive use. Reclaimed lands were defined as areas where the land has been leveled to reasonable slopes and surface drainage has been restored. Fulton County contains about 21,600 acres of unreclaimed and 15,500 acres of reclaimed strip-mined lands. Most unreclaimed areas are in woodlands, light cover, or no cover; most reclaimed areas are in light cover, light pasture, or heavy pasture. In 1973, none of the unreclaimed mining sites and less than 3 percent of the reclaimed sites were used as cropland.

2. Projected Uses of Land

The 1990 land use plan for Fulton County designates future land use on the basis of 1968 estimates of future demographic and economic change. Since the anticipated changes were minor, these future designations are closely related to the existing land use pattern (Figure III-9).

Residential uses are expected to increasingly concentrate in and near the established urbanized areas. Major residential growth is expected to the east and northwest of Canton; to the north, east, and west of Lewistown; to the west and northeast of of Farmington; and around Avon, Cuba, and Vermont. Increases are anticipated in the number of single-family, multifamily and mobile home dwellings in tract subdivisions, and decreases are expected in the number of farm residences.

Commercial uses are predicted to concentrate in the central business districts of Canton, Lewistown and Farmington. The plan anticipates major industrial areas near Liverpool and in and near Canton, Lewistown, and Farmington. The anticipated major new public lands are six reservoirs with adjacent forest preserves (see Figure III-10). Conservation and recreation expansion would concentrate in the surroundings of the Spoon River Scenic Drive along the river from Dickson Mounds to London Mills.

Most future strip mining is expected to occur north of Canton. A major emphasis in the County's land use policy is the reclamation of strip-mined lands. Stringent conditional use permits regulate the nuisance aspects of strip-mining and require substantial reclamation of the land. Land use is also regulated on a County-wide basis by a zoning ordinance, and Canton, Cuba and Farmington have separate ordinances.

3. Land Development Potential

The potential for actual land development depends upon the interaction among land suitability, accessibility and attractiveness, with the social and economic factors of land use demand discussed earlier. The suitability, accessibility and attractiveness of land are the physical components of developed potential; they deal with the conditions of the site, its location and aesthetics.

G. Environmentally Sensitive Areas

Fulton County has a number of environmentally sensitive land areas and resources.

Table III-18 1973 Land Use Survey of Strip-Mine Lands in Fulton County, Illinois (Sandberg, 1973)

Use \ Type of Land	Total Unreclaimed Lands: Unreclaimed Lands	Total Unreclaimed Lands: Mine Wastes	Total Unreclaimed Lands: Water Areas	Reclaimed Lands
A. Woodlands	8518	-	-	392
B. Light Cover	6547	-	-	4064
C. Light Pasture	1011	247	-	5992
D. Heavy Pasture	-	-	-	3123
E. Cropland	-	-	-	405
F. Residence	-	-	-	251
G. Commerce	-	-	-	-
H. Industry	222	316	-	-
I. Landfill	15	-	-	-
J. Public Recreation	-	-	-	-
K. Private Recreation	190	-	374	241
L. Public & Semipublic	-	-	9	-
M. Conservation-Wildlife	-	-	3888	-
N. Unused-No Cover	5068	1978	-	988
TOTAL ACRES	21,571	2,541	4,271	15,456
VALUE PER ACRE*		$259	**	$323

* Value Per Acre = 100% value in 1967 dollars
** Does not include the value of mining equipment and structures.

Notes:

A. Woodlands included dense, forested lands where the ground surface was not visible or rarely seen in the aerial photographic interpretation.

B. Light Cover describes areas with surface cover of some form or other, usually grasses, low shrubs and scattered trees.

C. Light Pasture often included newly reclaimed areas where surface foliage was provided for grazing. In other natural areas, the distinction between light cover and light pasture was made on the basis of visible animal paths from fields to barns or sheds.

D. Heavy Pasture included areas where large-scale grazing operations were found. Stock trails, animal pens, feeding stations and the like were often used to determine the scale of operation.

E. Cropland is determined by the visible pattern of planted or harvested crops.

F. Residence Areas are determined by the outline of buildings, driveways, and arrangement of lots.

G. Commerce includes small commercial facilities usually associated with highways in the smaller communities.

H. Industry includes active mining areas, railroads, coal tipples and similar intensive operations.

I. Landfill is an area where solid waste materials are buried in a deep trench and covered with dirt.

J. Public Recreation Areas are owned by a public agency or unit of local government and are made available for use by the general public.

K. Private Recreation Areas include golf clubs, private reserves, camps and the like and are available to members or owners, not the general public.

L. Public and Semipublic Lands include schools, churches, cemeteries, public sewage plants and similar uses.

M. Conservation-Wildlife Areas include water areas and surrounding lands which, by virtue of proximity, create a habitat for wildlife.

N. Unused-No Cover Lands are areas where soil conditions are not conducive to growth of natural vegetation. These lands are often associated with mine waste areas.

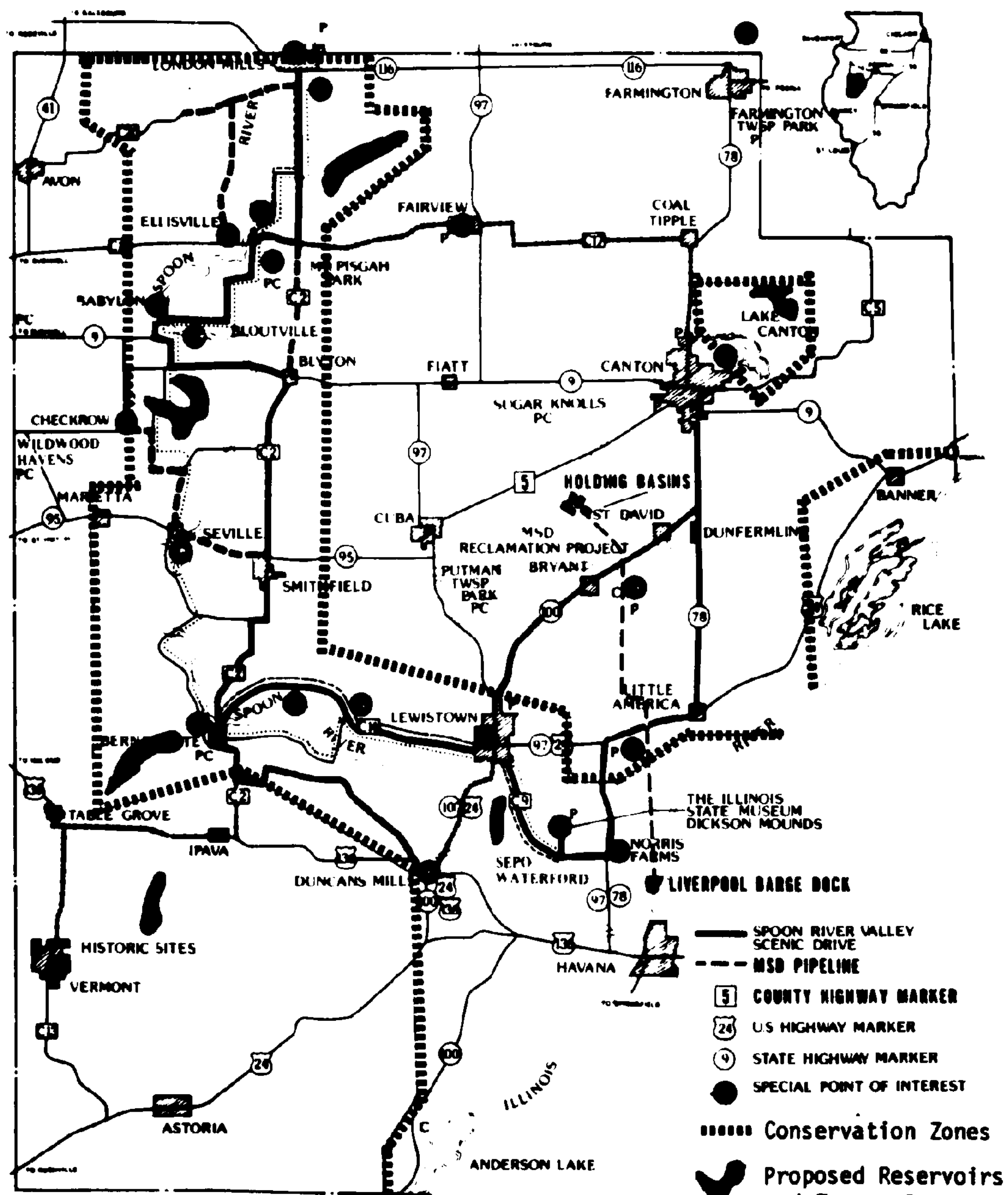


Figure III-10 Major Environmentally Sensitive Areas in Fulton County (Harland Bartholomew Associates, 1969)

These are depicted in Figure III-10 and identified in the ensuing discussion of water, land, and cultural resources.

1. Water Resources

Surface water is a source for some public and industrial water supplies in Fulton County. Six multi-use reservoirs (forest, conservation, recreation, and water supply) are planned to maximize future use of surface water supplies. Pollution in the Spoon River or Copperas Creek watersheds would severely degrade the value of these resources. The entire length of the Spoon River is especially valuable because it is one of the last remaining natural streams in the State of Illinois.

Wetland areas comprise another environmentally sensitive local resource; they are located primarily in the flood plain of the Illinois River and are not directly affected by the project. Major wetland conservation areas include Rice and Anderson Lakes, which serve as habitats for large populations of game and migratory birds. Lakes and ponds created by strip mining in the project area are currently important to a flock of Canada geese.

2. Land Resources

Besides the flood plain wetlands, there are four upland types of environmentally sensitive areas in Fulton County. The first of these, strip-mined land, is particularly susceptible to damage by erosion. Sparse vegetative cover, steep slopes, and poor soil permeability are three factors contributing to the erosion of unreclaimed or incompletely reclaimed strip-mined areas. Erosion diminishes downstream water quality and accelerates sedimentation in downstream reservoirs.

Prime agricultural land, watershed woodland, and tallgrass prairie are valuable natural resources. The prime agricultural lands in Fulton County are characterized by thick, deeply weathered loess soils, small topographic relief, and few stones in the upper soil layers. Large fields of these prime soils are well suited for highly mechanized methods of agricultural production.

The main values of local woodland are its recreation potential and ability to protect the quality of surface water by stabilizing soils and reducing runoff volume and velocity, which are key factors in erosion. The local importance of surface water in Fulton County intensifies the value of these woodlands. The most valuable woodlands are found in the watershed of the Spoon River valley and in watersheds upstream from each of the planned reservoirs.

Prairie, particularly tallgrass prairie, such as that being planted as a part of the Bluestem Management Plan, is environmentally valuable for a number of reasons. First, it would preserve a rare portion of Illinois' natural history. In addition, such prairie can serve as a conservation area for wildlife, including such locally rare species as the greater prairie chicken, sharp-tailed grouse, trumpeter swan, and the sandhill crane. Finally, prairie grasses, with their deep abundant roots, provide excellent soil-building and erosion control characteristics.

3. Cultural Resources

Fulton County has numerous areas devoted primarily to outdoor recreation. Local recreation needs of many residents are met by public park districts in Canton, Lewistown, and Farmington. Public recreation needs of a more regional scope are served by a 400-acre tract of land which has been made available to the County by the MSDGC. Private recreation includes an area at Lake Wee-Ma-Tuk, several private hunting and fishing areas on strip-mined lands, and campsites with trails for use of off-the-road vehicles on private lands. The most environmentally sensitive recreation resources are those located adjacent to streams and lakes.

Fulton County has a number of historic and archaeological sites. Old mansions, "underground railway" stations, and early shaft coal mines are located throughout the County. An extensive prehistoric mound-building culture left over 800 mounds in the area. The most important of these, the Dickson Mounds, are preserved as a state museum. According to National Register Assistant, Theodore Hild, no historic sites are affected by the project.

Chapter IV
Description of the Project

IV. THE CHOSEN ALTERNATIVE

The land reclamation project of the MSDGC is located centrally in Fulton County, Illinois. The project site is immediately east of the Village of Cuba or approximately 25 miles west-southwest of Peoria. Most of the site is between the Cuba-Canton Road (Illinois Route 5) and Illinois Route 100 near Canton to the northeast and Lewistown to the south. Big Creek flows southwesterly through the project site and merges with Spoon River, which is a tributary of the Illinois River, a major navigable waterway. A regional map prepared from a 1:250,000 USGS map, showing the project site and surroundings, is presented in Figure II-I, page II-6.

The surroundings of the project are rural. Some growth of population is expected, but the area is not in the path of urban or suburban growth. The major local economic influences are farming, strip mining, and manufacturing. Canton and Lewistown are the principal nearby central places. Peoria and Pekin have a major regional influence on the project area; they are the dominant centers of trade and employment within Fulton County. Land use in the area surrounding the project site is predominantly unintensive. The primary uses are row crop farming, livestock grazing and strip mining. Farming and mining are becoming highly mechanized, employing progressively fewer people.

More than 60 percent of the project site was strip mined for coal years ago, forming a rough terrain of depressions and lakes without drainage outlets. Soils have a high clay content and are relatively impervious. However, some paths of rapid flow developed by rearrangement and redistribution of soils and unconsolidated bedrock during mining operations. Access roads generally form the dividing ridge lines between adjacent mini-sections.

A. Description Of Project Features

Since 1971, the project site has been graded and shaped to create fields suitable for sludge application and row crop agriculture. Retention basins have been constructed to contain storm water run-off from application fields. Four holding basins have been constructed for the purpose of storing sludge and sludge supernatant. Figures IV-1 and IV-2 show the application fields and holding basins at the sites. A detailed description of the project features, operations, and environmental control and monitoring systems is presented in the following section.

1. Sludge Shipment and Supernatant Return

There are three types of sludges being shipped to Fulton County: sludge drawn from heated anaerobic digesters at the West Southwest (WSW) treatment plant of the MSDGC; sludge taken from the Lawndale lagoons, except in winter when icing prevents removal; and mixtures of the two. As stated previously, supernatant in the upper layer of sludge in the holding basins is no longer barged back to the head end of the West-Southwest treatment plant or to the Chicago Lawndale lagoons. Sludge and supernatant shipments are shown in Table IV-1 and Figure IV-3. More recently, sludge supernatant has been applied to the land during dry periods through gated irrigation pipes.

The total sludge shipped to the holding basins amounted to 1,397.5 million gallons or 5.7 million net tons from April 1972 to May 1975. Supernatant return totaled 477.4 million gallons or 1.93 million wet tons during the same period. Based on

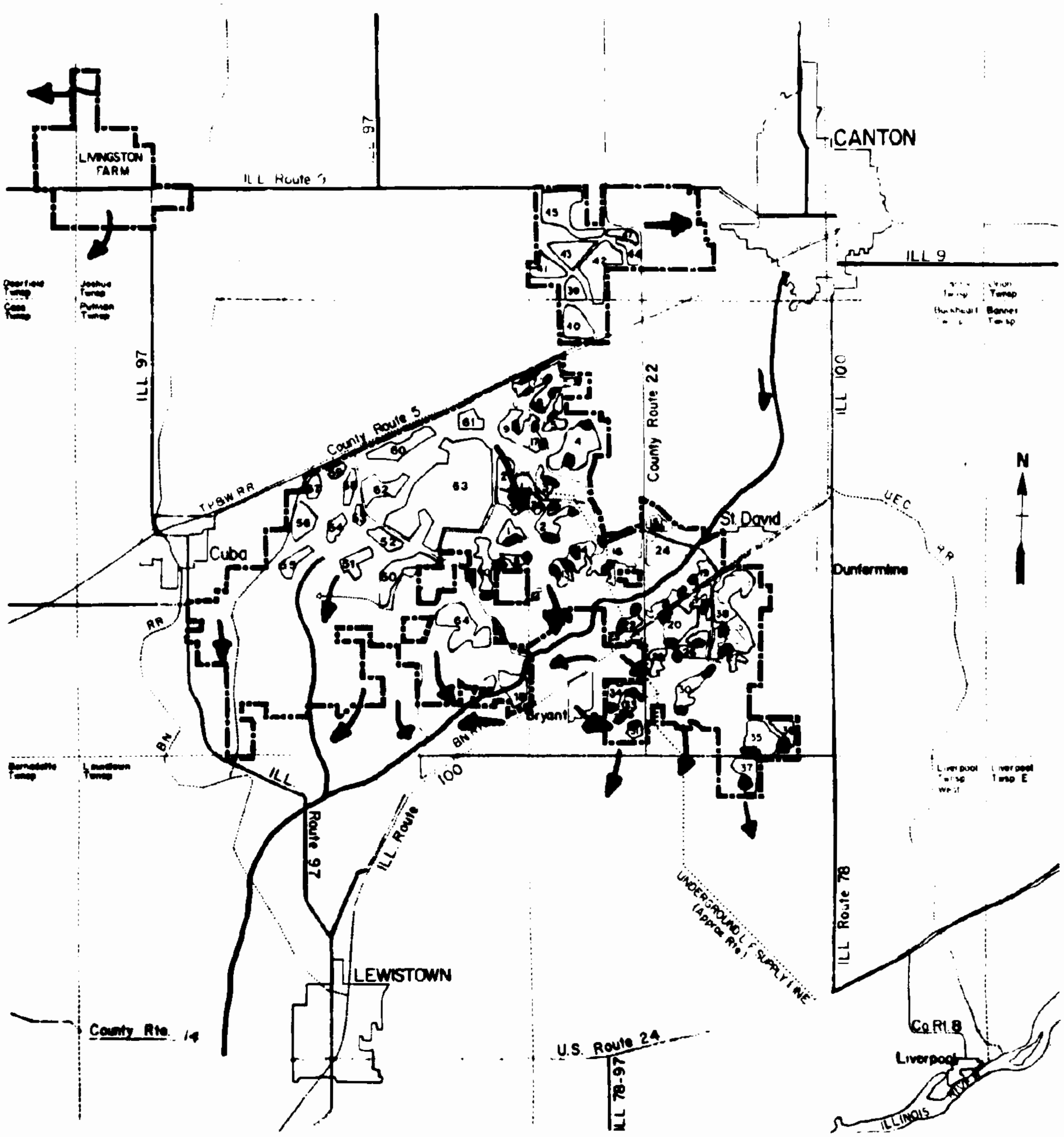


Figure IV-1 Sludge Application Fields at the Project Site and Their Runoff Retention Basins (MSDGC, 1975d)

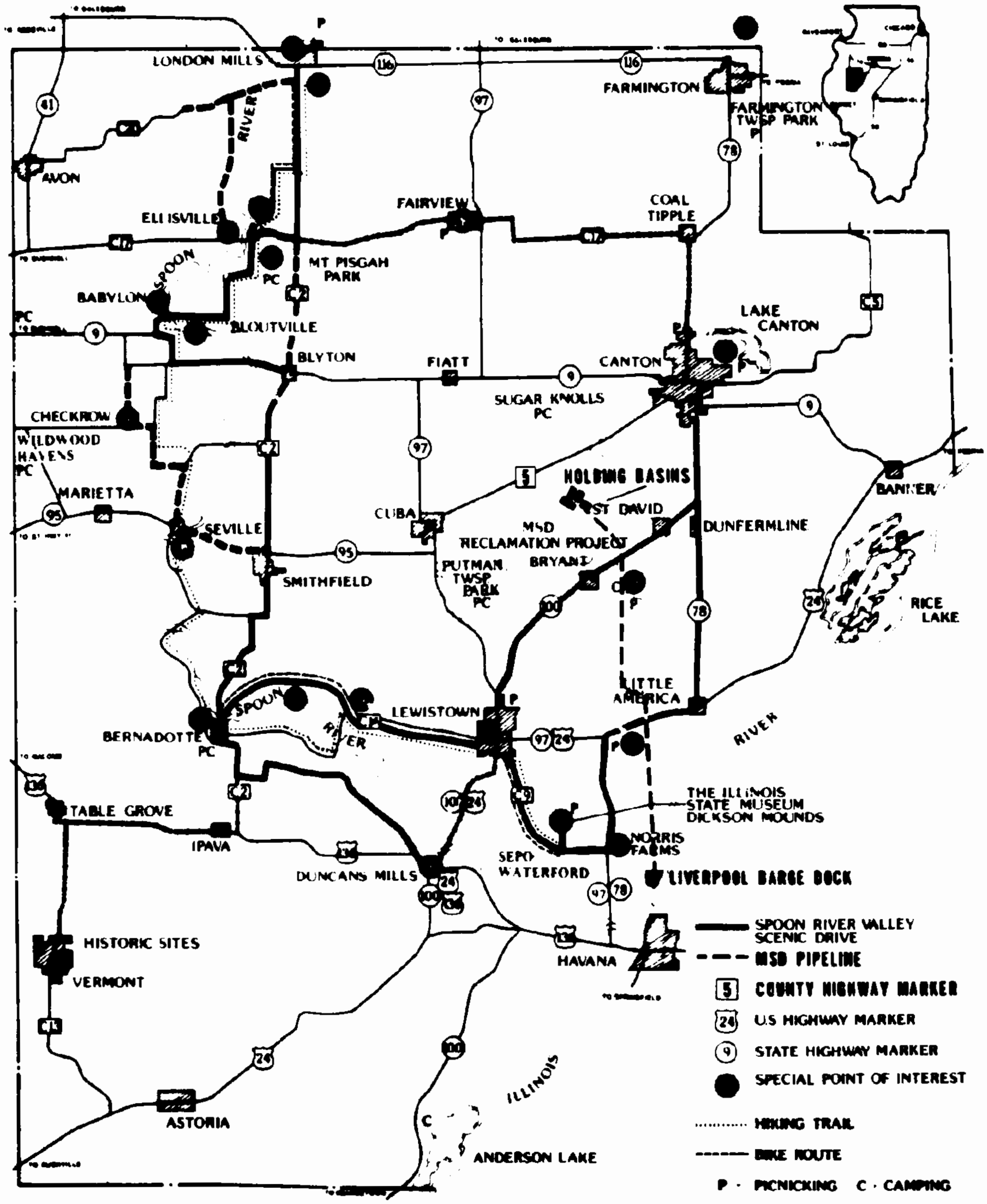


Figure IV-2 Unloading Dock, Pipeline Routing, and Holding Basins.

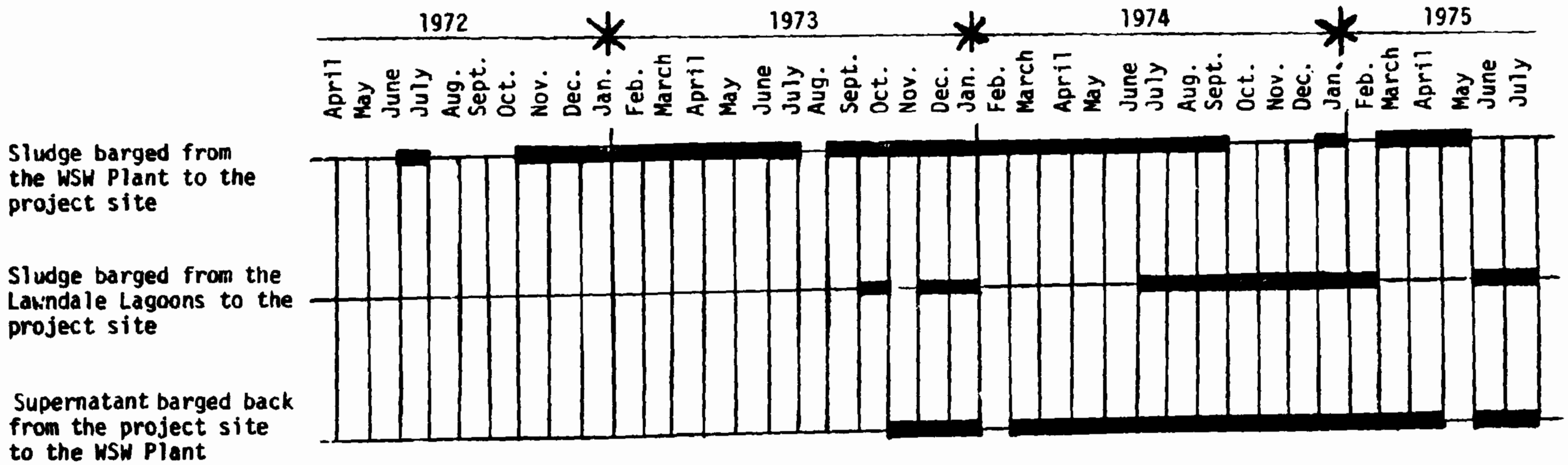


Figure IV-3 Past Sludge Shipments between West-Southwest Plant Lawndale Lagoons, and Holding Basins at Project Site (MSDGC, 1972 a,b, 1973 a through h, 1974 a through l, 1975 a through g)

Table IV-1. Amounts of Sludge and Supernatant Barged to and from the Holding Basins in Fulton County

PERIOD	Sludge Barged from:						Supernatant Returned to:			
	WSW Plant		Lawndale Lagoons		Both WSW & Lawndale		WSW Plant		Lawndale Lagoons	
	10^6 Gallons	Wet Tons	10^6 Gallons	Wet Tons	10^6 Gallons	Wet Tons	10^6 Gallons	Wet Tons	10^6 Gallons	Wet Tons
4th Quarter, 1972	164.3	690,065	--	--	--	--	--	--	--	--
1st Quarter, 1973	137.5	577,427	--	--	--	--	--	--	--	--
2nd Quarter, 1973	145.5	611,309	--	--	--	--	--	--	--	--
3rd Quarter, 1973	69.1	149,230	1.53	6,427	--	--	2.08	8,746	--	--
4th Quarter, 1973	84.5	354,769	8.13	34,129	47.0	197,317	56.6	209,199	--	--
1st Quarter, 1974	132.7	557,279	--	--	--	--	30.0	126,750	--	--
2nd Quarter, 1974	147.1	617,810	5.08	21,321	--	--	87.4	366,808	--	--
3rd Quarter, 1974	72.0	302,561	6.82	28,650	63.8	268,147	64.6	271,139	6.75	28,360
4th Quarter, 1974	41.9	175,812	--	--	77.8	327,017	113.1	475,022	2.52	10,587
1st Quarter, 1975	114.1	479,189	--	--	--	--	101.4	425,703	--	--
2nd Quarter, 1975	35.2	147,689	--	--	87.3	366,519	7.82	32,851	36.2	181,229
3rd Quarter, 1975	--	--	--	--	84.8	356,308	--	--	70.3	295,114
4th Quarter, 1975	61.4	257,758	--	--	22.2	93,362	65.3	272,783	23.3	97,655
1st Quarter, 1976	100.0	420,115	--	--	- -	--	6.2	26,221	--	--
2nd Quarter, 1976	11.4	47,888	--	--	106.7	448,340	--	--	--	--
3rd Quarter, 1976	--	--	--	--	104.0	437,004	--	--	--	--
4th Quarter, 1976	50.4	211,596	--	--	74.6	374,964	--	--	--	--
1st Quarter, 1977	20.0	84,101	--	--	--	--	--	--	--	--
April, 1977	--	--	--	--	--	- -	--	--	--	--
*** Subtotal	1,387.1	5,684,598	21.56	90,527	668.2	2868,978	534.5	2,215,222	139.1	612,945
*** Total	2,076.9 million gallons or 8,644,103 wet tons						673.6 million gallons or 2,828,167 wet tons			

* Excluding September 1975
** Excluding October 1975
*** Excluding September and October, 1975

the total wet tons of sludge applied to the project fields, the cumulative fluid volume of sludge applied was 244.8 million gallons through an application period of 13 months, beginning in April 1972 and ending in May 1975. Daily composite samples of sludge have been taken from the WSW plant loading dock and the Mannheim Road Terminal loading dock next to the Lawndale lagoons. The data on total solids, volatile solids and acids, and alkalinity are analyzed and plotted on logarithm-probability paper in Figures IV-4 through IV-7 for sludge originating from Lawndale lagoons and Figures IV-8 through IV-11 for sludge from the WSW plant digesters. Sludge drawn from WSW digesters is occasionally used to dilute sludge from Lawndale lagoons to improve pumping efficiency. Mixtures of plant and lagoon sludges are regarded as sludge from Lawndale since there are no data reflecting the mixture. In these figures, the frequencies of sludge constituent concentrations, such as total solids, volatile solids, volatile acids, or alkalinity, are given in percent.

Figures IV-4 through IV-11 show the geometric mean, geometric standard deviation, and number of observations, providing a general picture of the data spread or fluctuation. The plottings for volatile acids and alkalinity of sludges from both the WSW plant and Lawndale lagoons approximate two straight segments with a break point. Probably this is attributable to digester performance or to the different ages of sludge in the lagoons.

Properly digested sludge generally has high alkalinity and low volatile acids. Total solids and total volatile solids are less sensitive sludge quality indicators than are volatile acids or alkalinity. Sludge quality was compared with applicable sludge quality standards specified in the operating permit issued to the MSDGC. The applicable standards and the results of the comparative study are summarized in Table IV-3. In addition to the four parameters cited above, the pH value is included. Based on the length of the monitoring period, the number of samples, and the applicable standards, the number of deficiencies permitted was calculated and indicated in Table IV-3. Compliance of sludge quality with applicable standards is determined by comparing the actual number of deficiencies with the permissible number. The frequency of deficiencies is summarized below in Table IV-2.

Table IV-2. Compliance of Sludge Quality with Applicable Standards as of May 1975 (MSDGC, 1972a through 1975g; Enviro Control, Inc., 1976)

	Total Volatile Solids	Volatile Acids	Alkalinity	pH
Sludge from Lawndale Lagoons	Total compliance	Total compliance	Deficient 9.5% of the time	Total compliance
Sludge from WSW Plant	Deficient 3.8% of the time	Total compliance	Deficient 1.4% of the time	Deficient 1.3% of the time

The past deficiencies reported here are in some respects misleading. In November of 1975, the Fulton County Health Department revised the volatile acids and alkalinity standards to account for the fact that some of the sludge shipped to Fulton County has been in storage in the Lawndale lagoons for up to 15 years. Exceedingly long storage periods cause a decline in alkalinity as a consequence of ammonia volatilization. This at least partially accounts for the relatively high number

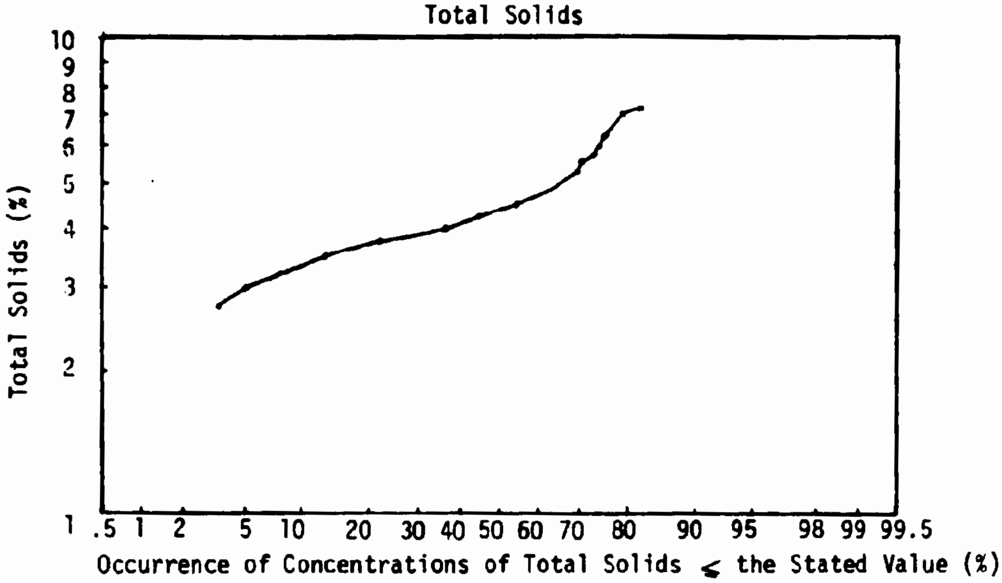


Figure IV-4 Total Solids Concentration in Sludge from the Lawndale Lagoons (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

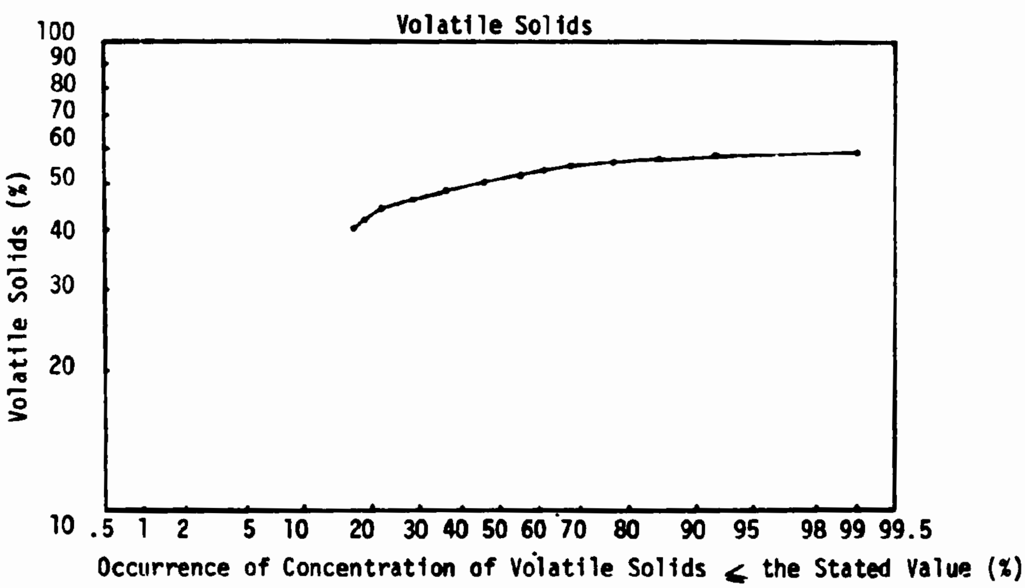


Figure IV-5 Volatile Solids Concentrations in Sludge from the Lawndale Lagoons (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

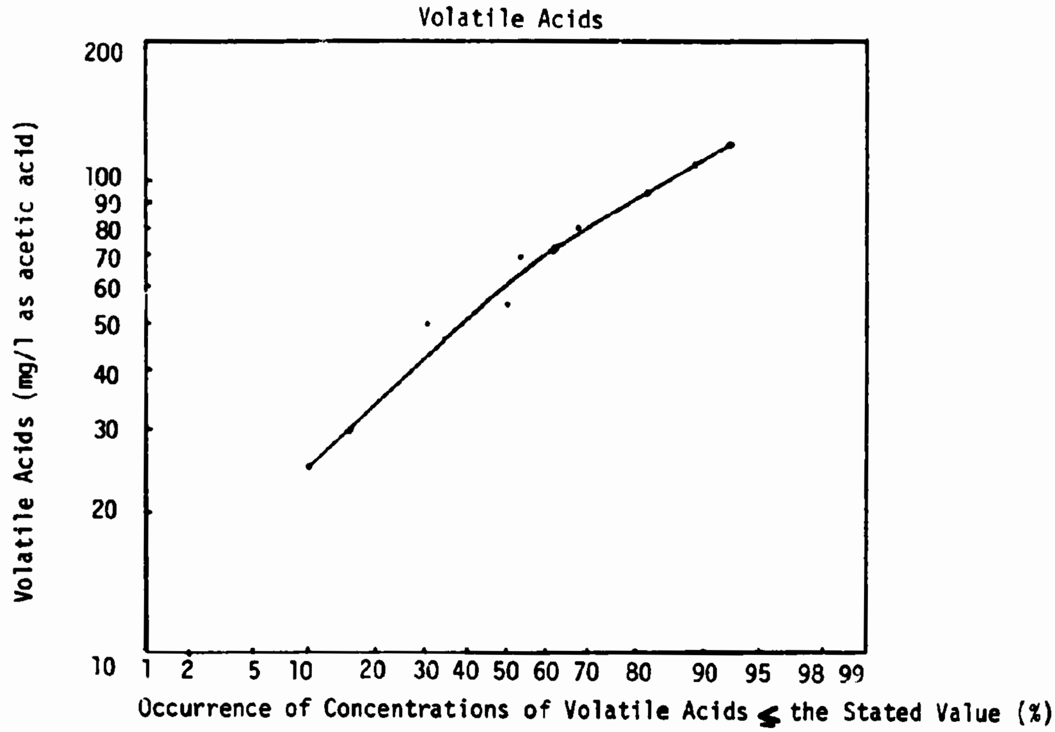


Figure IV-6 Volatile Acids Concentrations in Sludge from the Lawndale Lagoons (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

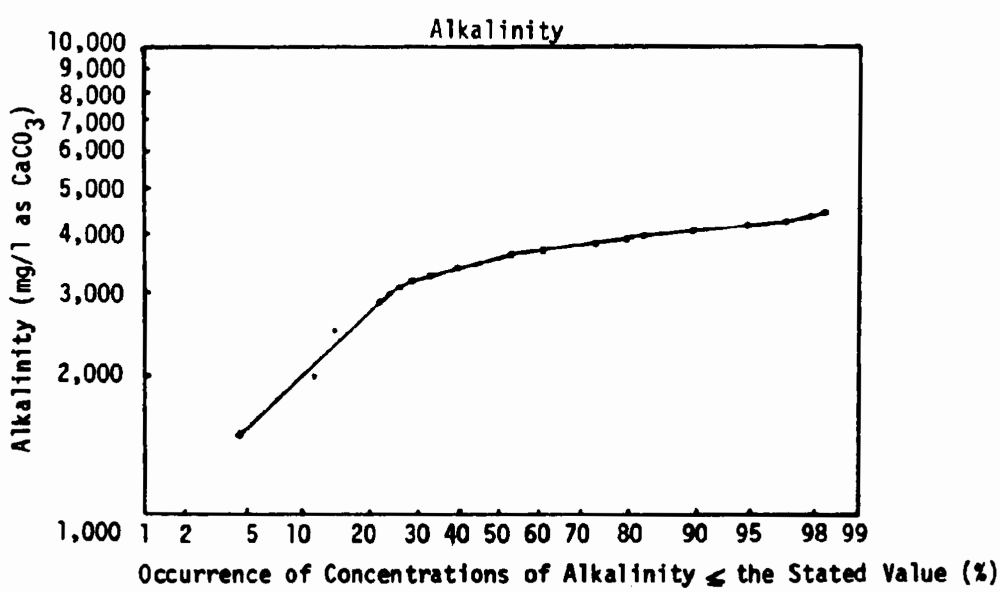


Figure IV-7 Alkalinity Concentrations in Sludge from the Lawndale Lagoons (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

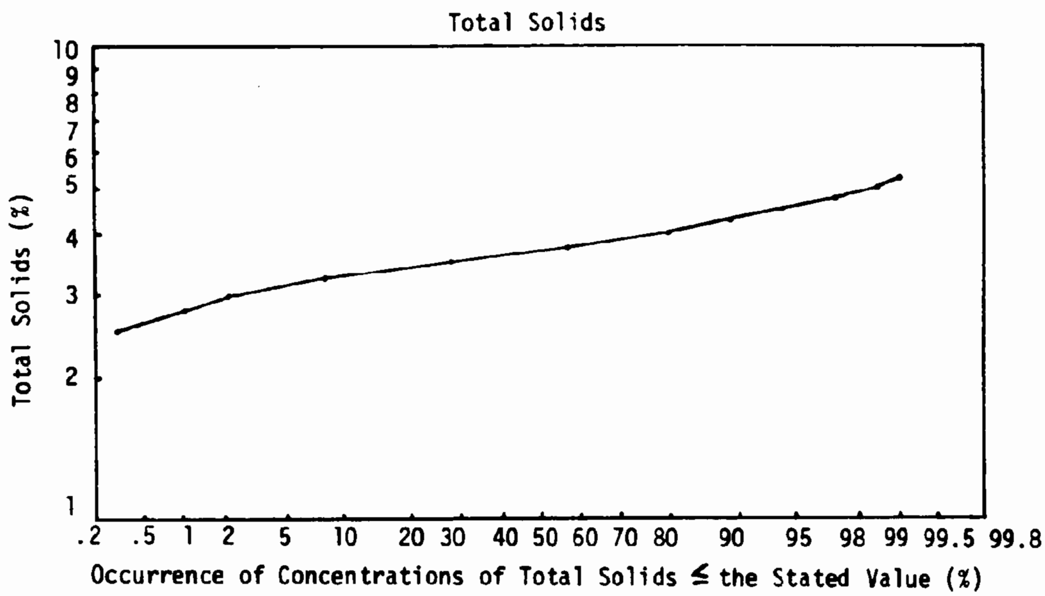


Figure IV-8 Total Solids Concentrations in Sludge from the WSW Plant (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

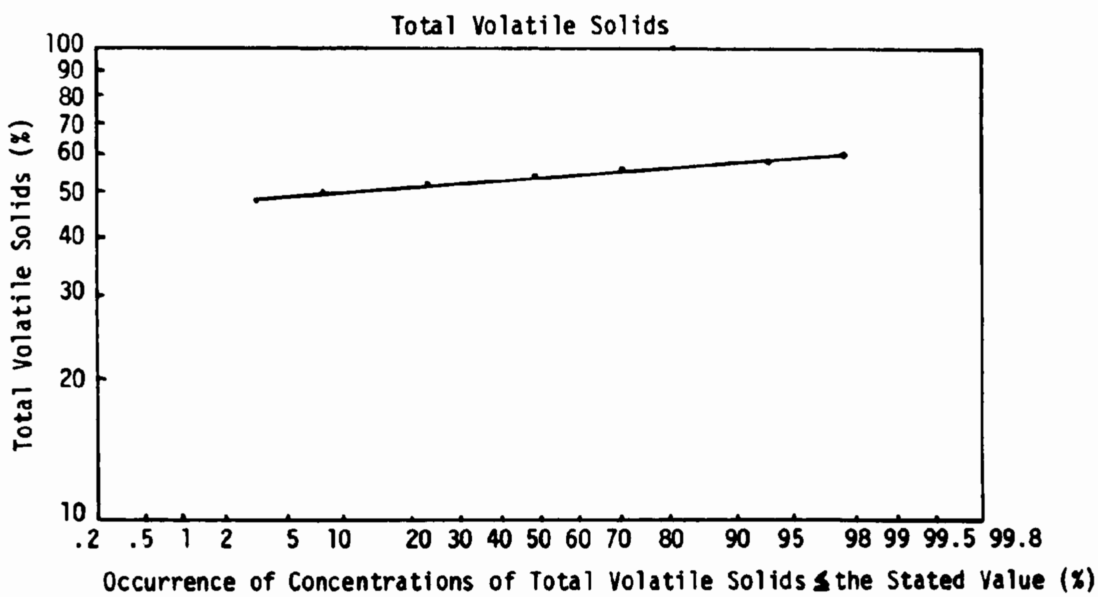


Figure IV-9 Total Volatile Solids Concentrations in Sludge from the WSW Plant (MSDGC, 1972a through 1975g; Enviro Control Inc., 1975)

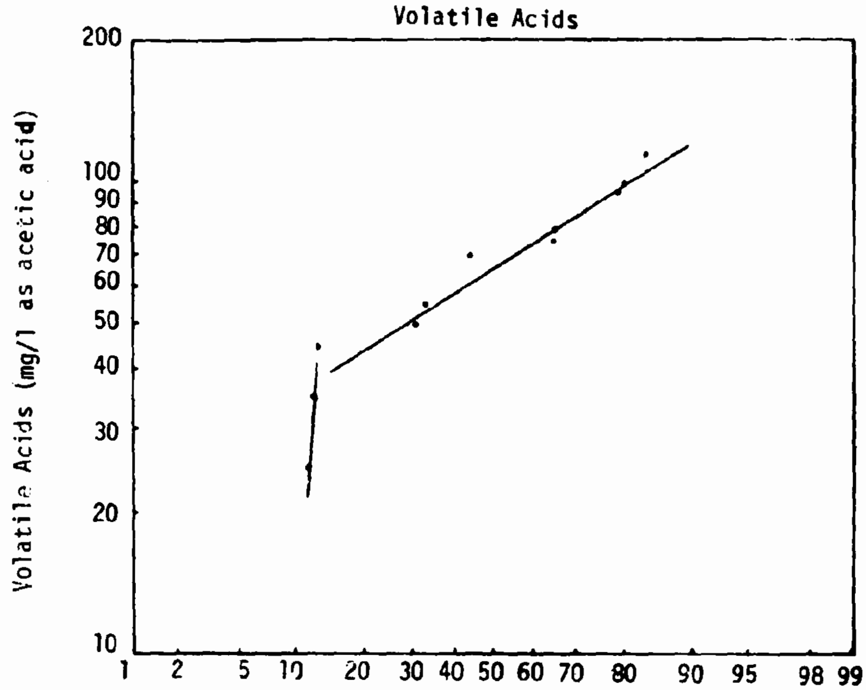


Figure IV-10 Volatile Acids Concentrations in Sludge from the WSW Plant (MSDGC, 1972 a through 1975 g; Enviro Control Inc., 1975)

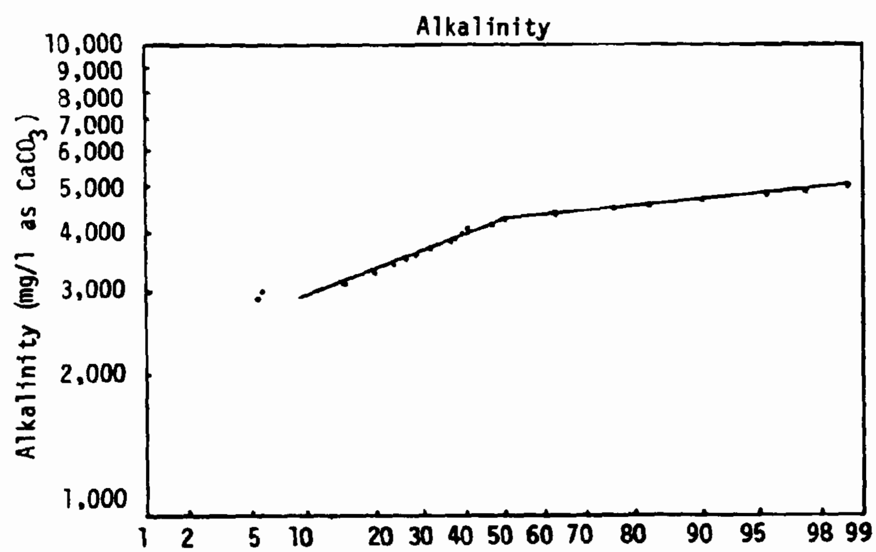


Figure IV-11 Alkalinity Concentrations in Sludge from the WSW Plant (MSDGC, 1972 a through 1975 g; Enviro Control Inc., 1975)

Table IV-3 Comparison of Sludge Characteristics With Applicable Sludge Quality Standards (MSDGC, 1972a through 1975g; Enviro Control, Inc., 1976)

Sludge Quality Parameter		Total Solids	Total Volatile Solids	Volatile Acids (as Acetic Acid)	Alkalinity (as $CaCO_3$)	pH
Applicable Sludge Quality Standards		Not Available	No 24-hr. composite sample may exceed 62% of total solids.	No more than five 24-hr. composite samples may exceed 300 mg/l in 30 days.	No more than 5% of the 24-hr. composite samples in 30 days may be lower than 2,500 mg/l.	No 24-hr. composite sample may be less than 6.9 units.
Sludge from Lawndale Lagoons	Number of Samples	147	130	69	137	141
	Geometric Mean	4.4%	51%	62 mg/l	3,800 mg/l	7.4(Arithmetic Mean)
	Geometric Standard Deviation	1.68	1.1	1.6	1.1	Not Applicable
	No. of Violations Permitted	Not Applicable	0	45	7	0
	Actual No. of Violations	Not Applicable	0	0	20	0
Sludge from WSW Plant	Number of Samples	396	367	241	222	394
	Geometric Mean	3.7%	54%	65 mg/l	4,200 mg/l	8.0(Arithmetic Mean)
	Geometric Standard Deviation	1.1	1.1	1.6	1.2	Not Applicable
	No. of Violations Permitted	Not Applicable	0	90	11	0
	Actual No. of Violations	Not Applicable	5	1	14	5

of alkalinity deficiencies of sludge taken from the Lawndale Lagoons. With the exception of alkalinity, sludge originating from the Lawndale Lagoons has a generally higher quality than sludge drawn from the WSW Plant digesters, which is also attributable to the aging of sludge in the lagoons. Sludge drawn from the digesters has occasionally been substandard in terms of total volatile solids, alkalinity, and/or pH. Fulton County amended their sludge quality standards in November 1975 recognizing problems associated with alkalinity. Since that time sludge segments have met all applicable standards. If the standards had not been changed, there would not have been much effect since sludge quality had improved.

2. Sludge Storage

The average sludge storage time in these holding basins can be estimated by a number of methods. Because the holding basins were never used at full capacity, a method for estimating the average storage time is as follows:

$$ts\ (\text{months}) = \frac{(Fb - Fr)MG}{Ff\ MG/month} = \frac{(1397.5-477.4) \times 10^6\ gal}{(244.8 \times 10^6\ gal/13\ months)} = 49\ \text{months}$$

Where ts = average storage time
Fb = sludge barged to the holding basins
Fr = supernatant returned to Chicago
and Ff = sludge applied to fields

This estimation does not account for loss of sludge water by evaporation or increase by rainfall. A storage time of 49 months is considerably long, and is a result of low sludge application volumes during the development stages of the project.

The application rate was originally proposed to be 70 dry tons per acre per year in the first year and taper down to 20 dry tons/acre/year in the fifth year of operations (Dalton and Murphy, 1973). These rates correspond to 726.5 and 207.6 million gallons of sludge, based on a 4 percent total solids content, applied to Fields #1 through #38, having a total area of 1,731.6 acres. Accordingly, the mean storage capacity was provided for at least a six-month storage or retention time.

Assuming a 20 dry tons/acre/year application rate and a 4 percent solids content, the basin could store sufficient solids for a maximum development of application fields of approximately 26,960 acres. Presumably this surplus capacity of the holding basins was justified for the purpose of stockpiling sludge reserves during the early years of project development or to maintain operations during years of discontinuous sludge shipments. More recently however, the 49 months average storage time and capacity for applying sludge to 26,960 acres per year when only 3,700 acres per year are actually being used demonstrates that the basins are not designed as part of the project design but rather as a sludge storage area for MSDGC sludge. This demonstrates that the holding basin volume is much larger than any needs the MSDGC might have for flexibility of operation. This situation presents considerably more potential for odor than basins sized only for staging project operation.

During the storage periods, sludge solids settle to the bottom of the holding basins, creating two layers of material. The top layer ranges through most of the basin and is composed of supernatant containing less than 0.25 percent solids. The bottom layer consists of settled and compacted sludge with solids up to approximately 10 percent. During periods of storage, it is estimated that approximately one-fifth of the nitrogen in the sludge is lost to the atmosphere in the form of ammonia.

Typical vertical profiles of sludge characteristics in the holding basins are shown in Figure IV-12. Profiles are presented for three holding basins and seven parameters. In general, pH values remain constant in the top five meters and then decrease with depth. Because large proportions of nitrogen and phosphorus compounds are associated with suspended solids which settle in the basins, the total suspended solids, total nitrogen, and total phosphorus concentrations are highest at the bottom of the holding basins. The same pattern of ammonia nitrogen concentration, which is constant in the top five meters and then increases with depth, is recorded for all three basins. Generally speaking, the total volatile solids and volatile acids are slightly enriched at the bottom of the basins. Conventional dredging equipment is utilized to withdraw solids from two of the holding basins. The cutter head mixes the concentrated solids with the liquid fraction and pumps the resultant mixture of approximately five percent solids to the main pumping station for further distribution.

3. Sludge Application

During application seasons, the sludge is pumped from the holding basins via a surface land pipe distribution system and applied to the land by a number of techniques. Field application devices available at the site include: traveling sprayer, center-pivot sprayer, moldboard plow incorporator, a tank truck, and, for supernatant only, gated irrigation pipe (MSDGC, 1975i). During the first few years of project operation, spraying was the major application method. It is no longer used. Spraying was accomplished by modular units consisting of pumps, an above-ground header system, and a "big gun" spray vehicle (Figure IV-13). To prevent clogging, the nozzle of the spray gun had a 2-inch diameter or larger. The pressure and spray rate were 90 pounds per square inch and 600 gallons per minute, respectively, and the horizontal throw was approximately 120 to 250 feet (MSDGC, 1975i).

Two types of tillage machines can be used to incorporate sludge into soil — the moldboard plow incorporator and the tandem disk incorporator (Figure IV-13 shows the latter). Sludge is presently incorporated into soil by a tractor-drawn tandem disk incorporator with a distribution manifold which directs sludge to each disk blade as it tills the soil. Sludge is thereby applied to the entire cross-sectional area of the soil being tilled. The soil injector (Figure IV-14) works on the same principle as the soil incorporator, except that an injector applies sludge to slots formed in the soil by a tool shank.

Application fields were developed from 1971 through 1973 in three stages, varying in size from 15 to 114 acres (Figure IV-1). Each field is provided with runoff berms and one or more runoff retention basin to divert and contain storm run-off and to control the water quality of field effluents.

Sludge is applied to the fields during the growing season. Periods of sludge application to various fields are shown schematically in Figure IV-15. Work hours are approximately 8 hours per day at the beginning of the application season, increase to a maximum of 16 hours per day, and taper off to 8 hours per day at the end of the season. Application on one field of a given module is generally completed before beginning on another field. However, two fields of a module are sometimes applied simultaneously. It takes approximately 30 minutes to complete application on one acre of land (MSDGC, 1975j). The sludge application rate in dry and wet tons per acre and total tonnage of sludge applied per year on each field are summarized in Table IV-4.

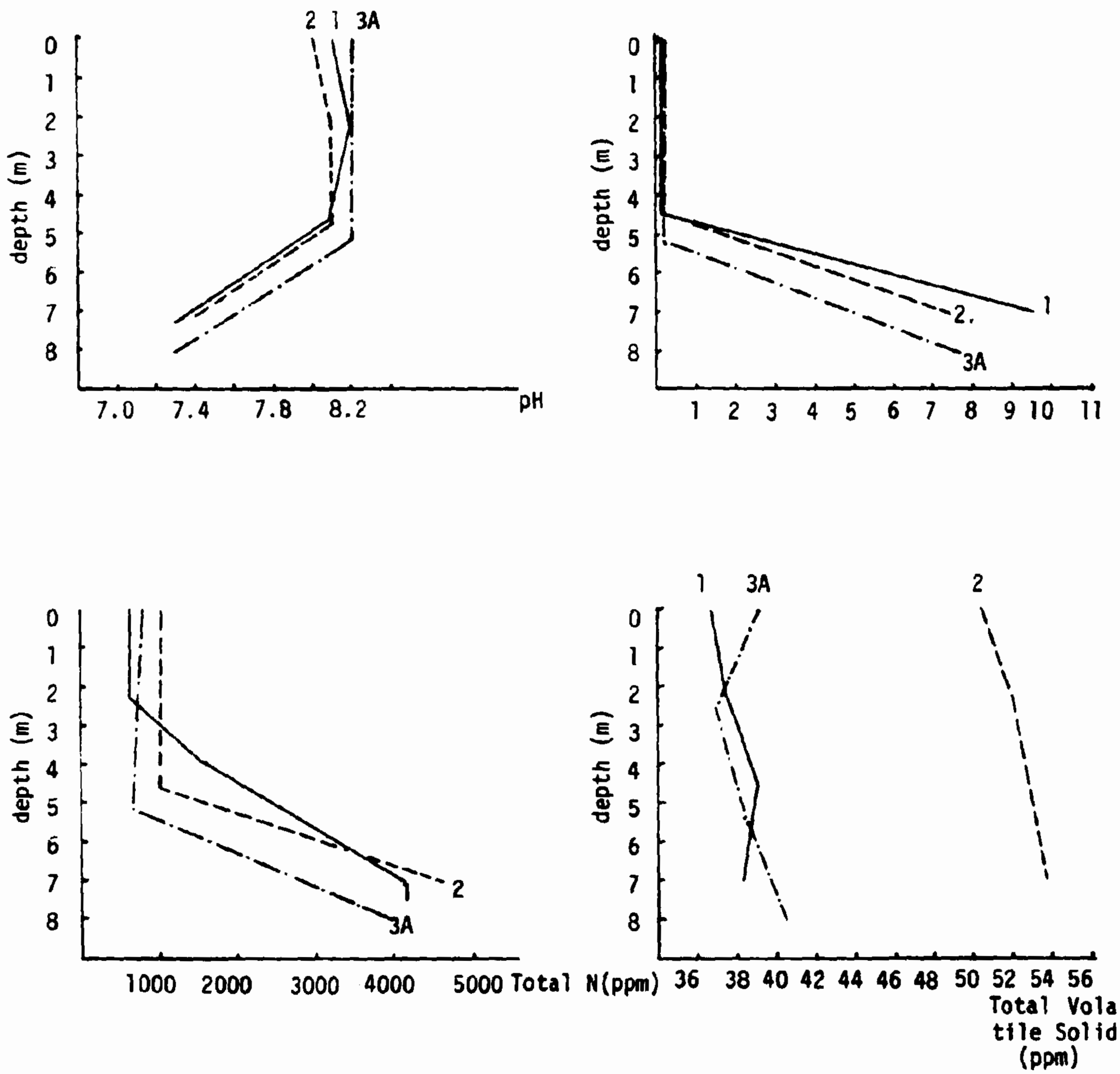
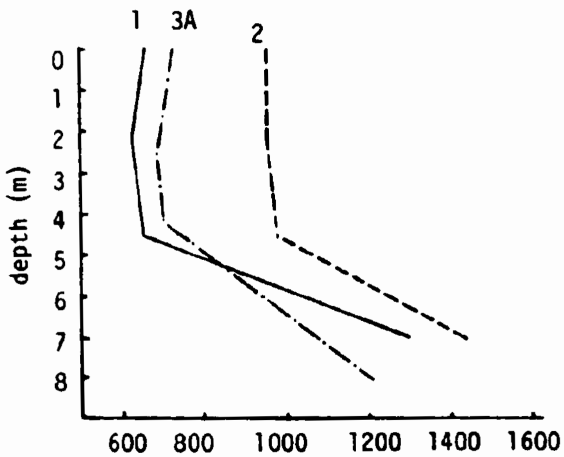
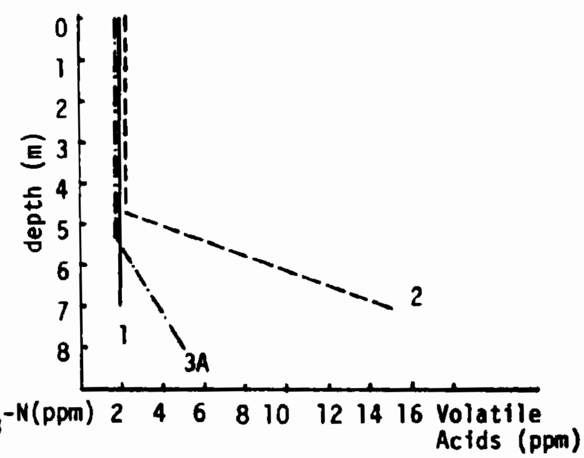


Figure IV-12 Typical Vertical Profiles of Characteristics of Sludge in Holding Basins 1, 2 and 3A, April 1975 (MSDGC, 1975 d)





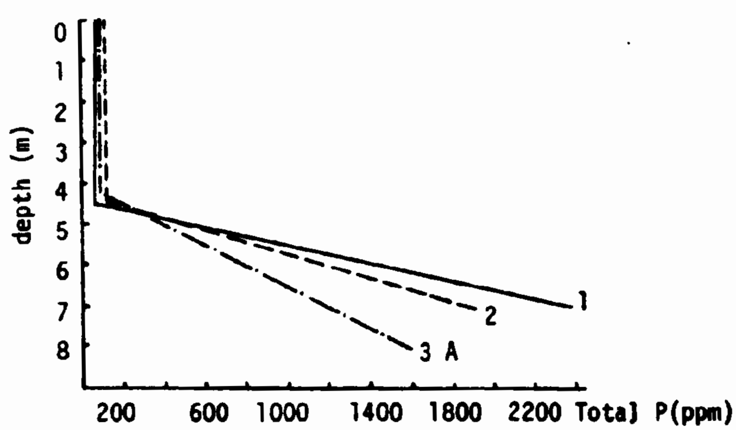


Figure IV-12 (Continued)

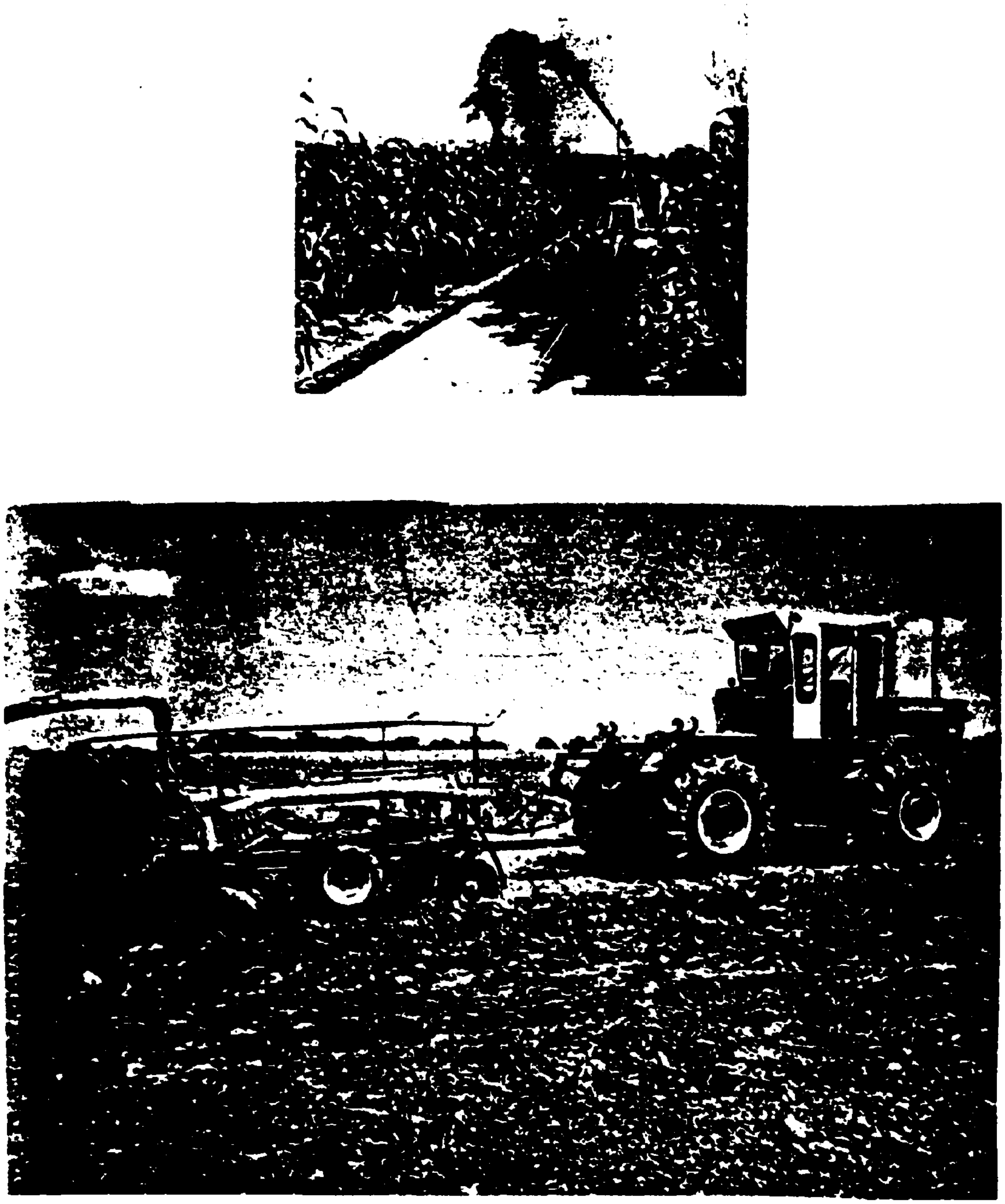


Figure IV-13 Traveling Sprayer Applying Liquid Sludge to a Corn Crop (top) and Disk Incorporation with Trailing Supply Hose (MSDGC, 1975h)

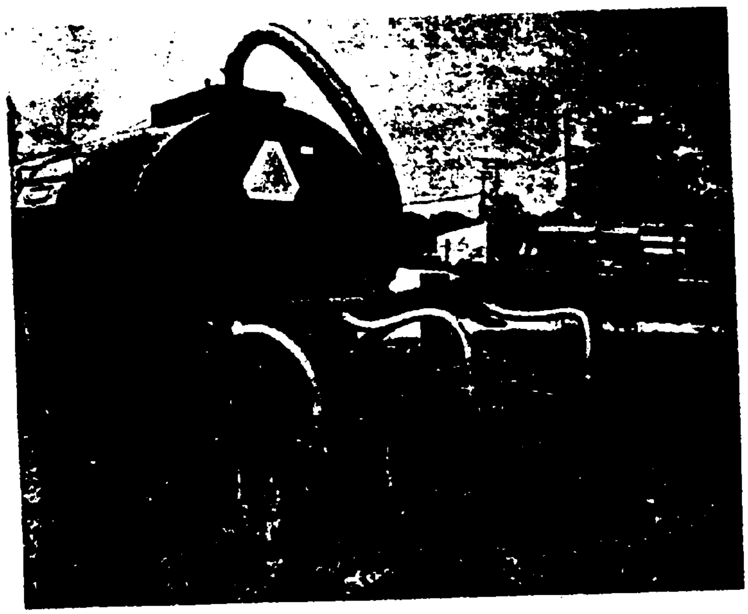


Figure IV- 14 Injection Unit Showing Three Injectors (MSDGC, 1975h)

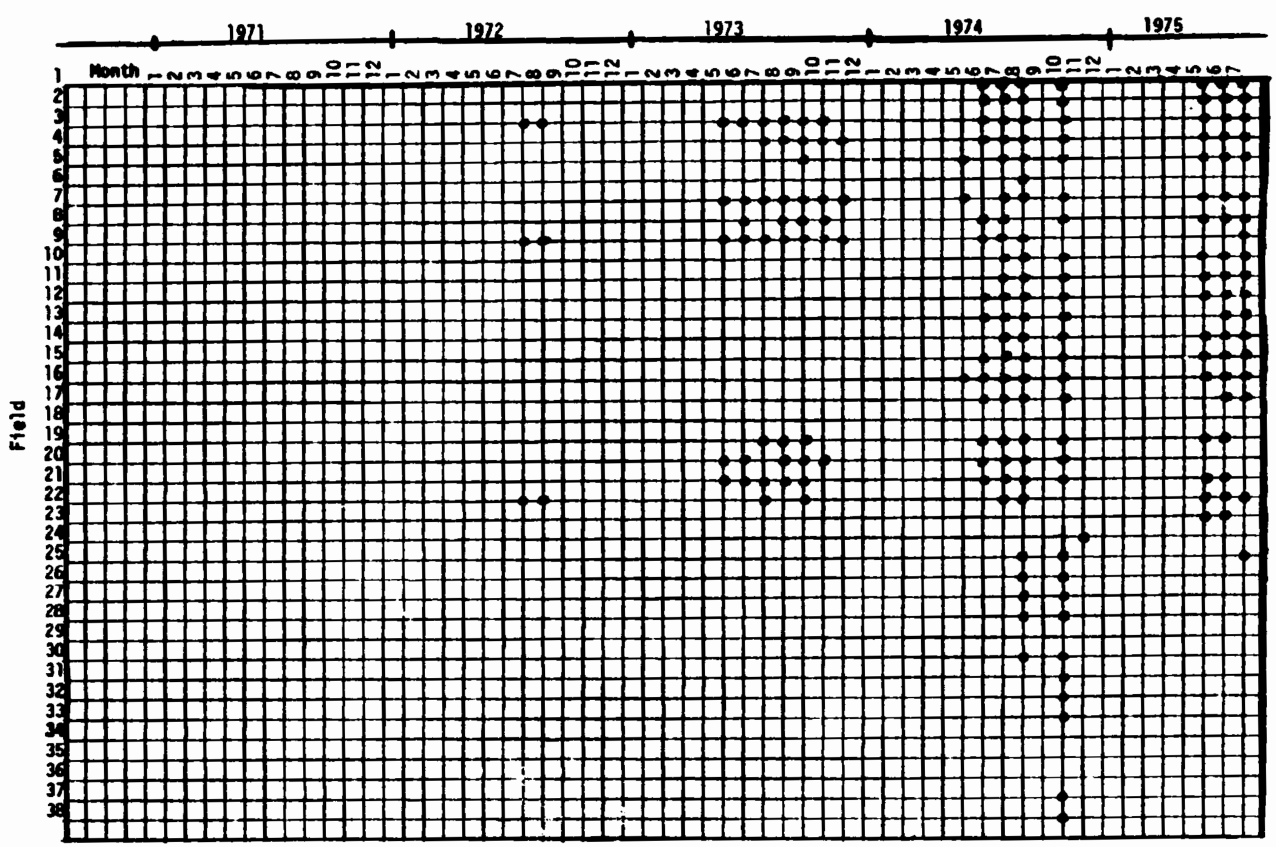


Figure IV- 15 Periods of Sludge Application to Fields in Fulton County

Table IV-4 Sludge Application Rates and Amounts (MSDGC - 1973 a through h, 1974 a through l, 1975 a through g)

Field	Field Size (acres)	Year 1973 dt/acre	Year 1973 dt	Year 1974 dt/acre	Year 1974 dt	Year 1975 (May, June & July) dt/acre	Year 1975 (May, June & July) dt
1	46	--	--	19.0	874.0	19.5	897.0
2	52	--	--	24.0	1,248.0	14.8	769.6
3	41	1.21	49.6	24.4	1,000.4	3.5	143.5
4	80	0.50	40.0	24.5	1,960.0	19.9	1,592.0
5	30	0.58	17.4	23.2	696.0	29.1	873.0
6	15	--	--	0.2	3.0	--	--
7	110	0.49	53.9	21.3	2,343.0	13.4	1,474.0
8	71	0.95	67.5	12.1	859.1	17.7	1,256.7
9	93	2.38	221.3	16.3	1,515.9	6.7	623.1
10	94	--	--	25.8	2,425.2	16.6	1,500.4
11	21	--	--	29.4	617.4	27.4	575.4
12	27	--	--	17.0	459.0	16.3	440.1
13	36	--	--	16.2	583.2	7.7	277.2
14	70	--	--	6.6	462.0	6.9	483.0
15	22	--	--	29.1	640.2	27.7	609.4
16	150	--	--	17.6	2,640.0	14.9	2,235.0
17	88	--	--	19.2	1,689.6	9.4	827.2
19	38	1.35	51.3	16.4	623.2	14.6	554.8
20	114	0.37	42.2	23.4	2,667.6	--	--
21	39	1.50	58.5	27.2	1,060.8	17.7	690.3
22	52	0.57	29.6	6.3	327.6	17.5	910.0
23	22	--	--	--	--	7.3	160.6
24	--	--	--	0.5	--	--	--
25	38	--	--	9.7	368.6	11.3	429.4
26	64	--	--	27.3	1,747.2	--	--
27	43	--	--	20.2	868.6	--	--
28	31	--	--	17.2	533.2	--	--
30	69	--	--	20.1	1,386.9	--	--
31	18.5	--	--	8.4	155.4	--	--
32	15	--	--	3.6	54.0	--	--
33	19	--	--	4.1	77.9	--	--
37	68.9	--	--	7.2	496.8	--	--
38	54.2	--	--	1.9	103.0	--	--

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1976

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
1	59237	49918	1084	2474	53.8
2	68979	58136	1117	2988	57.5
3	36636	30848	752	1526	37.2
4	97630	82266	1028	4181	52.3
5	25131	21177	705	1079	36.0
6	0	0	0	0	0
7	14371	12101	109	657	6.0
8	60098	50647	665	2439	32.1
9	44619	37593	428	1779	20.7
10	66970	56404	598	2816	30.1
11	26951	22712	1081	1110	53.0
12	16701	14075	519	732	27.2
13	14636	12336	343	638	17.7
14	15890	13393	191	707	10.1
15	59678	50285	1142	2615	59.4
16	97069	81791	544	3911	26.2
17	30859	26004	292	1326	15.0
18	0	0	0	0	0
19	20187	17000	446	851	22.4
20	48057	40480	355	1981	17.5
21	11898	10018	256	561	14.4
22	27714	23357	448	1110	21.4
23	3698	3114	141	167	7.6
24	0	0	0	0	0
25	0	0	0	0	0
SUB-TOTAL	847009	713655		35648	

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TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1976

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
26	64942	54736	855	2807	43.7
27	41228	34750	807	1655	38.5
28	31440	26501	854	1309	42.4
29	0	0	0	0	0
30	71505	60274	873	3100	45.0
31	2540	2138	115	113	6.1
32	10811	9115	608	429	28.7
33	19256	16232	854	773	40.7
34	12388	10431	145	575	8.0
35	76165	64167	486	3001	22.9
36	29040	24469	489	1164	23.3
37	10717	9024	130	499	7.2
38	0	0	0	0	0
39	23009	19398	462	980	23.4
40	47551	40088	498	1986	24.6
41	34508	29091	529	1402	25.5
42	101469	85544	528	4292	26.5
43	61865	52154	884	2636	44.6
44	12428	10478	308	577	17.0
45	52105	43930	301	2172	14.9
46	0	0	0	0	0
47	16754	14126	471	735	24.5
48	0	0	0	0	0
TOTAL	1,566,745	1,320,347		65,995	

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1977

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
1	0	0	0.0	0.0	0.0
2	45,431	38,253	735.6	1,869.4	36.0
3	0	0	0.0	0.0	0.0
4	53,028	44,650	558.1	2,397.0	30.0
5	0	0	0.0	0.0	0.0
6	0	0	0.0	0.0	0.0
7	68,560	57,728	524.8	3,159.9	28.7
8	0	0	0.0	0.0	0.0
9	28,441	23,948	273.7	1,102.5	12.6
10	61,419	51,715	550.2	2,914.1	31.0
11	0	0	0.0	0.0	0.0
12	15,227	12,821	474.9	703.7	26.1
13	30,882	26,002	722.3	1,291.2	35.9
14	45,639	38,428	549.0	2,016.8	28.8
15	39,680	33,410	759.3	1,792.3	40.7
16	62,242	52,408	349.4	2,812.6	18.8
17	73,995	62,304	712.0	3,298.6	37.7
18	0	0	0.0	0.0	0.0
19	16,911	14,239	374.7	701.6	18.5
20	43,588	36,701	321.9	1,628.7	14.3
21	23,194	19,530	500.8	1,080.8	27.7
22	8,822	7,428	142.8	388.2	7.5
23	11,273	9,492	431.5	513.9	23.4
24	0	0	0.0	0.0	0.0
25	41,887	35,269	928.1	1,925.3	50.7
26	67,167	56,554	883.7	2,969.5	46.4
27	36,415	30,661	713.1	1,602.4	37.3
28	0	0	0.0	0.0	0.0
29	0	0	0.0	0.0	0.0
30	91,654	77,173	1,118.4	3,883.9	56.3
31	11,354	9,560	516.8	510.1	27.6
32	0	0	0.0	0.0	0.0
33	0	0	0.0	0.0	0.0
34	42,262	35,585	497.0	2,063.4	28.8
35	56,244	47,357	360.1	2,278.2	17.3

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TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1977 (Cont'd)

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
36	27,275	22,965	459.3	1,441.0	28.8
37	38,507	32,423	470.6	1,647.2	23.9
38	0	0	0.0	0.0	0.0
39	25,020	21,067	501.6	1,119.0	26.6
40	28,541	24,032	293.1	1,060.0	12.9
41	33,035	27,815	505.7	1,550.6	28.2
42	102,342	86,172	531.9	4,657.1	28.7
43	43,819	36,896	625.4	2,051.0	34.8
44	518	437	12.8	19.5	0.6
45	34,132	28,739	196.8	1,233.9	8.5
46	0	0	0.0	0.0	0.0
47	24,648	20,754	691.8	1,123.5	37.4
48	0	0	0.0	0.0	0.0
TOTAL	1,333,150	1,122,510		58,806.7	

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1978

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
1	57,857	43,715	1,059.0	2,388.4	51.9
2	17,508	14,741	283.5	824.6	15.9
3	36,005	30,316	739.4	1,526.0	37.2
4	0	0	0.0	0.0	0.0
5	18,442	15,528	517.6	711.2	23.7
6	0	0	0.0	0.0	0.0
7	68,324	57,529	523.0	2,891.1	26.3
8	48,517	40,851	575.4	2,018.0	28.4
9	63,560	53,518	611.6	2,633.0	30.1
10	60,096	50,600	538.3	2,539.3	27.0
11	23,397	19,701	938.1	1,022.1	48.7
12	0	0	0.0	0.0	0.0
13	17,065	14,369	399.1	702.4	19.5
14	57,754	48,629	694.7	2,349.3	33.6
15	8,654	7,285	165.6	380.7	8.7
16	70,320	59,209	394.7	2,894.5	19.3
17	18,509	15,585	178.1	744.7	8.5
18	0	0	0.0	0.0	0.0
19	15,080	12,698	334.2	633.8	16.7
20	74,501	62,730	550.3	2,957.9	25.9
21	21,292	17,928	459.7	1,042.0	26.7
22	33,345	28,076	539.9	1,363.3	26.2
23	13,315	11,211	509.6	546.7	24.8
24	0	0	0.0	0.0	0.0
25	33,084	27,857	733.1	1,444.7	38.0
26	61,293	51,609	806.4	2,530.8	39.5
27	3,552	2,991	69.6	175.9	4.1
28	26,048	21,933	707.5	1,093.4	35.3
29	0	0	0.0	0.0	0.0
30	17,009	14,322	207.6	695.7	10.1
31	12,749	10,734	580.2	560.1	30.3
32	10,181	8,572	571.5	505.1	33.7
33	19,366	16,306	858.2	829.3	43.6
34	45,870	38,622	539.4	1,865.6	26.1
35	86,249	72,621	552.3	3,402.4	25.9

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1978 (Cont'd)

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
36	35,284	29,709	594.2	1,484.7	29.7
37	39,815	33,524	486.6	1,752.8	25.4
38	0	0	0.0	0.0	0.0
39	20,742	17,465	415.8	812.8	19.4
40	53,865	45,354	553.1	2,179.7	26.6
41	25,324	21,323	387.7	1,129.4	20.5
42	126,948	106,890	659.8	5,430.5	33.5
43	32,577	27,430	464.9	1,390.9	23.6
44	35,060	29,521	868.3	1,539.6	45.3
45	101,782	85,701	587.0	4,078.5	27.9
46	0	0	0.0	0.0	0.0
47	25,338	21,335	711.2	1,212.2	40.4
48	0	0	0.0	0.0	0.0
TOTAL	1,535,670	1,293,040		64,283.2	

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1979

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
1	0	0	0.0	0.0	0.0
2	55,656	46,863	901.2	2,491.5	47.9
3	5,155	4,341	105.9	254.2	6.2
4	73,522	61,906	773.8	3,356.9	42.0
5	21,844	18,393	613.1	1,005.7	33.5
6	0	0	0.0	0.0	0.0
7	0	0	0.0	0.0	0.0
8	41,177	34,671	488.3	1,845.9	26.0
9	0	0	0.0	0.0	0.0
10	61,323	51,634	549.3	2,650.6	28.2
11	23,385	19,690	937.6	982.4	46.8
12	23,413	19,713	730.1	1,101.3	40.8
13	29,190	24,578	682.7	1,321.6	36.7
14	14,348	12,081	172.6	632.6	9.0
15	57,858	48,716	1,107.2	2,547.7	57.9
16	126,090	106,168	707.8	5,630.3	37.5
17	104,944	88,363	1,009.9	4,683.8	53.5
18	0	0	0.0	0.0	0.0
19	30,383	25,583	673.2	1,266.4	33.3
20	73,839	62,172	545.4	3,508.1	30.8
21	24,775	20,861	534.9	1,154.7	29.6
22	31,794	26,771	514.8	1,479.4	28.5
23	14,879	12,528	569.5	652.3	29.7
24	0	0	0.0	0.0	0.0
25	10,675	8,988	236.5	455.7	12.0
26	10,813	9,105	142.3	482.6	7.5
27	34,812	29,312	681.7	1,586.2	36.9
28	41,221	34,708	1,119.6	1,872.1	60.4
29	0	0	0.0	0.0	0.0
30	80,232	67,555	979.1	3,540.4	51.3
31	14,865	12,517	676.6	646.5	34.[illegible]
32	7,505	6,320	421.3	333.3	22.[illegible]
33	23,805	20,044	1,054.9	1,052.6	55.4
34	40,581	34,169	477.2	1,892.2	26.4
35	83,693	70,470	535.9	3,588.4	27.3

TABLE IV-4 (Cont'd) Sludge Application Rates and Amounts

1979

FIELD NO.	VOLUME CU.YDS.	WET TONS TONS	WET TONS PER ACRE TONS/ACRE	DRY TONS TONS	DRY TONS PER ACRE TONS/ACRE
36	28,473	23,974	479.5	1,331.6	26.6
37	50,227	42,291	613.8	2,460.5	35.7
38	0	0	0.0	0.0	0.0
39	27,538	23,187	552.1	1,225.2	29.2
40	53,143	44,746	545.7	2,666.7	32.5
41	44,915	37,818	687.6	2,046.9	37.2
42	196,791	165,693	1,022.8	8,974.2	55.4
43	59,194	49,841	844.8	2,814.3	47.7
44	36,203	30,483	896.6	1,510.7	44.4
45	124,730	105,023	719.3	5,596.5	38.3
46	0	0	0.0	0.0	0.0
47	26,646	22,436	747.9	1,176.0	39.2
48	0	0	0.0	0.0	0.0
49	0	0	0.0	0.0	0.0
TOTAL	1,809,630	1,523,710		81,818.2	

According to the Illinois Environmental Protection Agency (IEPA), agronomic rates for sludge application to cropland are roughly in the range of five to twelve dry tons per acre per year depending on the crop grown. In 1975, place land Fields 31, 34, and 37 received 42.1, 31.7, 37.9, and 28.9 dry tons of sludge per acre; in 1976, Fields 19, 22, 35, 36 and 40 received 22.4, 21.4, 22.9, 23.3, and 24.3 dry tons per acre. The rates of application on place land generally decreased from 1975 to 1976. It is evident that some place lands have received sludge at "reclamation" rather than "agronomic" rates. Annual sludge application rates were originally proposed to be 75 dry tons per acre in the first year, tapering down to 25 dry tons per acre by the fifth year and continuing at that rate.

4. Supernatant Application at the Gale Farm

The original project design called for the shipping of sludge supernatant from the holding basins back to the head of the treatment plant. Table IV-1 (page IV-5) shows that this practice has not occurred since the first quarter of 1976. It was recognized that this expensive practice was possibly unnecessary, considering that the supernatant could be applied to land at the project site to provide nutrients for crops such as hay.

The property selected for supernatant application was the 3,015.3-acre Gale Farm, approximately 1,334 acres of which will eventually be utilized. Supernatant (0.1 percent solids) from two holding basins presently storing supernatant only is applied through gated pipe at agronomic rates. The supernatant flows through pipes and onto the application fields through slotted openings at intervals along the pipes, creating a sheet flow by gravity. The system has been in operation since September 1976. According to the Illinois Environmental Protection Agency Water Pollution Control Permit (see appendix A), the agronomic rate is defined as a rate necessary to supply a maximum of 120 pounds of available nitrogen per acre which corresponds to 30,000 gallons of sludge at 4.1 percent solids or 117,000 gallons of supernatant at 0.1 percent solids.

Fields where supernatant liquid is applied through gated pipe are constructed to be closed drainage systems not discharging to sourrounding surface water; there is consequently no monitoring of runoff from these fields. Supernatant liquid is generally applied to these fields to the limit of soil hydraulic capacity. The total amount of supernatant in wet tons, gallons and gallons per acre applied on each field during 1977 through 1979 is summarized in Table IV-5.

5. Land Purchases

On August 8, 1974, MSDGC purchased 2,106 acres of land in Fulton County formerly owned by the United Electric Coal Company. Approximately 90% of the land had been strip mined. On April 14, 1975, a land use-reclamation plan submitted by MSDGC to the Fulton County Plan Commission and County Board was approved.

This overall plan includes a program, to reclaim and revegetate the gob, slurry and acid lake area in the southwest portion of the property. This 200-acre site is located on the former Cuba Mine #9 refuse area and consists of 75 acres of slurry and 85 acres of gob, roads, dam and dumping areas. A 40-acre, highly

TABLE IV-5 SUPERNATANT APPLICATION AT FULTON COUNTY

1977

FIELD NO.	WET TONS (TONS)	GALLONS (1000'S)	GALLONS PER ACRE
51	41,822.0	10,024.7	99,550.5
52	7,615.3	1,825.4	81,490.5
53	5,354.8	1,283.6	147,534.0
54	34,654.4	8,306.7	149,400.0
55	23,927.2	5,735.4	155,852.0
56	38,908.7	9,326.4	140,670.0
57	18,124.7	4,344.5	89,948.1
58	30,781.5	7,378.3	160,050.0
59	10,914.6	2,616.2	91,157.8
60	19,710.1	4,724.5	94,679.6
61	0.0	0.0	0.0
62	54,816.3	13,139.5	150,509.0
63	394,627.0	94,592.1	128,295.0
64	0.0	0.0	0.0
65	0.0	0.0	0.0

1978

FIELD NO.	WET TONS (TONS)	GALLONS (1000'S)	GALLONS PER ACRE
51	37,204.2	8,917.9	88,558.6
52	8,275.1	1,983.5	88,551.0
53	5,558.6	1,332.4	153,149.0
54	54,207.6	12,993.6	233,697.0
55	30,737.1	7,367.7	200,209.0
56	46,580.5	11,165.3	168,406.0
57	19,429.5	4,657.3	96,423.4
58	38,276.8	9,175.0	199,023.0
59	8,049.9	1,929.6	67,232.1
60	11,651.5	2,792.9	55,969.2
61	5,301.4	1,270.8	36,726.8
62	30,206.6	7,240.5	82,938.4
63	497,716.0	119,302.0	161,810.0
64	18,455.5	4,423.8	68,585.8
65	0.0	0.0	0.0
TOTALS	811,650.0	194,553.0	

TABLE IV-5 (Cont'd) SUPERNATANT APPLICATION AT FULTON COUNTY

1979

FIELD NO.	WET TONS (TONS)	GALLONS (1000'S)	GALLONS PER ACRE
18	54,941.3	13,169.4	119,722.0
29	15,064.1	3,610.9	128,959.0
50	47,695.0	11,432.5	73,426.4
51	22,839.4	5,474.6	54,365.5
52	14,408.2	3,453.7	154,181.0
53	6,668.3	1,598.4	183,723.0
54	50,270.9	12,052.3	216,769.0
55	19,511.4	4,676.9	127,089.0
56	39,725.3	9,522.2	143,622.0
57	15,514.0	3,718.7	76,991.8
58	28,847.1	6,914.7	149,992.0
59	8,859.3	2,123.6	73,992.1
60	28,375.7	6,801.7	136,306.0
61	8,295.1	1,988.3	57,466.3
62	48,434.5	11,609.8	132,987.0
63	580,838.0	139,227.0	188,833.0
64	25,567.1	6,128.4	95,014.5
65	6,216.0	1,490.0	57,306.7
TOTALS	1,022,080.0	244,993.0	

acidic retention pond collects all surface runoff, and effluent from the site drains into a tributary of Big Creek and eventually into Spoon River.

Reclamation and revegetation will be accomplished through regrading the land to meet row crop requirements (generally 5 percent slope topography and the incorporation of approximately 200 equivalent dry tons per acre of liquid sludge (5 percent solids) by means of trenching, ridge and furrow, continuous excavation, irrigation, deep plowing and bulldozing, and/or plow or disc injection. Surface flow irrigation will be used for supplemental moisture and nutrients after plant material cover appears, at a rate of approximately 20 dry tons per acre annually. Plant materials will be selected on the basis of suitability to the restructured gob/slurry/sludge growth medium, germination and growth rate, and effectiveness for soil erosion control.

This project will serve as a full-scale demonstration project that can determine the engineering, environmental consideration, and methodology involved in using sewage sludge to reclaim this type of land. A comprehensive report will be published that will identify and assess experiments and studies that have been performed, and will provide accurate data in a design manual for the application of sludge to other gob slurry areas across the State.

B. Environmental Control And Monitoring Systems

To ensure against environmental degradation resulting from project operation, some systems for protection were incorporated into the project during the planning and development stages. These include a compact clay lining of holding basins to prevent groundwater contamination from seepage or percolation of sludge, control berms and retention basins to contain runoff from each field and to control water quality of field effluents, and terracing and grading of fields to reduce runoff velocity, erosion and sedimentation. The effectiveness of these control systems and the environmental soundness of project operations have been monitored using five systems pertaining to sludge, water, soil and rock, plants and aquatic biota, and air.

1. Holding and Runoff Basins

The holding basins were constructed following the engineering recommendations which concluded a subsurface investigation and evaluation (A&H Engingeering Corporation, 1971). The interior of the holding basins were contoured to take advantage of the natural terrain. No slopes within the basins are steeper than 1:5. A continuous compact earth lining was constructed within the perimeter of the basin embankment to prevent seepage. The earth lining has a minimum 2-foot thickness of compact clay. The degree of compaction is specified in the subsurface study report.

The fields were graded and reshaped and retention berms and desiltation areas with slotted standpipes were constructed at the tops of the terrace underdrains. These features were designed to retain storm runoff in the fields long enough to allow most of the silt to settle in the fields rather than wash into the retention basins. A typical runoff retention basin is shown in Figure IV-16. Runoff basins were designed to retain water so that it would not be released unless it meets

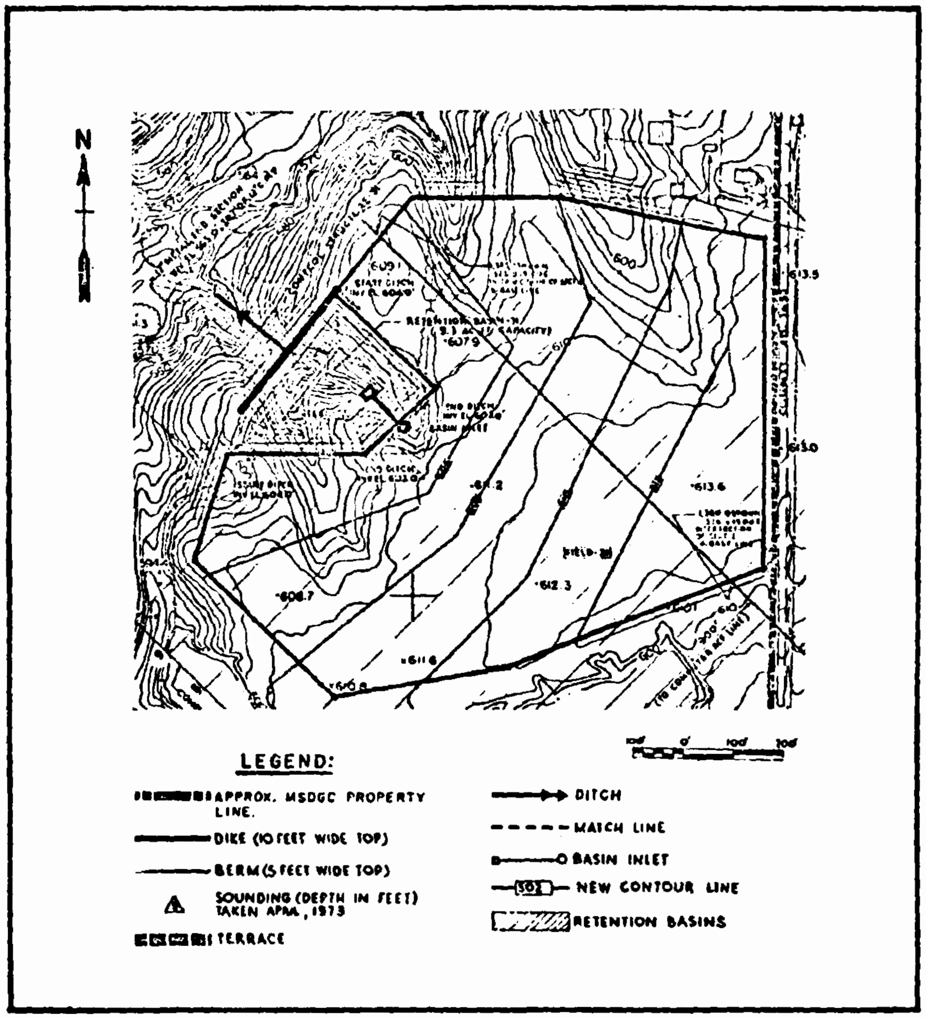


Figure IV-16 Typical Storm Runoff Retention Basin (MSDGC, 1973n) applicable water quality standards. Project design included recycling of substandard runoff by pumping it back on the fields if there was not sufficient basin storage capacity to permit extended storage for purposes of improving water quality; records indicate that this practice never occurred. In Figure IV-17 retention berms and basins, terraces and dikes,, basin inlet and outfall, and outfall control structures are shown for a typical field. The original and modified contours are also indicated.

2. Environmental Monitoring Systems

Extensive monitoring takes place in all aspects of the sludge handling and land application process—from the digesters at the West-Southwest Chicago plant to Fulton County. Many elements of the environment could be influenced by sludge application, including crops, air and groundwater (wells). A monitoring program exists at each place in the pathway where environmental elements could be impacted.

Monitoring of sludge, water, soils, crops and cattle, fish and algae, and air is conducted at the site by several agencies including the MSDGC, the Fulton County Health Department (FCHD), the University of Illinois (U of I), the Illinois Environmental Protection Agency (IEPA), the U.S. Geological Survey (USGS), and the Food and Drug Administration (FDA). Each of these systems is presented in capsule form below, followed by highlights of selected aspects of these programs.

a. Sludge Monitoring - There are 13 features in the sludge monitoring program:

- Weekly monitoring of digester feed for chemical and physical parameters and metals (MSDGC)
- Monthly sampling of digester feed and draw for indicator organisms and pathogens (MSDGC)
- Daily sampling of all sludge shipped to Fulton County for physical and chemical parameters; metals are analyzed weekly (MSDGC)
- Monthly sampling of digester feed, draw and sludge shipped to Fulton County for parasites (U of I)
- Quarterly sampling of all sludge shipped to Fulton County for indicator organisms and pathogens (MSDGC)
- Selected sampling of sludge shipped to Fulton County for chemical and physical parameters and trace organics (FCHD)
- Monthly profile sampling of the Fulton County holding basins for physical and chemical parameters (MSDGC)
- Quarterly sampling of sludge in holding basins for indicator organisms and pathogens (MSDGC)
- Selected sampling of the Fulton County holding basins for physical and chemical parameters and metals (FCHD)

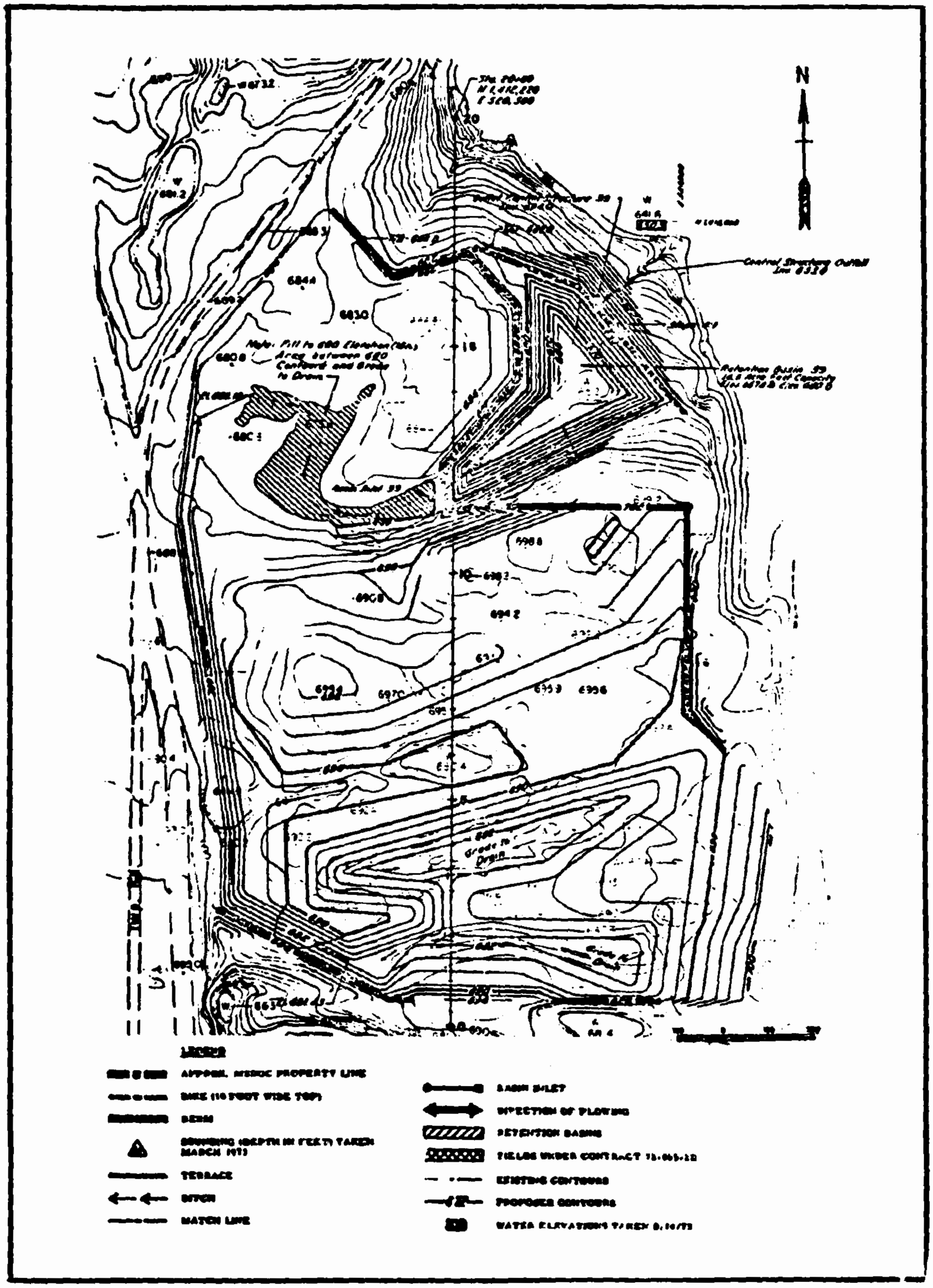


Figure IV-17 Drainage Control Features of a Typical Field (MSDGC, 1973n) o Weekly composite of daily sludge applications to fields for chemical and physical parameters and metals (MSDGC)

o Selected sampling of sludge applied to fields for physical and chemical parameters, metals and trace organics (USGS, FCHD, U of I, IEPA)

o Quarterly sampling of sludge applied to fields for indicator organisms and pathogens (MSDGC)

o Selected sampling of sludge applied to fields for parasites, chemical and physical parameters and trace organics (U of I).

The sludge analysis program was mainly designed to ensure adequate treatment of sludge before it is transported to the holding basins at the project site. For this purpose, twenty-four hour composite samples of sludge being barged to the project site are analyzed for compliance with sludge quality standards. In addition to measuring the volatile acids, pH value, total alkalinity and volatile solids, as required by the project's operating permit, total solids, total phosphorus, Kjeldahl nitrogen, ammonia nitrogen, and electrical conductivity are determined for each composite sample. Concentrations of chloride, sulfate, and 14 metal elements are determined weekly. There are daily grab samples of sludge from the pump station at the Liverpool barge depot, monthly profile samples at the sludge holding basins, and weekly composite samples from the distribution pump station. The supernatants returned from the holding basins are also sampled and analyzed. A typical data log is presented in Table IV-6.

b. Water monitoring - There are 7 features in the surface and ground water monitoring programs:

- Sampling of all runoff basins before and after discharge for chemical and biological parameters (MSDGC)
- Selected sampling of runoff basin discharges by IEPA and FCHD for chemical, biological, and physical parameters and trace organics
- Selected sampling of streams, reservoirs and runoff basin discharges by MSDGC and subsequent analysis by USGS for trace organics
- Monthly sampling of reservoirs and streams for chemical, biological, and physical parameters and metals (MSDGC)
- Selected sampling of reservoirs and streams for chemical, biological, and physical parameters, metals, and trace organics (FCHD, USGS, IEPA)
- Monthly sampling and analysis of wells for chemical, physical, and biological parameters and metals (MSDGC)
- Selective sampling of wells for metals, chemical and physical parameters and trace organics (USGS, FCHD, IEPA).

The water monitoring system includes water sampling, analysis, data reporting and data reduction. Water samples are taken from 26 wells, 1 spring, 11 stream samp-

Table IV-6 Fulton County Land Reclamation Project Sewage Sludge Analysis, April 1975 (MSDGC, 1975g)

	MDL*	Date 4/3	4/5	4/6	4/7
Total Solids %		3.72	3.38	3.37	3.42
Total Volatile Solids %		52.62	54.15	55.68	54.62
Volatile Acids** (mg/l)		67.00	67.00	45.00	90.00
pH		7.40	7.50	7.80	7.60
Total P (mg/l)	0.01	980.00	830.00	1,010.00	890.00
Cl- (mg/l)	1.0	292.00			404.00
$SO_4^=$ (mg/l)	1.0				
N-Kjeldahl (mg/l)	1.0	2,849.00	2,681.00	2,513.00	2,632.00
NH_3-N (mg/l)	1.0	1,344.00	1,372.00	1,421.00	1,435.00
Alkalinity as $CaCO_3$ (mg/l)	0.1	3,900.00	4,780.00	4,920.00	4,940.00
Electrical Conductivity (µmhos/cm)	1.0	7,300.00	8,000.00	7,500.00	8,000.00
Al (mg/l)	1.0	220.00			200.00
Cd (mg/l)	0.01	7.00			7.00
Ca (mg/l)	1.0	1,200.00			1,010.00
Cr (mg/l)	0.02	93.80			86.90
Cu (mg/l)	0.01	48.00			48.80
Fe (mg/l)	0.1	1,370.00			1,652.00
Pb (mg/l)	0.03	30.40	(no samples taken)		32.60
Hg (µg/l)	0.1	151.00			140.00
Mg (mg/l)	1.0	500.00			490.00
Mn (mg/l)	0.01	13.20			14.80
Ni (mg/l)	0.1	13.00			13.00
K (mg/l)	1.0	220.00			200.00
Na (mg/l)	1.0	110.00			150.00
Zn (mg/l)	0.1	115.00			98.00

*MDL = minimum detection limit of laboratory.
**As acetic acid.

mg/l - milligrams per liter
umhos/cm - micromhos per centimeter
ug/l - microgram per liter

ling stations located on 8 creeks or streams, effluent sampling stations at runoff basins, and at a number of reservoirs. The locations of sampling stations are indicated in Figure IV-18. Water quality parameters analyzed and reported include:

- Physical parameters such as total suspended solids (TSS), total dissolved solids (TDS), total volatile solids (TVS) electrical conductivity, and temperature
- Chemical parameters such as pH, total alkalinity, dissolved oxygen (D.O.), total phosphorus (P), total Kjeldahl nitrogen (N), ammonia nitrogen (NH_3-N), nitrate and nitrite nitrogen (NO_2+NO_3-N)
- Anions such as chlorine (Cl) and sulfate (SO_4) and cations such as potassium (K), sodium (Na), calcium (Ca), and magnesium (Mg)
- Trace metals such as zinc (Zn), cadmium (Cd), copper (Cu), chromium (Cr), manganese (Mn), lead (Pb), iron (Fe), aluminum (Al), mercury (Hg), and selenium (Se)
- Biological and microbiological parameters such as 5-day biochemical oxygen demand (BOD_5) and fecal coliforms.

In addition, groundwater elevations have been observed and recorded monthly. Water samples are collected and examined every month, and findings are summarized in a monthly report entitled Environmental Protection System Report for Fulton County, Illinois. Typical examples of data are given in Tables IV-7 and IV-8. The former table reports the quality of well, reservoir, spring and stream waters; the latter shows the quality of effluent from retention basins. Samples taken prior to project operation constitute baseline information for the "no-action" water quality situation. Changes are revealed by comparing water quality resulting from project operation with the baseline data.

c. Soil monitoring - The soil monitoring program includes sampling of the plow layer (0-6 in.) and soil borings to bed rock taken and analyzed for physical and chemical parameters by the MSDGC.

Prior to project operation, 52 soil borings to bedrock approximately 40 feet deep were made to determine the physical and chemical characteristics of soils and rock. Physical tests included the penetration test, strength test, density test, compressibility test, permeability test, and field pumping tests. Stratigraphs of types of soils and their geographical distribution were established. The texture, color, moisture content, grain size distribution, and permeability of the spoil material were analyzed (A&H Engineering Corporation, 1971). Chemical analyses included exchangeable calcium, organic carbon, and hydrochloric acid-extractable metals such as manganese, zinc, copper, cadmium, chromium, nickel, lead, and aluminum, for both spoils and place land (MSDGC, 1975). It was proposed that, 5 years after project initiation (1977), another set of soil borings would be made to bedrock to investigate changes in soil chemistry, if needed (Dalton and Murphy, 1973). To date, no changes have occurred in the upper horizons of soil to necessitate repeating the extensive soil boring program (Dalton, 1980 personal communication).

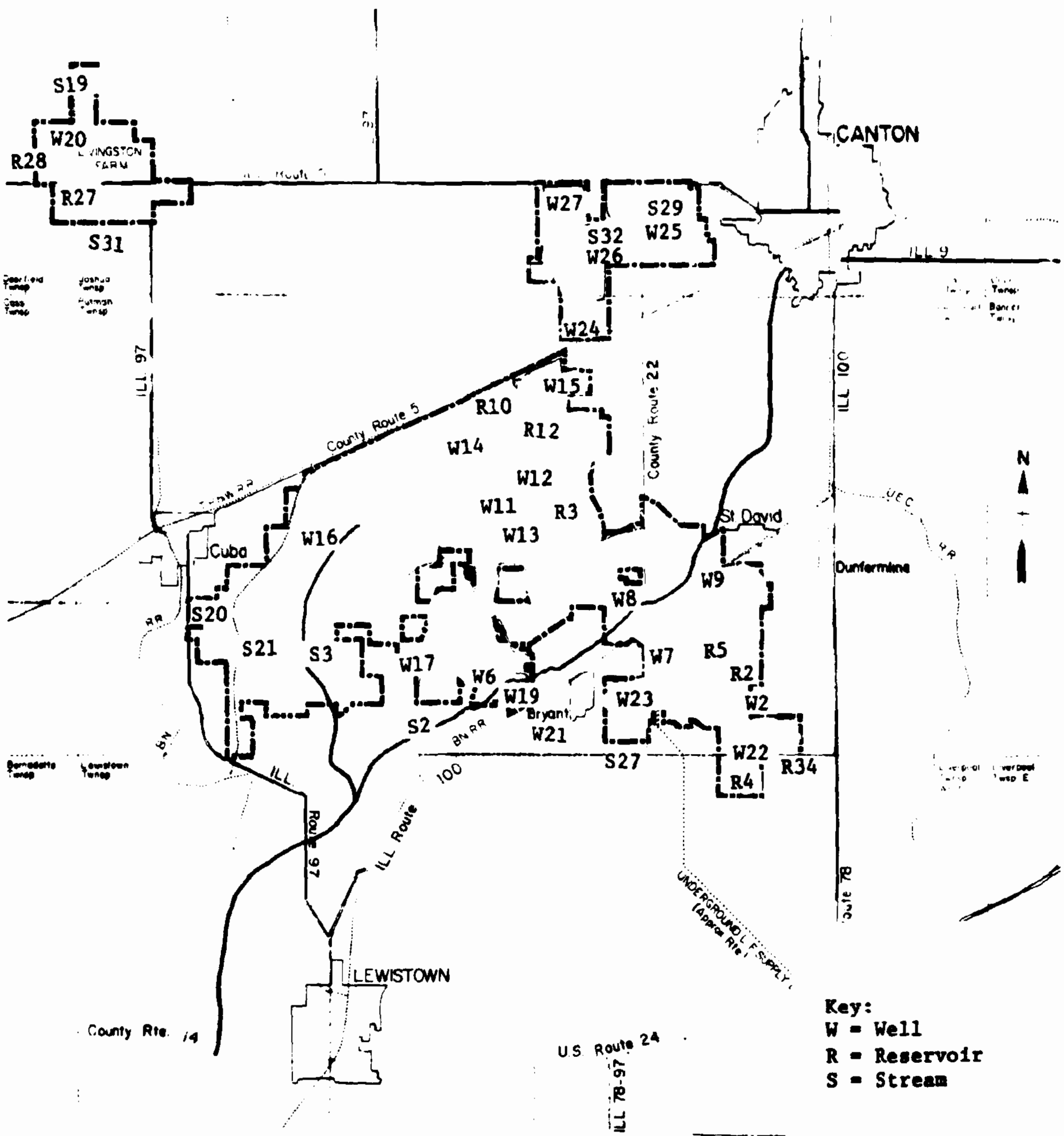


Figure IV-18 Water Monitoring Locations in Fulton County (MSDGC, 1975d)

Table IV-7 Fulton County Land Reclamation Project
Water Analysis, April 1975 (MSDGC, 1975g)

Sampling Stations:			Well Data		Reservoir Data		Stream & Spring Data		
			W1	W2	R1	R2	SPR	S1	S2
DATE:		MDL*	4/ 7	4/ 7	4/ 9	4/ 9	4/ 7	4/16	4/16
PH			7.20	7.40	7.80	8.10	7.70	7.80	7.80
TOTAL P	MG/L	0.01	0.15	0.38	0.09	0.13	0.10	0.56	0.33
CL-	"	1.0	15.00	21.00	9.00	12.00	15.00	29.00	27.00
SO4=	"	1.0	192.00	67.00	485.00	493.00	1383.00	360.00	501.00
N-KJELDAHL	"	0.5	0.80	1.30	1.50	1.50	0.80	2.40	2.30
N-NH3	"	0.1	0.70	1.10	0.40	0.30	0.80	1.40	0.90
N-NO2+NO3	"	0.01	0.01	0.00	3.48	2.56	0.09	3.16	3.40
ALK AS CACO3	"	1.0	390.00	420.00	360.00	470.00	500.00	260.00	240.00
ELEC.COND.	UMHOS/C		700.00	650.00	825.00	950.00	2600.00	900.00	1000.00
K	MG/L	1.0	0.00	0.00	3.00	3.00	8.00	4.00	4.00
NA	"	1.0	12.00	12.00		20.00	137.00	66.00	76.00
CA	"	1.0	121.00	121.00	135.00	165.00	528.00	130.00	135.00
MG	"	1.0	60.00	52.00	74.00	72.00	195.00	68.00	78.00
ZN	"	0.1	0.00	0.20	0.00	0.00	0.00	0.00	0.00
CD	"	0.01	0.00	0.00		0.00	0.00	0.00	0.00
CU	"	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CR	"	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NI	"	0.1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MN	"	0.01	0.19	0.15	0.04	0.24	1.67	0.42	0.40
PB	"	0.01	0.00	0.00	0.00	0.03	0.00	0.00	0.00
FE	"	0.1	3.40	7.40	0.00	0.00	3.00	0.80	0.70
AL	"	1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HG	UG/L	0.1	0.00	0.00	0.10	0.40	0.12	0.10	0.10
SE	MG/L	0.2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FC	PER 100 ML	2	0.00	0.00	0.00	2.00	0.00	7.2E+04	3900.00
D.O.	MG/L	0.5			11.40	11.50			
TEMP.	°C				3.00	4.00			
STATIC H2O EL.	FT.				2.00	5.00	10.00	37.00	16.00
BOD	MG/L				844.00	913.00	3230.00	843.00	1010.00

*MDL=MINIMUM DETECTION LIMIT OF LABORATORY. ALL VALUES LESS THAN THESE ARE REPORTED AS ZERO.

Table IV-8 Retention Basin Effluent Quality (MSDGC, 1975g)

Field Runoff Basin Log at the District Site in Fulton County, Illinois

Basin number	4-1	5-1	7-3	8-1
Stage reading	35%	35%	60%	45%
Date opened/checked	9:30 a.m. 4/15	9:45 a.m. 4/15	10:15 a.m. 4/15	10:30 a.m. 4/15
R&D approval	Yes	Yes	Yes	Yes
Sampled	Yes	Yes	Yes	Yes
Date closed	3:00 p.m. 4/15	9:30 a.m. 4/17	10:15 a.m. 4/21	8:00 a.m. 4/16
No. days open	0.23	2.00	6.00	0.90
Discharge (MG)	0.04	0.31	0.72	0.42
Comments				

Field Runoff Basins - Water Analysis and Discharges at Fulton County During April 1975

Date Sampled	4-15-75	4-15-75	4-15-75	4-15-75
Source	B-2-2	B-3-1	B-4-1	B-5-1
TSS mg/l	43	38	220	33
BOD mg/l	4	8	23	7
FC per 100 ml	<10	20	<10	<10
Date discharged	4-15-75	4-15-75	4-15-75	4-15-75
Quantity MG	0.32	1.48	0.04	0.31

Yearly plow layer samples are analyzed for pH, electrical conductivity available phosphorus, organic carbon, exchangeable ammonium and bases, nitrate, cation exchange capacity and acid-extractable metals. Also, twice yearly there are 140 centimeter shallow soil borings made.

d. Crop and cattle monitoring - Grain and leaf samples are taken yearly and analyzed for metals by the University of Illinois and the MSDGC.

The chemical composition of plants grown in sludge-fertilized fields and those grown on control plots are determined so as to evaluate the plants' nutrient uptake rates and to detect any buildup of chemical constituents. The analysis includes samples from stalks, leaves and grain of the fertilized plants. A detailed evaluation of this data is performed in Chapter V.

The University of Illinois also monitors a control and experimental cattle herd for growth rate, parasites, trace organics and metals in various tissues obtained either by surgical biopsy or at slaughter.

e. Fish and algae monitoring - The MSDGC yearly checks the condition of indigenous fish populations in the Fulton County reservoirs. On a quarterly basis, the MSDGC determines the numbers and types of algae in these reservoirs.

An ecological study of aquatic biota in streams and reservoirs was initiated in June 1971. At the start of the project, benthos samples were taken from Reservoirs R3, R10 and R12. Fish and plankton have been sampled, collected and analyzed monthly, and data reported quarterly. The fishery study includes fish population, diversity, and the body condition or "well being" of various fish species such as bluegill, large mouth bass and green sunfish. The body condition of the fish population is determined and reported by the weight-length factor or condition factor K. The plankton study of reservoir water includes plankton counts and population distribution among identified species.

Besides these ecological data, more than 38 physical, chemical and biological parameters of the sample water are analyzed for studies of phenomena such as lake eutrophication. These include pH value, conductivity, alkalinity, solids concentrations, different forms of nitrogen compounds, total phosphorus, dissolved oxygen, water temperature, water transparency, 14 metals, and several cations (MSDGC, 1972a through 1975g; Campbell and Lind, 1969; General Water Quality Standards for Illinois' Waters). Control Reservoir 10 has been maintained to differentiate changes in conditions of fish and plankton from such conditions in the non-control reservoirs which receive discharges from field runoff basins.

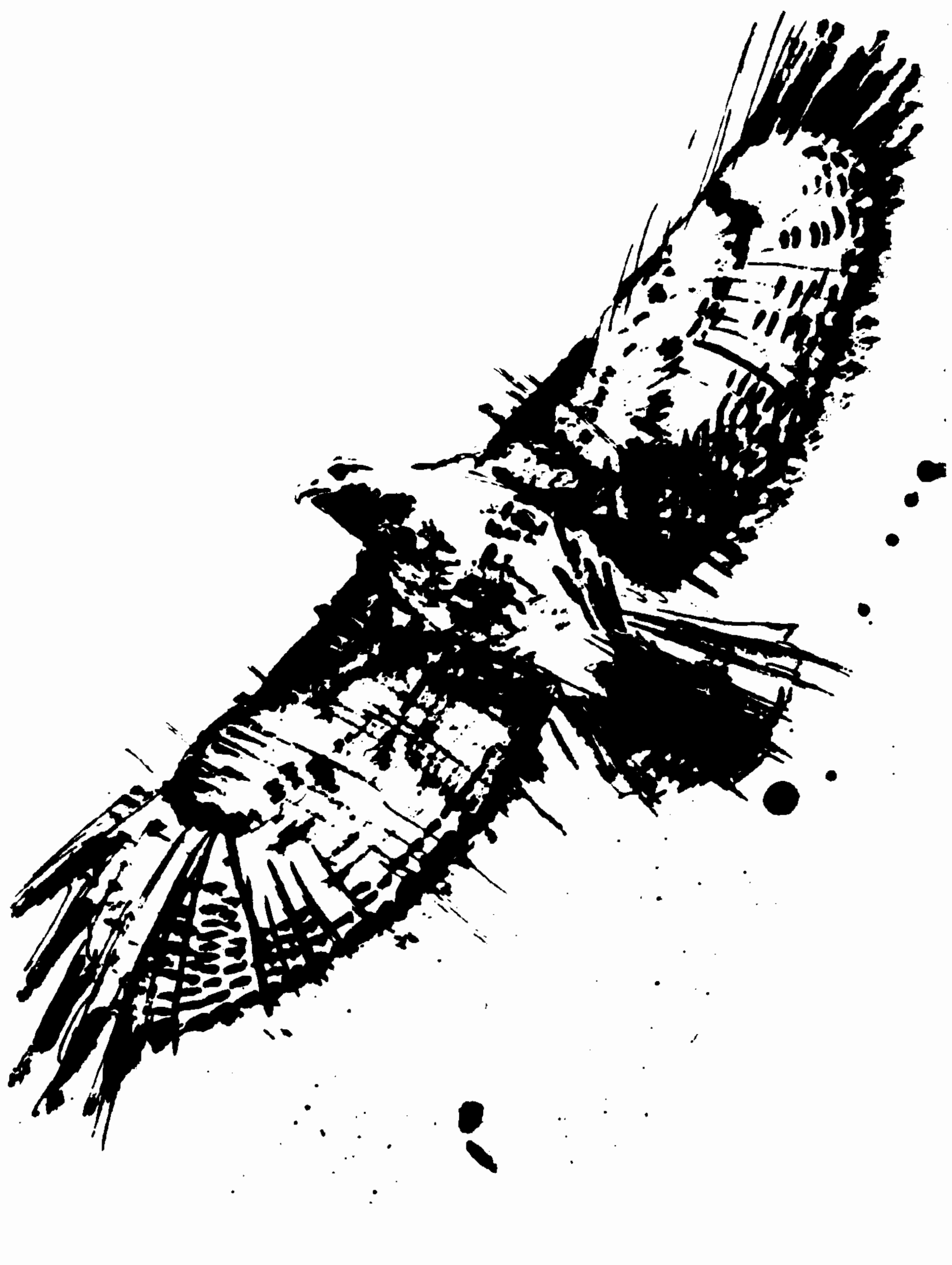
f. Air monitoring - There are six features in the air monitoring program:

- The MSDGC maintains a weather station on the property to measure precipitation, wind, temperature, and relative humidity
- Ambient ammonia levels are measured three times per week at the holding basins
- The FCHD investigates odor complaints and takes odor samples which are analyzed by the Midwest Research Institute

- All odor complaints to the FCHD are investigated by MSDGC personnel
- Odor samples are taken by MSDGC personnel and analyzed by the Illinois Institute of Technology Research Institute
- Ambient air samples have been analyzed for viruses by the USEPA.

To establish the air quality situation at the site, a meteorological station was set up close to the holding basins and an air sampling program designed. Air temperature, wind speed and direction, relative humidity and rainfall were observed daily and compiled in a monthly report. In addition to general weather observations, atmospheric ammonia concentration has been monitored at the downwind berm of the holding basins on a batch basis. During ammonia monitoring periods, average wind speed and direction, air temperature, dew point, and volume of air sampled are measured.

Chapter V
Environmental Impacts of the Project



V. ENVIRONMENTAL IMPACTS OF THE PROJECT

This chapter will discuss the significant environmental impacts of the project and relate these impacts to available options for municipal sludge disposal or utilization. General background information is provided concerning soils, land use, surface and ground water, and air; and a discussion is presented on theoretical aspects of the project on health considerations.

The MSDGC project has had a significant beneficial impact upon the land use and economic factors of Fulton County. These benefits have been the reclamation of land taken out of agricultural activity and the production of cash crops and jobs within the County. Details on these are provided.

During the project period, no significant adverse impacts have been surfaced. During early stages of the project, odor and visual problems were encountered. Through public input and advanced technology, the MSDGC has responded to several problem areas and modified their approach. Several times during the project period poor quality effluent was released from the retention basins to surface waters. Steps have been taken to remedy this situation both in operational procedures and redesign or restoration of existing structures.

Several unanswered questions have persisted in scientific and regulatory areas. These questions concerning heavy metal application rates, pathogens and PCB's have been addressed in USEPA regulation 40 CFR 257 published in September 1979. In the "Criteria for Disposal of Solid Waste" prepared by USEPA, large land application sites, such as Fulton County, would continue to operate, if accompanied by a well-organized monitoring system and the other safeguards mentioned earlier.

The questions of total loading of heavy metals and their impact on crops is somewhat muted by the constituents of the unconsolidated soils at the project area. Many of the contaminates found in sludge are also found in the project soils. The MSDGC monitors the surface and groundwater and crops. The results would indicate that only moderate increases in heavy metals in crops are associated with the project.

A. Soils

The utilization of sludge solids on land has both long and short term impacts on soils. Most of the generalized impacts on soils have been noted in reports prepared by the Council of Agricultural Science and Technology and USEPA and will be only referenced for this text.

1. Background

Soil is a chemically and biologically active medium. A wide spectrum of microorganisms such as bacteria, protozoans and fungi, as well as macro-organisms such as earthworms and insects inhabit the upper portion of the soil. The soil organisms are capable of both structural and chemical modification of the soils while utilizing organic matter as an energy source. The combined actions of both plants and animals cause decomposition of organ matter into water, mineral compounds and humus which is recycled with the soil system.

The bulk of most soils consists of a variety of minerals falling into three size ranges - sand, silt and clay. These minerals contribute inorganic elements to the soil/biota and to growing plants as they are slowly dissolved by water. Clay surfaces carry a net negative charge which attracts cations in solution. The cations which become adsorbed onto clay particles can be exchanged with other cations; the capacity of a soil to adsorb and exchange ions is known as the "cation exchange capacity" (CEC) and is measured in milliequivalents per 100 grams of soil. Adsorption and precipitation reactions in soil are also influenced by changes in the soil pH, which cause changes in the clay surfaces affecting the adsorption characteristics and CEC of the soil. The adsorption capacity of soils is also affected by reactions of iron, aluminum and manganese, which form hydrous oxides or sesquioxides. Hydrous oxides have highly adsorptive surfaces and in many soils and sediments control the solubility of heavy metals (USEPA, 1976).

The interactions among infiltrating rainwater, minerals, organic matter, crops, and soil biota allow for the decomposition of organic substances and the recycling of decomposition products. Inorganic elements are also alternately fixed and mobilized. This assimilative and recycling capability of soil renders it a natural medium for the treatment of waste materials (USEPA, 1976).

Similar to organic matter from other sources, sewage solids undergo many types of reactions after being applied to soil. These general reactions are illustrated in Figure V-1. Reaction rates and conditions are governed by sludge properties and application rates, cover crop, soil type, CEC, organic matter, soil organism loading, environmental characteristics such as temperature, and so forth. For this reason, the extrapolation of results from a particular soil study to predict the behavior of other soils is tenuous. A combination of a host of chemicals already being held in the soil with the infinite number of physical, chemical and biological transformations renders the soil system less predictable than, for example, ground or surface water systems. In Fulton County, the situation is made even more complex by the high background metal levels present in the mine spoil.

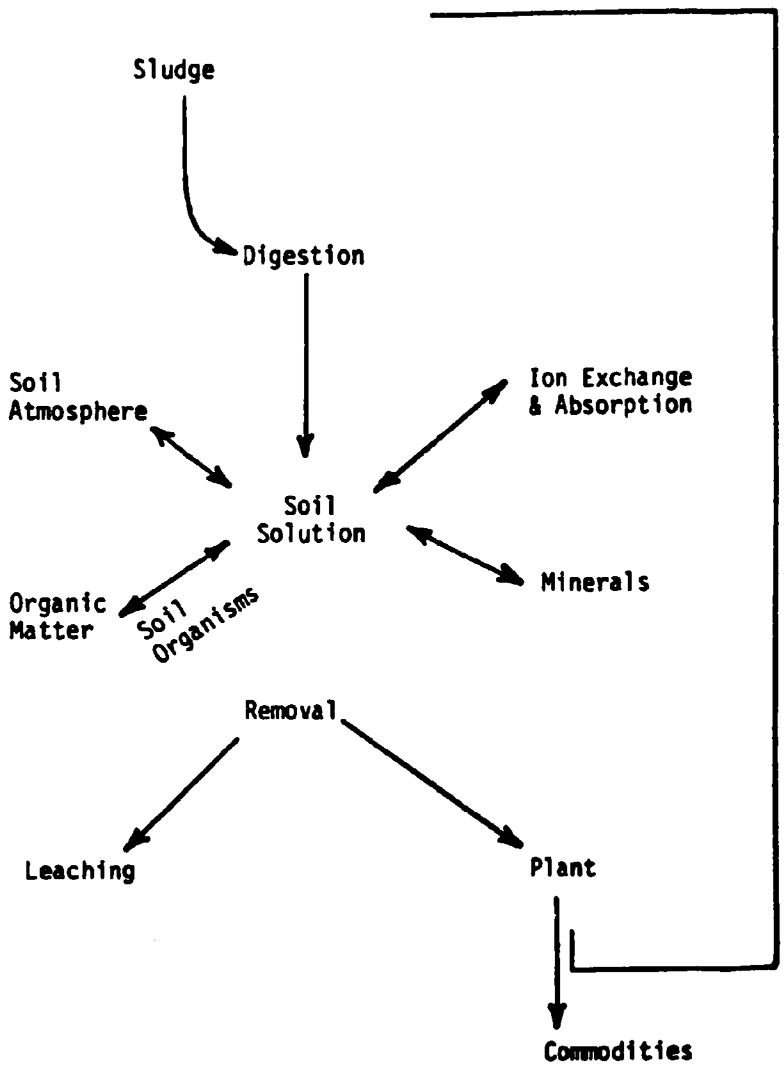


Figure V-1   Major Interactions of Sludge and Soil Constituents (Lindsay, 1972).

Most of the 15,000 acres of land at the project site have been significantly impacted by previous strip-mining operations. The results of strip mining were unconsolidated soils and rock left in an unreclaimed state. Top soils were either hauled away or mixed with strip mining spoils leaving the surface with materials low in organic matter. While some early attempts were made to reclaim parts of the land, nothing was successful.

Until such time as the project land could be level and the organic content of the soils increased, the soil could not be returned to its former use, farming. The MSDGC project was aimed at reclamation of land and soils by using sludge solids to build organic matter in soils.

The physical effects of sludge application to strip-mined soils are beneficial. The high organic content of sludge provides a matrix for ionic loading and water adsorption, contributing to increased agricultural productivity.

Increased aggregate stability resulting from the addition of organic matter results in increased infiltration and permeability rates, increased aeration porosity, and decreased bulk density. These properties, in turn, influence soil erosion potential, the soil atmosphere, and the types of reactions occurring in the soil. Erosion potential decreases with increased water infiltration rates and stabilization of soil particles, with a resulting decrease in dislodgement and filtration. In addition, a surface layer of organic matter reduces the energy of raindrop or spray droplet impact. Reduced erosion may be among the most positive benefits derived from sludge application.

The presence of organic matter is chemically significant to the application of sludge to agricultural land. The trace elements in municipal wastes may occur largely in association with complex organic polyanions. This interaction between heavy metals and humic, polymeric substances in the sludge and soil may have a profound effect upon the mobility and toxicity of metal ions when sewage sludge is applied to agricultural soils. The reactions of metal ions in the soil include solution, oxidation, reduction, precipitation, adsorption, absorption, and complexation, all of which may result in a buildup of trace metals.

The organic matter in Fulton County strip-mined soils begins at an extremely low level and increases on a long-term basis, until it reaches a steady state equilibrium. Like other soils, if sludge application were to be discontinued this steady state would not be maintained resulting in a decrease in organic matter due to decomposition. Agricultural activity could not be economically sustained at depressed soil organic matter levels. If the land were to lay fallow, a new equilibrium would be reached, based upon the level of bacterial population changes.

There is a direct link between amount of soil organic matter and cation exchange capacity. As the organic matter in a soil increases so does the CEC. Most trace minerals can be absorbed onto the soil-organic matrix. The significance of the cation exchange capacity of a soil is that cations derived from sludge may be incorporated in the soil exchange complex. Heavy metal cations, for instance, are strongly absorbed on soil colloids. Once incorporated into the soil exchange complex, they can be temporarily or permanently immobilized or become part of the complex from which plants absorb nutrients. Plant absorption is desirable as a means of removing certain elements from the system or undesirable if the elements are harmful (USEPA, 1976). As a rule, plants do not accumulate large quantities of soil elements other than nitrogen, phosphorus and potassium, and the actual quantity removed permanently from the soil by commercially salable products is small even for these. Metal reactions do not necessarily follow expected patterns, and quantitative prediction of the fate of heavy metals in soil is therefore difficult.

2. Erosion of the Project Site

Although the addition of sewage sludge to soil reduces erosion through its beneficial influence on soil structure, erosion can still occur in significant quantities. Drainage and erosion control measures (berms, dikes, grading) were described in Chapter IV. Actual control of soil erosion depends to a great extent on the level of maintenance of dikes and berms, on farming practices, and on the methods and amounts of sludge application. Actual field observation of application practices is used to demonstrate the need for good maintenance procedures.

Observation of selected fields were conducted during October 1976 and September 1977. Inspection of Field #4 in 1976 showed that faulty grading caused a portion of the runoff to be channeled to the field's perimeter rather than collecting in the established basins, causing severe erosion on the perimeter of the field. Terracing procedures which were not in accordance with SCS practice contributed to erosion on Fields #4 and #14, inspected in 1976. Fields #4, #10, #11, #14 and #43, (See Figure IV-1) in which sludge is incorporated by tandem disk into the top six to eight inches of soil, were inspected in 1977. High sludge application rates in these fields necessitate five to six passes of the disk. This practice can lead to a highly compacted zone starting six to eight inches below the surface. This compaction may result in saturation of the upper soils with relatively little rainfall or sludge application.

Most of the existing fields were designed for application via the traveling gun, which would spray solids across the surface of the soils. When this practice was discontinued, some fields were reshaped to accommodate the large tractors and tandem disks. Other small fields apparently were "abandoned" from future use. Many of the redesigns were not recorded by the MSDGC and were discovered by actual site inspections. Much reshaping and filling of settled areas has been accomplished at the site. However, further work may be necessary to prevent further erosion.

The current practice at the Fulton County site is to apply sludge solids to approximately one-half of the total available agricultural acreage each year. This practice does not allow for crops to be grown on these fields due to the repeated applications during the normal growing season. Therefore, a field is cropped one year and lies fallow the next year while sludge is being applied. Records indicate that in reality cropping may occur only once in three years. The combination of compaction of soils and lack of a cover crop can greatly increase runoff and soil erosion.

Faulty convex grading on the older of the five application fields inspected was found to result in runoff being channeled toward the field perimeters, creating deep gulleys. Lack of vegetation in control berms, runoff channels and basin dikes were also seen to contribute to soil erosion. Newer fields were observed to be superior to older ones in terms of proper grading and related runoff control. Concave grading of the newer fields creates backup reservoirs for use when the runoff retention basins are filled.

Problems were noted in the gated pipe operation on Field #61. The gated pipe delivers supernatent to field areas which are established in grass and hay producing vegetation. This area was partially reclaimed prior to MSDGC purchase. The MSDGC has used the rolling contour of the land to the maximum extent possible to create a gravity flow of supernatent to increase hay productivity. Attempts have been made to balance the flow of the system; however, due to the contour of the land, sheet flow is usually not accomplished. The flow of supernatent is toward rills and gullies. Erosion has resulted. This may be corrected by construction of control berms and spreader ditches. Another control may be utilization of vegetation that is more tolerant of large quantities of water thereby holding more water.

In 1976, repairs occurred on Fields #8, 9, 13, 16, 17, 26, 35, 37, 44, 45, and 47 to correct erosion conditions and improve field operations. Considerable seeding for erosion control also took place, including the seeding of about 270 acres of berms. Additional seeding was performed in that year on Fields #24, 38, 51, 52, 57, 59 and 62 for soil erosion control and hay production. Proposed plans for repair of ditches and erosion gullies on Fields #61 and 63 include reshaping of eroded areas to divert surface runoff, revegetation, and in Field #61, construction of an earthen dam with a control structure, construction of berms, rock picking, chisel plowing, fertilizing, tandem disk and drag harrowing, seeding, and mulching.

It appears that problems of drainage control due to less than optimum grading schemes, especially with the older application fields, will persist into the future and possibly be compounded by the new practice of cropping only in alternative years. Further field modifications based upon new operational data and observations would reduce this impact. This work should be done in conjunction with cleaning out siltation basins and berm repairs.

3. Chemical Effects on Soils at the Project Site

Monitoring of project fields includes the determination of 0.1 Normal hydrochloric acid (N HCl) extractable metals in soils. Zinc, cadmium, nickel, and copper concentrations of surface soils for typical sludge amended mine spoil and non-mined fields at Fulton County are shown in Table V-I. The

Field #	Year	Sludge Applied Metric tons / hectare dry basis	Zinc ug/g dry basis	Cadmium ug/g dry basis	Nickel ug/g dry basis	Copper ug/g dry basis
3 Mine-spoil field, cropped	1972	12.9	20.0	--	--	--
	1973	2.7	--	1.22	0.59	11.4
	1974	54.7	20.9	1.47	2.58	9.84
	1975	22.8	71.6	5.63	8.20	31.6
	1976	--	133	8.19	11.4	42.2
4 Mine-spoil field, Fallow	1972	--	--	--	--	--
	1973	1.1	--	--	--	--
	1974	54.9	10.9	0.43	6.24	5.40
	1975	85.8	93.5	7.63	10.6	38.2
	1976	--	125	9.04	12.9	42.8
20 Non-mined field, cropped	1972	--	10.8	0.28	4.07	3.11
	1973	0.8	--	--	--	--
	1974	52.4	13.5	0.36	3.63	4.37
	1975	20.4	72.4	5.12	11.3	21.9
	1976	--	124	7.33	12.8	32.6
36 Non-mined field, Fallow	1972	--	--	--	--	--
	1973	--	--	--	--	--
	1974	--	8.0	0.17	4.72	2.67
	1975	--	6.8	1.18	3.15	2.97
	1976	84.9	96.6	6.94	7.15	30.0

Table V-1. Zinc, Cadmium, Nickel and Copper Concentrations in Surface Soils, and Annual Sludge Application Rates, for Typical Sludge-Amended Mine Spoil and Non-Mined Fields at Fulton County (Peterson etal; 1977).

table shows that concentrations of 0.1 N HCL extractable zinc, cadmium, nickel and copper in the selected application fields increased with each year of sludge applications.

The agricultural issues associated with long-term soil contamination are whether contaminated soils can support plant growth and, if so, whether the crops grown on such soils will present a health hazard to consuming animals and humans. These issues are related to the long-term availability of metals that have accumulated in the soil, which is discussed in detail in Section D of this chapter. Experiments that have been performed using recovery of extractable metals from soils to indicate plant availability have shown that heavy metals that have accumulated in soil can be available to plants for a considerable period of time (Chaney, 1978).

B. Water

Surface water quality is assessed at streams, reservoirs and runoff basins and groundwater quality is assessed at wells and springs. Potential impacts on surface and groundwater are delineated separately below.

1. Surface Water Quality

There are 11 stream water quality monitoring stations and 10 reservoir stations throughout the project area; these are designated, respectively: S1, S2, S3, S19, S20, S21, S27, S29, S31, S32, S33; and R1, R2, R3, R4, R5, R10, R12, R27, R28, R34. Their locations are shown in Figure V-2. Application fields receiving or scheduled to receive sludge are provided with at least one runoff retention basin, the effluent quality of which is analyzed whenever there is a discharge. Water quality samples from these stations and basins are analyzed and summarized.

a. Water Quality of Streams - Water quality observations versus violations of Illinois standards is summarized in Table V-2. The data separation into two time periods, a result only of the updating of this document, provides a useful indication of whether violations have increased during the later years of the project. Trends in selected water quality constituents for all stream stations are presented in Table V-3.

The pH values and concentrations of chlorine, chromium, nickel and selenium are within standards at all stations. All stations show violations of total dissolved solids and iron, while most exhibit violations of sulfate ion, copper and manganese throughout the monitoring period. Most of these violations probably result from runoff over strip-mined land. In addition, stations stations S20, S21, and S33 indicate numerous violations in standards for ammonia nitrogen.

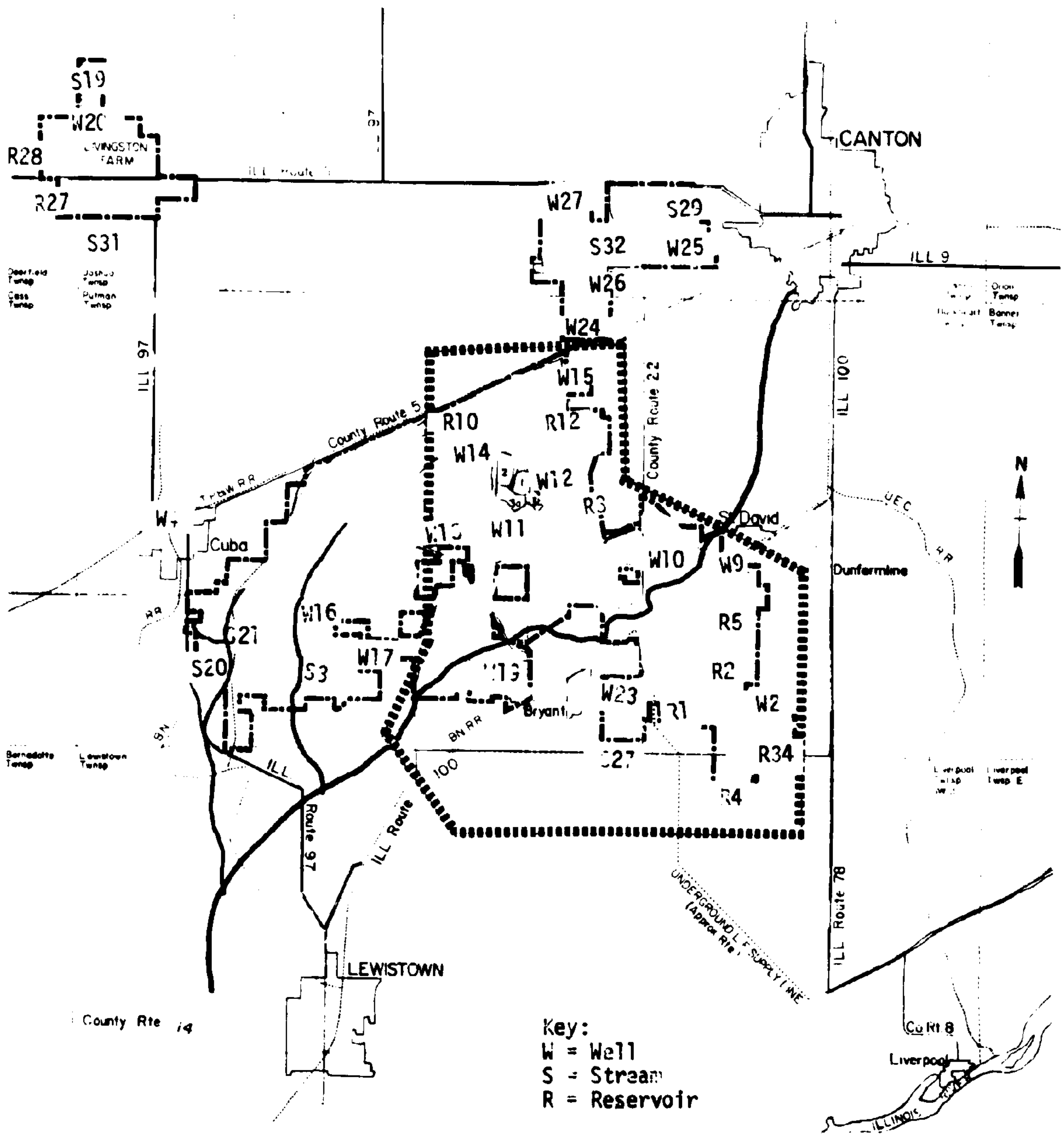


Figure V-2 General Area Applied with Sludge and Water Monitoring Stations (MSDGC, 1972a through 1975g).

Table V-2 Ratio of Violations and Observations Reported at Various Stream Sampling Stations, July 1972 to July 1975 (MSDGC, 1972a through 1975g; General Water Quality Standards for Illinois Waters)

Stream Sampling Station \ Contaminant	pH	Cl^-	$SO_4^=$	NH_3-N	Cd	Cr	Cu	Fe	Pb	Hg	Mn	Ni	Se	Zn	TDS
S1	0/31	0/31	5/31	12/31	0/31	0/31	11/31	20/31	3/31	0/31	1/31	0/31	0/15	0/31	6/10
S2	0/31	0/31	13/31	5/31	0/31	0/31	11/31	16/31	3/31	0/31	1/31	0/31	0/15	0/31	9/10
S3	0/31	0/31	15/31	1/31	1/31	0/31	1/31	10/31	5/31	1/31	1/31	0/31	0/15	0/31	7/8
S19	0/31	0/31	0/31	0/31	0/31	0/31	4/21	3/31	4/31	1/31	0/31	0/31	0/14	0/31	2/9
S20	0/4	0/4	4/4	4/4	0/4	0/4	0/4	2/4	0/4	0/4	1/4	0/4	0/4	0/4	4/4
S21	0/3	0/3	3/3	4/4	0/4	0/4	0/4	4/4	1/4	0/3	4/4	0/4	0/4	0/4	3/3
S27	0/31	0/31	6/31	0/31	0/31	0/31	5/31	14/31	1/31	0/31	2/31	0/31	0/15	0/31	7/9
S29	0/31	0/31	0/31	0/31	0/30	0/31	5/31	4/31	5/31	1/31	0/31	0/31	0/15	0/31	1/8
S31	0/31	0/31	21/31	0/31	0/31	0/31	7/31	5/31	7/31	1/31	20/31	0/31	0/14	10/31	9/9
S32	0/31	0/31	9/31	0/31	0/31	0/31	4/31	6/31	5/31	5/31	0/31	0/31	0/15	0/31	7/8
S33	0/9	0/9	9/9	5/9	1/9	0/7	1/9	8/9	1/9	0/9	9/9	0/9	0/9	3/9	7/8

Table V-2 (Cont'd)

Stream Sampling Station \ Contaminant	pH	Cl^-	$SO_4^=$	NH_3-N	Cd	Cr	Cu	Fe	Pb	Hg	Mn	Ni	Se	Zn	TDS
S1	0/21	1/21	1/	3/21	1/21	0/21	2/21	14/21	1/21	0/21	0/21	0/21	0/14	0/21	8/21
S2	0/21	0/21	7/	0/21	1/21	0/21	0/21	7/21	0/21	0/21	1/21	0/21	0/14	0/21	14/21
S3	0/21	0/21	15/	0/21	0/21	0/21	0/21	2/21	0/21	0/21	3/21	0/21	0/15	0/21	20/20
S19	0/21	0/21	0/21	0/21	0/21	0/4	2/21	5/21	0/21	0/21	2/21	0/21	0/18	1/21	3/20
S20	0/21	1/21	15/21	18/21	0/21	0/21	3/21	3/21	1/21	0/21	0/21	0/21	0/18	0/21	19/20
S21	0/9	0/9	6/9	1/9	0/9	1/9	2/9	7/9	0/9	0/9	8/9	0/9	0/6	0/9	7/9
S27	0/21	0/21	9/21	0/21	0/21	0/21	1/21	5/21	0/21	0/21	4/21	0/21	0/17	0/21	14/19
S29	0/21	0/21	1/21	0/21	0/21	0/21	1/21	3/21	0/21	0/21	2/21	0/4	0/17	0/21	4/21
S31	0/21	0/21	16/21	0/21	0/21	0/21	5/21	6/21	1/21	1/21	18/21	0/21	0/18	0/21	18/21
S32	0/21	0/21	2/21	2/21	0/21	0/21	0/21	4/21	0/21	0/21	4/21	0/21	0/18	0/21	12/21
S33	0/21	0/21	17/21	5/21	0/21	0/21	3/21	18/21	0/21	0/21	19/21	0/21	0/18	2/21	20/21

AUGUST 1975 - APRIL 1977

Table V-3 The NO_2+NO_3-N, NH_3-N, Phosphorus, Iron, and Fecal Coliform Content of Streams for 1971-1976
(Zenz et.al., 1976, Enviro Control, 1977, MSDGC)

	S1	S2	S3	S19	S20	S21	S27	S29	S31	S32	S33
NO_2+NO_3-N (Nitrite and nitrate nitrogen)											
1971	2.65	2.22	.10	-	-	-	-	-	-	-	-
1972	2.82	2.48	.11	1.79	-	-	1.6	5.95	1.99	1.6	-
1973	3.12	2.57	.15	5.13	-	-	2.85	10.08	3.00	2.86	-
1974	2.34	1.87	.12	3.46	-	-	1.83	7.36	1.87	1.53	-
1975	1.99	1.85	.10	3.20	.37	.57	2.11	8.00	2.49	1.91	.75
1976	2.62	1.83	.07	3.47	.12	.95	1.34	5.46	3.01	1.49	.87
Phosphorus											
1971	1.20	.77	.20	-	-	-	-	-	-	-	-
1972	1.27	.67	.25	.12	-	-	.21	.15	.23	.08	-
1973	.89	.46	.13	.16	-	-	.19	.12	.13	.14	-
1974	.69	.44	.09	.15	-	-	.16	.10	.09	.12	-
1975	.70	.48	.16	.16	2.41	.19	.11	.12	.15	.07	.40
1976	1.20	.70	.11	.13	3.57	.22	.12	.21	.15	.13	.30
NH_3-N (Ammonia nitrogen)											
1971	2.6	1.8	.40	-	-	-	-	-	-	-	-
1972	2.5	1.13	.33	.50	-	-	.32	.32	.33	.30	-
1973	.77	.59	.25	.15	-	-	.37	.15	.10	.15	-
1974	1.0	.60	.20	.20	-	-	.30	.20	.30	.20	-
1975	1.71	.90	.41	.35	4.44	5.50	.25	.17	.20	.25	1.28
1976	.76	.30	.10	.12	6.02	2.02	.15	.25	.22	.63	.87
Fecal Coliform*											
1971	-	-	-	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-	-	-	-
1973	8000	4700	172	325	-	-	1148	315	173	100	-
1974	22,000	9564	344	6758	-	-	2175	1390	185	349	-
1975	14,241	3980	161	397	1385	230	813	<204	300	<26	423
1976	1060	209	58	135	1420	42	361	249	227	34	245
Iron											
1971	1.50	1.30	.30	-	-	-	-	-	-	-	-
1972	1.91	1.84	1.80	1.07	-	-	1.05	.82	.80	1.3	-
1973	1.21	1.10	.87	.71	-	-	1.08	.82	.43	.5	-
1974	1.20	1.10	.60	.52	-	-	.99	.70	.60	.40	-
1975	1.98	2.02	.50	1.98	.44	6.87	.92	.68	.53	.59	11.84
1976	1.58	1.55	.70	.48	.59	5.82	.64	.65	.98	.64	4.44

*Geometric mean

These stations might be influenced by the surface runoff from a cattle feedlot, effluents from failing or improperly maintained septic tanks in the community of Cuba, seepage from an oxidation pond, and landfill leachate within the project property. Some changes in experimental sample design should be accomplished to provide information on suspected sources of contamination.

Comparing violations of Illinois standards during both time periods shows that the extent of violations has remained, for the most part, unchanged. This appears to indicate that stream water quality has not significantly deteriorated as a result of sludge application. This is corroborated by the trend analysis in Table V-3, which presents annual average for nitrite and nitrate nitrogen, total phosphorus, ammonia nitrogen, fecal coliforms, and iron in each stream station. The table shows no discernible trends in any parameter for any station, further indicating that stream water quality has remained unaffected by sludge application.

The number of violations reported at S2 correlates with that at S1, and water quality at both of these stations is strongly influenced by pollution sources upstream from S1, including effluent from the Canton Sewage Treatment Plant. Data did show that there have been effluent quality standard violations at the treatment plant as well as other sources in the Big Creek stretch between station S1 and the treatment plant. The new Canton treatment plant began operation in May 1976 and better quality water in Big Creek is expected.

The summary completed in 1977 indicates that downstream station S2 demonstrates better overall quality than station S1, indicating that dilution and instream purification occur along Big Creek between these two stations. This cleansing is, however, insufficient to reduce pollutants at S2 to acceptable levels. It must be emphasized that project influences on Big Creek water quality are difficult to assess because of the strong influence of treatment plant effluents, which tend to mask any project contributions that may exist. It can be stated, however, that because the "existing" water quality has been so poor, potential contributions from the project are of little concern.

The only parameters showing increased violations of standards in 1977 in S2 over S1 are sulfate and total dissolved solids (TDS). Although increased TDS may indicate that runoff basins provided for the sludge application fields have not been effective in removing dissolved solids, numerous other sources may be responsible for this increase.

The monitoring program was not designed to segregate sources affecting water quality and, as a result, no conclusion can be made regarding this observation.

The only biological water quality parameter measured at these monitoring stations is fecal coliform concentration. Fecal coliforms, while non-pathogenic, indicate that pathogenic organisms of fecal origin may be present in the water. Annual geometric mean fecal coliform concentrations are presented in Table V-3. This table shows that fecal coliform counts in most stations have been high but have not been increasing. High fecal coliform concentrations are probably due to contamination by human or animal waste in effluents from the Canton Sewage Treatment Plant (S1 and S2) and faulty septic tanks, and in runoff from cattle feedlots. The observation that these values have not been increasing indicates that sludge application is not responsible for high fecal coliform counts.

Fecal coliform concentrations generally decrease between stations S1 and S2 as demonstrated in Figure V-3. A natural decrease in S2 counts over high S1 counts (caused by pollutant sources upstream, including effluents from the Canton Sewage Treatment Plant) is expected to occur from die-off and dilution. The important issue is whether the observed decrease is less than the natural decrease would have been in the absence of sludge application. Although this issue cannot be resolved because of the many other sources of fecal coliforms in that area, valuable insight can be gained from a study performed by Lue-Hing et al, 1977. This study concerns bacterial levels in R3, S1, and S2 from 1972 to 1975. Station R3 is located at the discharge of Reservoir 3 which drains approximately 2000 hectares of the site, ultimately to the stretch of Big Creek between S1 and S2. The study reports that although total plate counts increased at all sampling sites from 1972 through 1975, levels of fecal coliforms in R3 were consistently one to one and one-half orders of magnitude lower than in Big Creek. Drainage from these 2000 hectares could, therefore, not have been responsible for poor water quality in Big Creek in terms of indicator organisms.

Due to the span of time between the printing of the Draft and Final EIS, water quality data from 1979 was reviewed to determine if any changes had taken place. The data was taken from the 1980 MSDGC operating report. Most parameters indicate that the water quality actually improves as it flows from sampling point S1 (above the project site) to sampling point S2 (below the project site). The only parameters to decline somewhat were total dissolved solids, calcium, sodium, chlorine and sulfate. This data is very encouraging but may not reflect any rainfall events or correlate with sludge spreading operations since the sampling was performed on November 6, 1979. A map (Figure V-4) and the data (Table V-4) follow.

The evidence points to the conclusion that sludge application has not affected stream water quality.

b. Water quality of reservoirs - Reservoir water quality is first generally analyzed; Table V-5 shows the overall minimum and maximum for all water quality constituents, collectively for all reservoirs. This analysis provides an indication of which parameters violate Illinois water quality standards. Table V-6 then presents trends in selected water quality constituents for specific reservoirs. Table V-5 shows that pH values and ammonia

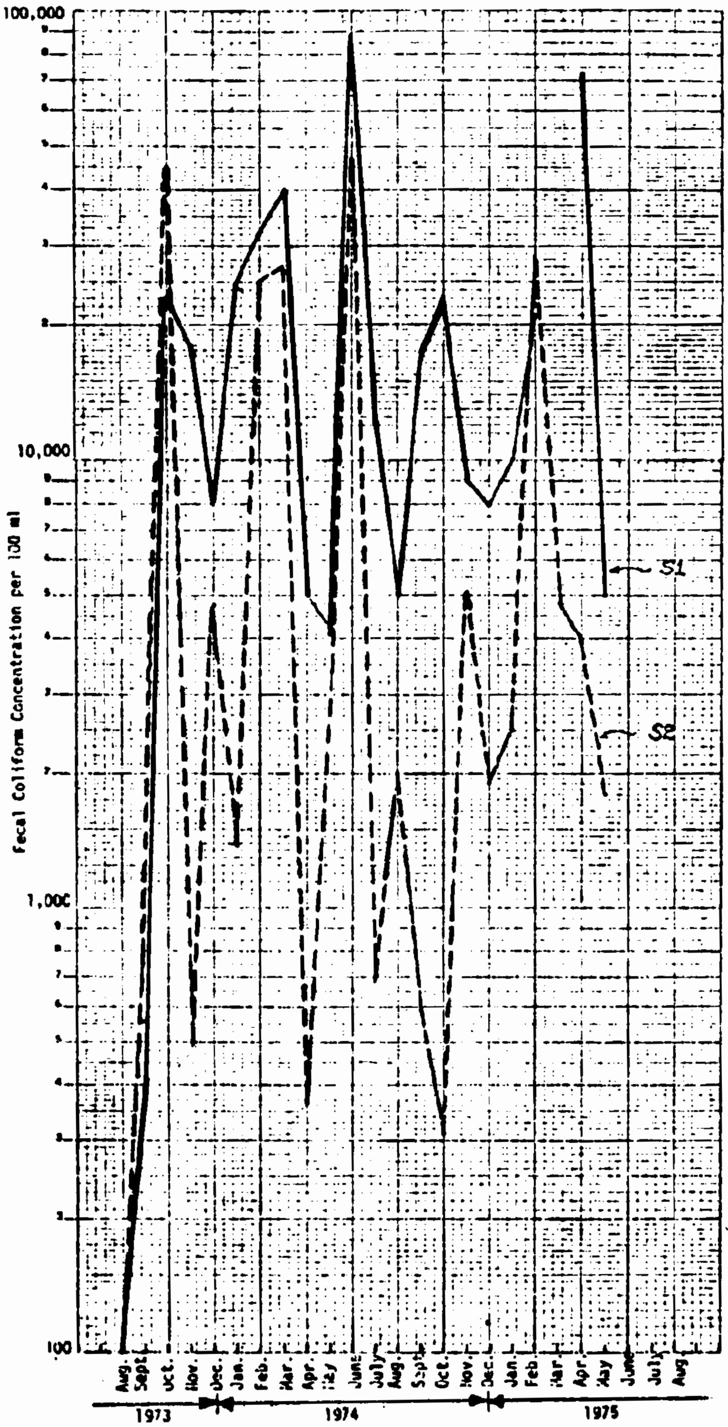


Figure V-3 Variation of Fecal Coliform Concentrations with Time for Stations S1 and S2 (MSDGC, 1972a through 1975q).

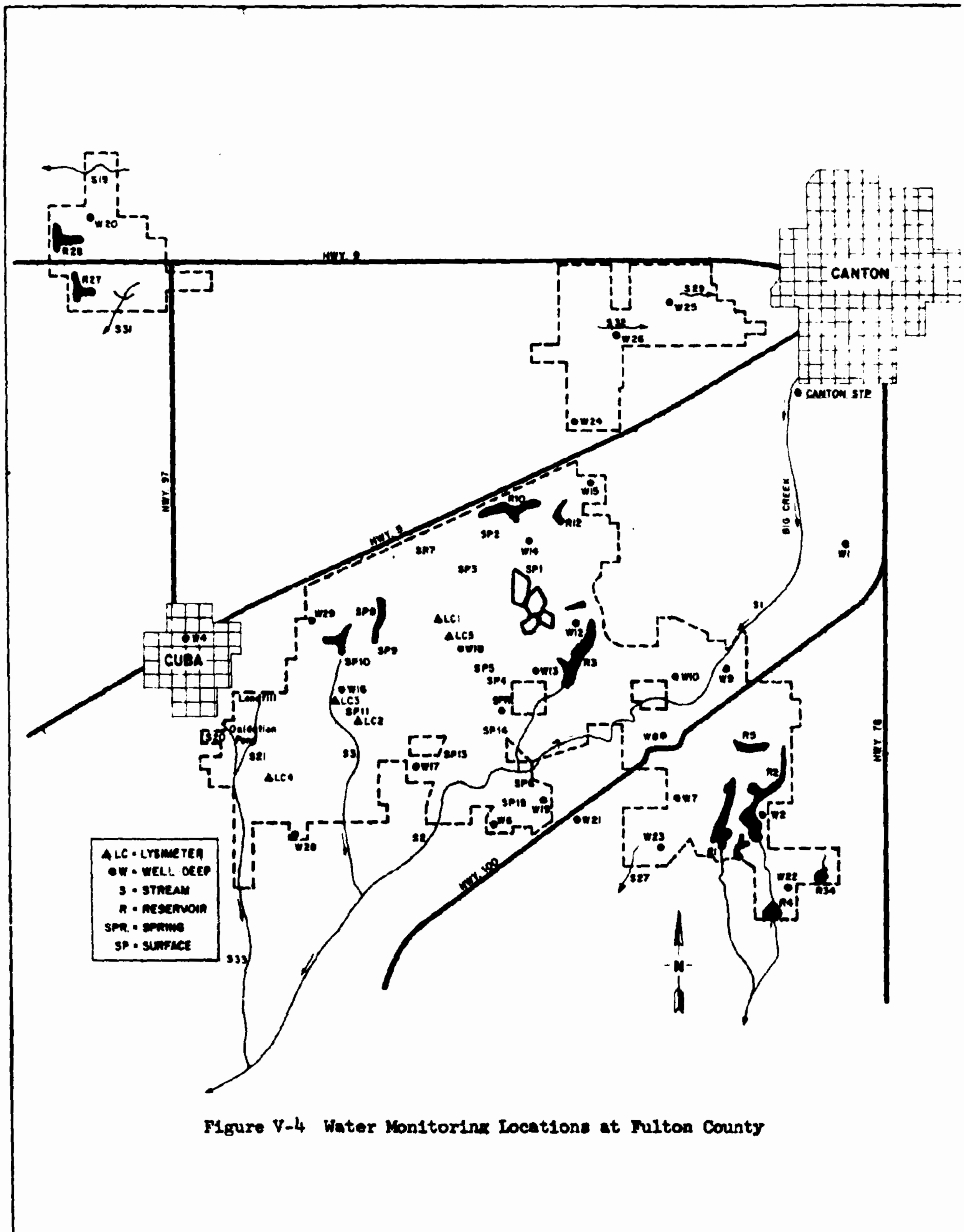


Figure V-4 Water Monitoring Locations at Fulton County

TABLE V-4

FULTON COUNTY LAND RECLAMATION PROJECT
WATER ANALYSIS - FULTON COUNTY
STREAM AND SPRING DATA
NOVEMBER 1979

STREAM NUMBER:			SPR	S1	S2	S3
DATE SAMPLED:		MDL*	11/ 5	11/ 6	11/ 6	11/13
PH			7.80	8.10	8.00	8.20
TOTAL P	MG/L	0.01	0.02	3.27	2.00	0.08
CL-	"	1.0	22.00	43.00	44.00	14.00
SO4=	"	1.0	306.00	447.00	521.00	1313.00
N-KJELDAHL	"	0.1	0.70	2.40	1.80	0.30
N-NH3	"	0.1	0.30	1.30	0.70	0.00
N-NO2+NO3	"	0.01	0.06	2.25	1.96	0.06
ALK AS CACO3	"	5.0	541.00	250.00	261.00	333.00
EL.COND.	UMHOS/CM		2500.00	1260.00	1440.00	1700.00
K	MG/L	1.0	8.00	7.00	8.00	7.00
NA	"	1.0	150.00	70.00	90.00	94.00
CA	"	1.0	410.00	228.00	110.00	210.00
MG	"	1.0	120.00	58.00	74.00	140.00
ZN	"	0.1	0.00	0.00	0.00	0.00
CD	"	0.01	0.00	0.00	0.00	0.00
CU	"	0.01	0.00	0.00	0.00	0.00
CR	"	0.02	0.00	0.00	0.02	0.06
NI	"	0.1	0.00	0.00	0.00	0.30
MN	"	0.01	1.23	0.20	0.19	0.27
PB	"	0.01	0.10	0.00	0.00	0.20
FE	"	0.1	2.30	0.70	0.70	1.00
AL	"	1.0	0.00	0.00	0.00	0.00
HG	UG/L	0.1	0.00	0.00	0.00	0.30
SE	MG/L	0.2	0.00	0.00	0.00	0.00
F. COLIFORM/100 ML		2	0.00	50.00	20.00	4.00
BOD	MG/L	0.5				
TSS	"		4.00	6.00	5.00	2.00
TDS	"		3096.00	1150.00	1299.00	2174.00

*MDL=MINIMUM DETECTION LIMIT OF LABORATORY. ALL VALUES LESS THAN THESE ARE REPORTED AS ZERO

TABLE V-4
(Cont'd)

FULTON COUNTY LAND RECLAMATION PROJECT
WATER ANALYSIS - FULTON COUNTY
STREAM AND SPRING DATA
NOVEMBER 1979

STREAM NUMBER:			S19	S20	S29	S31
DATE SAMPLED:			11/ 5	11/ 5	11/ 5	11/ 5
		MDL*				
PH			8.10	7.00	7.99	8.10
TOTAL P	MG/L	0.01	0.13	6.04	0.16	0.04
CL-	"	1.0	9.00	442.00	19.00	31.00
SO4=	"	1.0	586.00	560.00	1196.00	670.00
N-KJELDAHL	"	0.1	0.80	11.10	1.20	0.80
N-NH3	"	0.1	0.00	5.80	0.20	0.00
N-NO2+NO3	"	0.01	0.05	0.06	0.45	0.21
ALK AS CACO3	"	5.0	290.00	304.00	391.00	212.00
EL.COND. UMHOS/CM			1120.00	3000.00	1400.00	2000.00
K	MG/L	1.0	4.00	18.00	6.00	2.00
NA	"	1.0	20.00	470.00	74.00	52.00
CA	"	1.0	110.00	170.00	140.00	230.00
MG	"	1.0	79.00	60.00	100.00	120.00
ZN	"	0.1	0.00	0.00	0.00	0.10
CD	"	0.01	0.00	0.00	0.00	0.00
CU	"	0.01	0.00	0.00	0.00	0.02
CR	"	0.02	0.00	0.00	0.00	0.00
NI	"	0.1	0.10	0.10	0.10	0.10
MN	"	0.01	0.39	0.13	0.15	0.80
PB	"	0.01	0.10	0.00	0.10	0.00
FE	"	0.1	0.90	1.40	0.60	1.70
AL	"	1.0	1.00	0.00	1.00	1.00
HG	UG/L	0.1	0.00	0.00	0.00	0.00
SE	MG/L	0.2	0.00	0.00	0.00	0.00
F. COLIFORM/100 ML		2	10.00	220.00	0.00	430.00
BOD	MG/L	0.5		19.00		
TSS	"		3.00	48.00	6.00	4.00
TDS	"		1159.00	2398.00	1508.00	2344.00

*MDL=MINIMUM DETECTION LIMIT OF LABORATORY. ALL VALUES LESS THAN THESE ARE REPORTED AS ZERO

TABLE V-4
(Cont'd)

FULTON COUNTY LAND RECLAMATION PROJECT
WATER ANALYSIS - FULTON COUNTY
STREAM AND SPRING DATA
NOVEMBER 1979

STREAM NUMBER:			S32	S33
DATE SAMPLED:			11/ 5	11/ 5
		MDL*		
PH			8.00	8.10
TOTAL P	MG/L	0.01	0.00	0.11
CL-	"	1.0	37.00	179.00
SO4=	"	1.0	1225.00	1232.00
N-KJELDAHL	"	0.1	0.50	0.80
N-NH3	"	0.1	0.00	0.00
N-NO2+NO3	"	0.01	0.25	0.86
ALK AS CACO3	"	5.0	753.00	302.00
EL.COND. UMHOS/CM			2700.00	2500.00
K	MG/L	1.0	0.00	6.00
NA	"	1.0	150.00	220.00
CA	"	1.0	110.00	200.00
MG	"	1.0	90.00	100.00
ZN	"	0.1	0.00	0.10
CD	"	0.01	0.00	0.00
CU	"	0.01	0.00	0.00
CR	"	0.02	0.00	0.00
NI	"	0.1	0.10	0.10
MN	"	0.01	0.02	2.49
PB	"	0.01	0.00	0.10
FE	"	0.1	0.30	0.60
AL	"	1.0	1.00	0.00
HG	UG/L	0.1	0.20	0.00
SE	MG/L	0.2	0.00	0.00
F. COLIFORM/100 ML		2	0.00	250.00
BOD	MG/L	0.5		
TSS	"		10.00	7.00
TDS	"		2781.00	2477.00

*MDL=MINIMUM DETECTION LIMIT OF LABORATORY. ALL VALUES LESS THAN THESE ARE REPORTED AS ZERO

Table V-5 Water Quality of Reservoirs (MSDGC, 1972a through 1975g; General Water Quality Standards for Illinois' Waters)

Water Quality Parameter and Unit	Reservoir Samples 1971	1972	1973	1974	1975	1976	Illinois Surface Water Quality Standards
pH	6.9-10.1	6.9-10.0	7.3-8.9	7.3-9.0	6.9-9.0	7.1-9.0	6.5-9.0
Total P (mg/l)	0-1.2	0-1.20	0.02-0.73	0-2.60	0-1.1	0-.32	≤0.05
Cl (mg/l)	1-30	1-30	5-20	2-312	2-130	3-52	≤500
SO_4 (mg/l)	4-1508	4-1,508	16-781	13-1,160	13-1013	0-1057	≤500
N-Kjeldahl (mg/l)	0-23	0-4.4	0-2.4	0-4.5	0-7.6	0-4.7	--
NH_3-N (mg/l)	.1-1.5	0.1-1.5	0-1.07	0-2.0	0-5.7	0-4	≤1.5
NO_3+NO_3-N (mg/l)	0-1.1	0-1.10	0-8.30	0-6.30	.01-15.50	0-7.9	--
Alkalinity (as $CaCO_3$) (mg/l)	70-580	70-580	80-500	56-530	30-900	49-490	--
Conductivity (mho)	120-2500	120-2,500	300-3,340	570-2,300	300-2000	250-2900	--
Ca (mg/l)	9-360	9-360	45-367	45-550	20-418	35-250	--
K (mg/l)	2-12.7	0-13	1-8	2-10	1-10	.1-11	--
Na (mg/l)	1-535	1-535	9-229	9-265	9-219	4-241	--
Al (mg/l)	--	--	0-3.77	0-4.0	0-6	0-4	--
Cd (mg/l)	0-.1	0-0.1	0-0.02	0-0.03	0-.02	0-.05	≤0.05
Cr (mg/l)	0-.11	0-0.11	0-0.02	0-0.03	0-.1	0-.12	Cr(+6)≤0.05 Cr(+3)≤1.0
Cu (mg/l)	0-.15	0-0.16	0-0.13	0-0.08	0-.02	0-.15	≤0.02
Fe (mg/l)	0-3.6	0-3.6	0-1.9	0-9.2	0-22	0-4	≤1.0
Pb (mg/l)	0-.31	0-0.31	0-0.33	0-0.27	0-.13	0-.6	≤0.1
Mg (mg/l)	10-483	10-483	34-132	35-162	20-137	17-155	--
Mn (mg/l)	0-1.19	0-1.19	0-1.22	0-1.55	0-1.23	0-3.48	≤1.0
Hg (ug/l)	0-.9	0-0.9	0-0.8	0-3.0	0-3.2	0-2	≤0.5
Ni (mg/l)	0-.38	0-0.38	0	0-0.1	0-14	0-.2	≤1.0
Zn (mg/l)	0-.6	0-0.6	0	0-0.4	0-.2	0-.9	≤1.0
T.S.S. (mg/l)	--	--	--	0-231	1-350	1-141	--
T.D.S. (mg/l)	--	--	--	422-2,092	189-6940	302-2467	≤1,000
Fecal Coliforms (1/100 ml)	<2-4000	0->7,000	0-7,600	0-1,500	0-4100	0-5600	≤200 (geometric mean)
D.O. (mg/l)	6.2-20	6.0-20.0	5.6-15.6	8.4-15.3	4.9-14.2	6.5-17	≥5 (anytime)

Table V-6 The NO_2+NO_3-N, NH_3-N, Phosphorus, Iron, and Fecal Coliform Content of Reservoirs for 1971 - 1976 (Zenz etal., 1976; Enviro Control, 1977; MSDGC)

Constituent	Year	R1	R2	R3	R4	R10	R12	R27	R28	R34
NO_2 + NO_3-N	1971	.16	.32	.16	—	.09	.08	—	—	—
	1972	.07	.17	.09	.04	.09	.11	.09	—	.94
	1973	.05	.35	.48	.24	.11	.35	.13	.09	2.85
	1974	.17	.69	.65	.05	.30	.70	.07	.04	2.90
	1975	1.48	.92	1.26	1.27	.27	1.17	.08	.16	3.51
	1976	.60	.39	1.26	.22	.08	2.50	.16	.11	1.96
Phosphorus	1971	.20	.26	.29	—	.1	.16	—	—	—
	1972	.10	.09	.13	.12	.07	.06	.08	—	.48
	1973	.12	.09	.30	.16	.15	.12	.17	.11	.21
	1974	.06	.07	.09	.09	.06	.06	.29	.07	.17
	1975	.08	.11	.18	.22	.06	.05	.08	.06	.16
	1976	.10	.10	.14	.13	.08	.08	.11	.09	.16
NH_3-N	1971	.30	.3	.4	—	.4	.5	—	—	—
	1972	.20	.3	.2	.4	.2	.3	.2	—	1.0
	1973	.13	.14	.3	.3	.08	.16	.10	.06	.59
	1974	.10	.20	.4	.2	.2	.4	.10	.10	.7
	1975	.27	.17	.42	.18	.21	.22	.16	.13	1.11
	1976	.26	.11	.24	.12	.09	.16	.19	.14	.66
Fecal Coliform	1971	—	—	7	—	—	—	—	—	—
	1972	—	—	5	—	—	—	—	—	—
	1973	5	19	6	34	11	11	18	5	196
	1974	10	38	18	56	17	85	24	5	620
	1975	5	5	7	18	6	3	8	3	371
	1976	3	5	5	7	6	6	5	2	63
Fe (Iron)	1971	.16	.2	.4	—	.28	.1	—	—	—
	1972	.4	.3	.4	.9	.2	.5	.3	—	2.0
	1973	.2	.34	.3	.9	.34	.26	.38	.30	1.3
	1974	.2	.3	.1	1.1	.3	.3	.17	.12	1.6
	1975	2.07	.24	.32	1.12	.43	.43	.29	.23	1.68
	1976	.27	.27	.33	1.32	.34	.29	.57	.39	1.06

nitrogen levels in these reservoirs generally conform to Illinois water quality standards. Concentrations of chlorides and metals such as cadmium, chromium, nickel and zinc are normally within state standards. The reservoirs do, however, exhibit high levels of total phosphorus, sulfate, copper, iron, lead, manganese and mercury which violate Illinois standards, as well as occasionally elevated levels of inorganic nitrogen. A comparison of these violations to those recorded in 1971 and 1972, before significant amounts of sludge were applied, reveals that the same parameters have shown consistent violations during both time periods. These violations cannot, therefore, be attributed to sludge application but rather to surface runoff over strip-mined areas or sources probably unrelated to project operations.

High salt content often increases the level of total dissolved solids above the standard. This parameter was not monitored until 1974, however, and no comparison can be made to pre-project conditions. Fecal coliform concentrations in all reservoirs have remained generally low, indicating that the treated and aged sludge applied to the fields has a low fecal coliform level and/or the runoff retention basins are effective in removing fecal bacteria.

Annual average values for total phosphorus, ammonia-nitrogen, nitrite and nitrate nitrogen, iron, and fecal coliforms are presented in Table V-6 for reservoirs R1, R2, R3, R4, R10, R12, R27, R28, and R34. R5 was excluded from the trend analysis because sampling data are unavailable before 1975.

Table V-6 shows no trends in any reservoir for phosphorus, ammonia, iron, or fecal coliforms. Nitrite and nitrate nitrogen levels in reservoirs R3 and R12, however, have been rising. Although both reservoirs are located in the vicinity of fields applied with sludge during the earlier stages of the project, it is difficult to attribute nitrite and nitrate nitrogen increases to any particular source; for example, R3 receives drainage from other pastures and croplands. The drinking water standard for ammonia nitrogen (which does not apply to this situation and is mentioned here only as a measure of the potential significance of the upward trend) is 10 milligrams per liter. Throughout the life of the project, this level has never been exceeded in R3 and R12, and in fact has been exceeded in all the reservoirs only once, when reservoir R34 was shown to contain 15.50 milligrams per liter in December 1975.

Dissolved oxygen (D.O.) concentrations determine the capacity of a water body to support aquatic life. The State of Illinois specifies that a minimum of 6 milligrams per liter of D.O. must be maintained for 16 hours of a 24-hour period, and a minimum of 5 milligrams per liter of D.O. must be maintained at all times. The D.O. status of reservoirs R1, R2 and R3 are discussed below. Data are unavailable for the other reservoirs.

D.O. levels, average water temperatures, and average theoretical saturation values of D.O. in the three reservoirs are presented in Figure V-5. As the

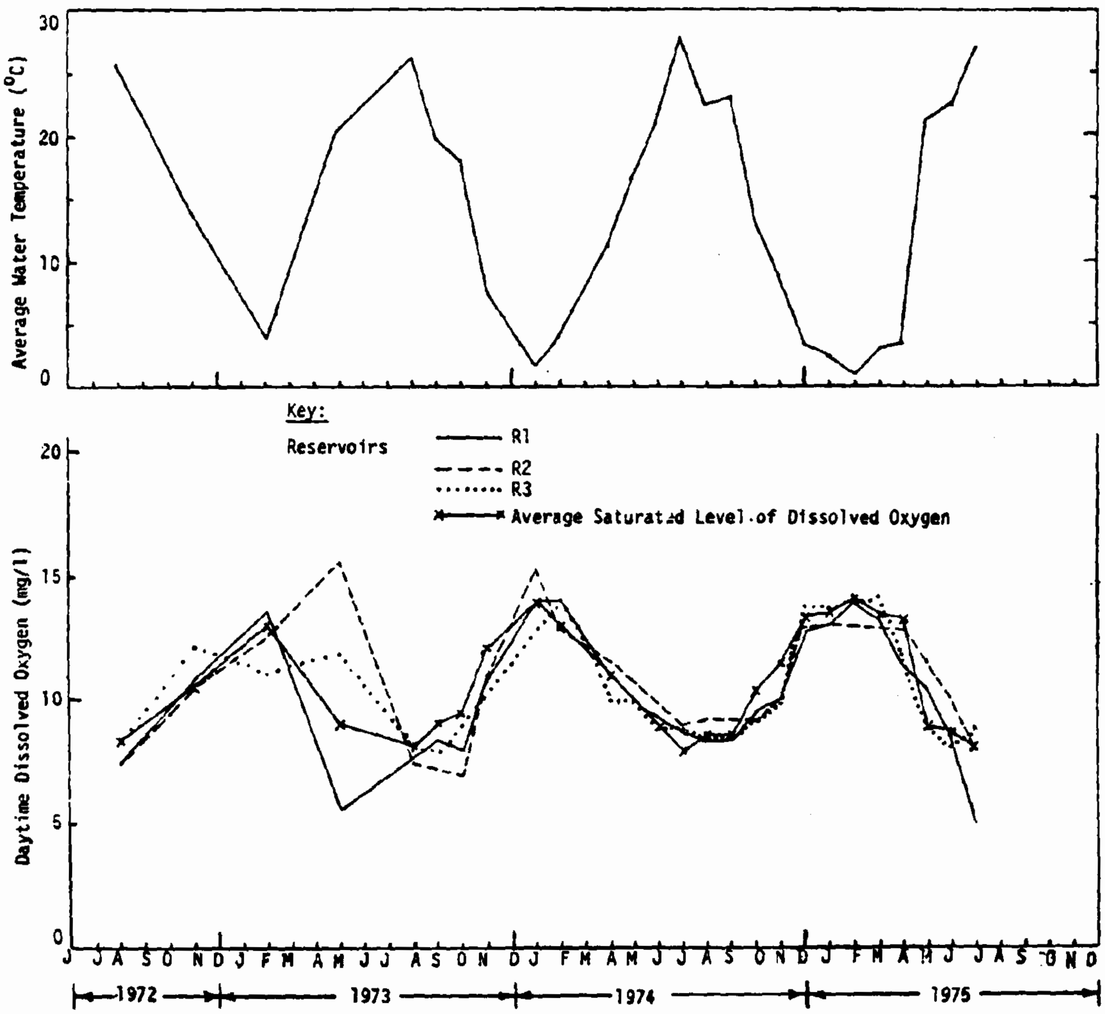


Figure V-5 Reservoir Water Temperature and Level of Dissolved Oxygen. (D.O.) (MSDGC, 1972a through 1975g; and Enviro Control, Inc. 1976).

data indicate, D.O. levels are generally higher than the minimum standard of 5 milligrams per liter. The D.O. levels of all three reservoirs form a typical seasonal pattern, with D.O. peaking in winter and at a minimum in summer. This cyclic pattern is, as expected, opposite to the seasonal variation of reservoir temperature. D.O. levels are close to the average theoretical saturation values, and are therefore predominantly influenced by water temperature and the reservoir mixing characteristics. The reservoirs probably have not received large inputs of oxygen-demanding pollutants such as carbonaceous and nitrogeneous organic materials.

During May 1973 and July 1975, D.O. levels dropped below 6 milligrams per liter in reservoir R1, which receives runoff basin effluents from sludge application fields #26, #27, #28, and #30. Sludge was not applied to these fields until August 1974. Runoff retention basin B-30-2 discharged into reservoir R1 after the reservoir water was sampled on July 9, 1975. Therefore, no connection between observed low D.O. concentrations in reservoir R1 and the project operation can be established.

The reservoir data for 1979 indicated that at no time did the D.O. level fall below 5 milligrams per liter.

During the summer, when ambient temperatures are high and D.O. saturation levels are low, nighttime D.O. levels may be much lower than daytime levels. This is attributable to the continued depletion of D.O. by planktonic respiration while photosynthetic oxygen regeneration is absent. Nighttime monitoring of D.O. is therefore essential to complete the assessment of possible environmental impacts resulting from project operations.

c. Water quality and capacity of runoff basins - More than 50 runoff retention basins have been constructed within the project property as of July 1975. With the exception of field #38, on which sludge was applied in October 1974, all fields receiving or scheduled to receive sludge are provided with at least one basin. Each runoff basin is coded with the same number as the field it serves, with a sub-number when more than one basin is provided for a particular field. For example, basin B-20-3 represents basin #3 of field #20.

Effluent quality - The criteria for field runoff basin effluent discharge was developed by the Illinois EPA (IEPA). The IEPA operating permit issued in 1974 was appended with the following two conditions which regulate the effluent quality from retention basins.

(1) SPECIAL CONDITION #9: The effluent discharge from any retention basin approved under this permit must meet the applicable effluent requirement for discharge to the waters of the State as required by Illinois Pollution Control Board Rules and Regulations Chapter 3. The point of discharge to the waters of the State is considered to be the overflow structure of each of the retention basins.

(2) SPECIAL CONDITION #10: This permit is issued with the condition that the following contaminant concentrations are considered to be

background values and the numerical effluent standards shall be considered met at the designated effluent sampling point described in Special Condition #9 when the background concentration plus the allowable regulatory concentration is greater than the measured concentration for the appropriate parameters:

Illinois EPA background Concentrations for Field Runoff Retention Basins Discharges at the District Site in Fulton County, Illinois

	Total Suspended Solids (mg/l)	BOD (mg/l)	Fecal Coliform (counts) / 100 ml
Arithmetic Mean	61.7	2.75	-
Standard Deviation	87.3	1.48	-
Geometric Mean	-	-	94.3

The applicable effluent standards by which the District is currently operating these field runoff retention basins, therefore, are TSS ≤99 mg/l, BOD ≤ 33 mg/l, and fecal coliform ≤494 counts/100 ml. The average quality of the effluent from these basins must conform to these criteria to qualify for release. These values are arrived at by adding the background values (above) to the "secondary treatment" effluent requirements of 37 mg/l TSS, 30 mg/l BOD, and 400 counts/100 ml.

Effluent quality of a runoff basin is analyzed whenever there is a discharge. The discharge of effluents from the runoff basin is necessary to reduce the water level even in the absence of sludge application. The arithmetic or geometric mean, maximum, and minimum levels of TSS, BOD, and fecal coliforms in each runoff basin are presented in Table V-7.

Discharge from runoff basins occurs intermittently and rarely more than once a month. Therefore, the effects of a discharge upon the receiving reservoir or creek probably diminish to insignificant levels when the subsequent discharge is made.

<u>Storm runoff capacities</u> - Runoff basins were constructed to provide a retention capacity for runoff from a 100-year storm. The purpose of the basins is to retain runoff from application fields for the length of time required to meet standards before the runoff water is discharged. Project designs called for the recycling of substandard basin water by pumping to the application field, but records indicate this has never been done. One way in which the effectiveness of runoff basins in containing 100-year storm runoff can be calculated is by comparing the design capacity of the basins with the anticipated volume of storm runoff. The 24-hour runoff volumes for 25-year and 100-year storms are calculated using SCS runoff

Table V-7 Effluent Quality of Runoff Retention Basins (MSDGC, 1972a through 1975g; and Enviro Control, Inc., 1976)

	Parameter	Effluent Standard	Runoff Retention Basin										
			B-1-1	B-2-1	B-2-2	B-2-3	B-3-1	B-4-1	B-4-2	D-5-1	B-6-1	B-7-1	B-7-2
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	5	4	8	9	25	16	1	14	3	2	6
	No. of Violations		0	0	1	2	7	1	0	2	1	2	0
	Mean (mg/l)		22.2	9	35.5	33.3	49.1	13.7	10	86.5	78	92.5	21.3
	Maximum (mg/l)		36	16	43	82	353	220	--	644	184	93	52
	Minimum (mg/l)		9	4	10	7	1	1	--	5	8	92	8
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall not exceed 6.75 mg/l	5	4	8	8	19	12	1	13	2	--	4
	No. of Violations		3	1	3	1	9	6	1	10	0	--	2
	Mean (mg/l)		9.2	7.3	9.1	4.5	12.9	10.9	21	11.2	2.5	--	7
	Maximum (mg/l)		13	16	29	8	66	23	--	32	3	--	11
	Minimum (mg/l)		4	2	2	2	2	1	--	1	2	--	5
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	5	4	8	9	26	12	1	13	2	1	4
	No. of Violations		0	0	0	0	2	0	0	1	1	0	0
	Geo. Mean (1/100 ml)		23	14	16	22	74	12	80	31	31	180	25
	Maximum (1/100 ml)		60	40	20	130	2,000	180	--	1,300	1300	--	130
	Minimum (1/100 ml)		<10	<10	<10	2	2	<10	--	2	2	--	<10

	Parameter	Effluent Standard	Runoff Retention Basin										
			B-7-3	B-8-1	B-8-2	B-9-1	B-9-2	B-9-3	B-10-1	B-10-2	B-11-1	B-12-1	B-13-1
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	12	12	7	21	11	3	3	1	8	5	4
	No. of Violations		1	4	3	0	3	1	0	0	4	0	0
	Mean (mg/l)		32.6	49.4	122.1	30.8	43.1	77.3	29	41	58.6	29	36.3
	Maximum (mg/l)		127	101	148	64	94	218	38	--	89	50	49
	Minimum (mg/l)		4	5	17	3	11	6	22	--	28	8	21
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall not exceed 6.75 mg/l	10	10	6	16	4	--	3	1	8	5	4
	No. of Violations		4	5	1	6	0	--	2	0	8	3	3
	Mean (mg/l)		6.3	6.5	5	7.9	4.5	--	7.7	6	15	10	9.3
	Maximum (mg/l)		14	14	12	22	5	--	11	--	34	22	14
	Minimum (mg/l)		2	2	2	1	3	--	5	--	7	2	3
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	11	11	6	19	7	1	3	1	8	5	4
	No. of Violations		0	1	0	4	1	0	0	0	0	0	0
	Geo. Mean (1/100 ml)		26	26	14	46	85	<10	17	<10	25	14	21
	Maximum (1/100 ml)		160	520	130	840	500	--	50	--	150	30	190
	Minimum (1/100 ml)		2	<10	2	2	2	--	<10	--	<10	<10	<10

Table V-7 Continued

Parameter		Effluent Standard	Runoff Retention Basin										
			B-13-2	B-14-1	B-15-1	B-16-1	B-17-1	B-17-2	B-19-1	B-20-1	B-20-2	B-20-3	B-21-1
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	2	0	6	8	9	4	5	13	7	7	4
	No. of Violations		0	--	2	0	2	2	2	0	3	1	0
	Mean (mg/l)		16	--	35.5	15.3	40.1	40.1	63.8	79.8	108.6	34.7	26.3
	Maximum (mg/l)		26	--	76	30	153	68	100	59	312	37	62
	Minimum (mg/l)		6	--	10	2	1	31	20	3	17	1	6
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall Not exceed 6.75 mg/l	2	0	6	8	6	3	4	10	6	4	2
	No. of Violations		0	--	3	7	1	2	2	5	4	1	0
	Mean (mg/l)		4	--	8.2	10.3	3.5	16.7	7.5	6.3	18.8	5	2
	Maximum (mg/l)		5	--	17	20	7	38	12	10	73	7	3
	Minimum (mg/l)		3	--	3	3	2	3	3	3	2	3	1
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	2	0	6	8	9	4	4	11	6	5	5
	No. of Violations		0	--	1	0	0	0	0	0	1	1	1
	Geo. Mean (1/100 ml)		33	--	69	22	17	15	34	15	32	21	36
	Maximum (1/100 ml)		190	--	5,000	160	190	50	70	80	2,8[illegible]	1,000	2,800
	Minimum (1/100 ml)		<10	--	<10	<10	<10	<10	<10	<10	2	2	2

Parameter		Effluent Standard	Runoff Retention Basin										
			B-22-1	B-22-2	B-23-1	B-25-1	B-25-2	B-26-1	B-26-2	B-27-1	B-27-2	B-28-1	B-30-1
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	20	12	0	3	1	5	6	4	4	5	5
	No. of Violations		0	4	--	0	0	0	0	0	0	0	0
	Mean (mg/l)		16.4	81.9	--	15.3	6	23.6	17	11.8	13.3	23.4	12
	Maximum (mg/l)		34	188	--	25	--	45	32	26	19	61	17
	Minimum (mg/l)		4	2	--	9	--	3	8	5	6	4	5
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall not exceed 6.75 mg/l	11	6	0	3	1	5	6	4	4	5	5
	No. of Violations		7	3	--	0	0	2	3	0	0	3	2
	Mean (mg/l)		8.5	7.2	--	5.7	4	6.6	6.8	5	5.75	8.6	6.4
	Maximum (mg/l)		16	11	--	6	--	11	12	5	7	14	9
	Minimum (mg/l)		3	3	--	5	--	4	4	5	4	4	4
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	16	11	0	3	1	5	6	4	4	5	5
	No. of Violations		0	0	--	0	0	0	0	1	0	0	0
	Geo. Mean (1/100 ml)		16	49	--	<10	<10	12	26	71	<10	21	<10
	Maximum (1/100 ml)		320	400	--	--	--	20	100	2,600	--	130	--
	Minimum (1/100 ml)		2	<10	--	--	--	<10	<10	<10	--	<10	--

Table V-7 Continued

	Parameter	Effluent Standard	Runoff Retention Basin										
			B-30-2	B-31-1	B-32-1	B-33	B-34-1	B-34-2	B-35-1	B-36-1	B-37-1	B-39-1	B-40-1
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	6	0	0	0	0	0	0	0	0	3	2
	No. of Violations		0	--	--	--	--	--	--	--	--	0	0
	Mean (mg/l)		16.5	--	--	--	--	--	--	--	--		
	Maximum (mg/l)		28	--	--	--	--	--	--	--	--		
	Minimum (mg/l)		6	--	--	--	--	--	--	--	--		
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall not exceed 6.75 mg/l	6	0	0	0	0	0	0	0	0	3	2
	No. of Violations		2	--	--	--	--	--	--	--	--	1	0
	Mean (mg/l)		6.3	--	--	--	--	--	--	--	--		
	Maximum (mg/l)		9	--	--	--	--	--	--	--	--		
	Minimum (mg/l)		4	--	--	--	--	--	--	--	--		
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	6	0	0	0	0	0	0	0	0	3	2
	No. of Violations		0	--	--	--	--	--	--	--	--	0	0
	Geo. Mean (1/100 ml)		<10	--	--	--	--	--	--	--	--		
	Maximum (1/100 ml)		--	--	--	--	--	--	--	--	--		
	Minimum (1/100 ml)		--	--	--	--	--	--	--	--	--		

Table V-7 Continued

	Parameter	Effluent Standard	Runoff Retention Basin										
			B-41-1	B-42-1	B-42-2	B-43-1	B-44-1	B-45-1	B-47-1				
Total Suspended Solids	No. of Observations	Arithmetic mean of TSS shall not exceed 66.7 mg/l	3	2	4	3	5	3	3				
	No. of Violations		1	0	0	0	2	0	0				
	Mean (mg/l)												
	Maximum (mg/l)												
	Minimum (mg/l)												
Biological Oxygen Demand	No. of Observations	Arithmetic mean of BOD shall not exceed 6.75 mg/l	3	2	4	3	5	3	3				
	No. of Violations		1	2	2	2	1	0	1				
	Mean (mg/l)												
	Maximum (mg/l)												
	Minimum (mg/l)												
Fecal Coliforms	No. of Observations	Geometric mean of fecal coliforms shall not exceed 494.3 per 100 ml	3	2	4	3	5	3	3				
	No. of Violations		0	0	0	0	0	0	0				
	Geo. Mean (1/100 ml)												
	Maximum (1/100 ml)												
	Minimum (1/100 ml)												

curve number 98, assuming low soil permeability and no conservation practices, evapotranspiration or depression storage. Although assumptions result in slightly overestimating storm runoff, the evaluation of retention basin effectiveness also assumes that the basins are completely empty prior to each storm, and that the basin capacities are not diminished by sedimentation of suspended solids from previous storm runoff. The effectiveness of a runoff basin is seriously impaired when a storm occurs before the basin is entirely empty. Emptying the basins before a predicted storm may cause bottom sediment contaminated with sludge particles to be discharged to the receiving water.

Table V-8 summarizes the design capacity of each retention basin and calculated storm runoff volume for 25 and 100-year storms. From these calculations the retention basins for fields 3, 14, 20, and 21 appear unable to contain the 25-year storm runoff and basins for fields 4, 7, 11, 12, 19, 22, 25, 26, 29, 30, 39, 40, 42, 43, 44, 45, and 47 are unable to contain the 100-year storm runoff. Actual field observations indicate that these may not be the worst case events. The worst case may occur when basins are partially full prior to application, the ground becomes saturated by application and then intermittent heavy rainfall occurs within several days. This was observed in September 1977.

Some deficiencies between correlation of calculated retention basin capacities and observed deficiencies can be explained in terms of variables ranging from characteristics of storm to the condition of the soil at the time of storm. However, the most likely explanation lies in the applicability of the SCS method to the project site. The SCS method as used here provides the amount of runoff that can be expected on the basis of "average site characteristics". Ideally, a different runoff curve should be applied to each field, depending on local hydrologic conditions of the soil, soil type, soil depth, type of crop grown, conservation treatment, and many other factors. These factors must be considered at Fulton County, where each retention basin is tailored to the runoff volume expected from a particular field. Other sources of error can likely be found in predicting the portion of a field draining into each of its retention basins, as explained above with respect to field #2. Runoff basins with inadequate capacity for containing 100-year storm runoff as well as runoff from recurring, high intensity storms, are particularly ineffective in removing suspended solids from storm runoff. Numerous violations of effluent standards for total suspended solids and biochemical oxygen demand show that the runoff retention basins have been ineffective. Prolonged violations could result in siltation and excess dissolved oxygen depletion in receiving waters.

2. Groundwater quality

Groundwater quality was assessed from samples collected from 26 wells and one spring during a six year period. The ideal approach to groundwater analysis would have included a designation of background wells measuring natural parameter variations and a trend analysis among remaining wells before and after sludge application. Unfortunately, this could not be accomplished in a comprehensive fashion for Fulton County. First, this

Table V-8 Capacity of Runoff Retention Basins and Volume of 24-Hour Storm Runoff (MSDGC 1972c through 1972g and 1973i through 1973k; Enviro Control, Inc., 1976)

Runoff Retention Basins

Field Number	Basin	Capacity Per Basin (acre-ft)	Capacity Per Field (acre-ft)	Calculated 24-Hr. Runoff (acre-ft.) 25-Yr. Storm	100-Yr. Storm
1	B-1-1	24.4	24.4	15.0	19.6
2	B-2-1	21.5			
	B-2-2	4.1	28.5	16.9	22.1
	B-2-3	2.9			
3	B-3-1	12.9	12.9	13.3	17.4
4	B-4-1	25.9			
	B-4-2	6.2	32.1	26.0	34.0
5	B-5-1	15.3	15.3	9.8	12.8
6	B-6-1	6.6	6.6	4.8	6.4
7	B-7-1	5.9			
	B-7-2	16.0	38.9	35.8	46.8
	B-7-3	17.0			
8	B-8-1	25.2			
	B-8-2	6.4	31.6	23.1	30.2
9	B-9-1	43.2			
	B-9-2	13.7	61.8	56.9	74.4
	B-9-3	4.9			
10	B-10-1	21.5	44.5	30.6	40.0
	B-10-2	23.0			
11	B-11-1	8.0	8.0	6.8	8.9
12	B-12-1	11.0	11.0	8.8	11.5
13	B-13-1	9.5	48.5	5.1	15.3
	B-13-2	39.5			
14	B-14-1	14.3*	14.3	22.8	29.8
15	B-15-1	10.5	10.5	7.2	9.4
16	B-16-1	70.3	70.3	48.8	63.8
19	B-19-1	14.2	14.2	12.4	16.2
20	B-20-1	15.0			
	B-20-2	11.2	35.0	37.1	48.5
	B-20-3	8.8			

Table V-8 continued

Field Number	Basin	Capacity Per Basin (acre-ft)	Capacity Per Field (acre-ft)	Calculated 24-Hr. Runoff (acre-ft.) 25-Yr. Storm	100-Yr. Storm
21	B-21-1	4.5	4.5	12.7	16.6
22	B-22-1	13.7	21.6	16.9	22.1
	B-22-2	7.9			
23	B-23-1	14.9	14.9	7.2	9.4
25	B-25-1	6.9	14.4	12.4	16.2
	B-25-2	7.5			
26	B-26-1	13.8	22.6	20.8	27.2
	B-26-2	8.8			
27	B-27-1	17.5	24.6	14.0	18.3
	B-27-2	7.1			
28	B-28-1	13.5	13.5	10.1	13.2
29	B-29-1	14.9	14.9	12.7	16.6
30	B-30-1	7.2	27.3	22.4	29.3
	B-30-2	20.1			
31	B-31-1	9.3	9.3	6.0	7.9
32	B-32-1	15.8	15.8	11.1	14.5
33	B-33	*			
34	B-34-1	26.4	38.7	23.3	30.4
	B-34-2	12.3			
35	B-35-1	14.2**			
36	B-36-1	78.8	93.0	59.0	77.1
37	B-37-1	35.7	35.7	22.4	29.3
38	NA	NA	NA	17.6	23.0
39	B-39-1	14.6	14.6	13.7	17.9
40	B-40-1	30.7	30.7	26.7	34.9
41	B-41-1	23.3	23.3	17.9	23.4

Table V-8 continued

Field Number	Basin	Capacity Per Basin (acre-ft)	Capacity Per Field (acre-ft)	Calculated 24-Hr. Runoff (Acre-ft.) 25-Yr. Storm	100-Yr. Storm
42	B-42-1	33.3	57.7	52.7	68.9
	B-42-2	24.4			
43	B-43-1	23.1	23.1	19.2	25.1
44	B-44-1	11.6	11.6	11.1	14.5
45	B-45-1	48.1	48.1	47.5	62.1
47	B-47-1	12.5	12.5	9.8	12.8

Note: NA - Not Available
*Field #33 drains its runoff to Retention Basin B-32-1 of Field #32.
**Field #35 drains its eastern portion of runoff to Retention Basin B-36-1 of Field #36.
*Field #14 drains some of its runoff to basins serving fields #13 and #16.

would have required a highly detailed and presently unavailable tracing of groundwater flow. Secondly, sludge application was initiated at different times and rates on each field, making a clear cut definition of "before and after" impossible. Technology currently exists to measure groundwater flow and direction. This could be utilized if it becomes necessary to isolate a groundwater pollution source.

While this type of analysis could not be conducted comprehensively, certain wells were selected to represent a cross section of those in the mine spoil area of the site, an analysis of which was not constrained by the above problems. It must be emphasized that this analysis does not at this stage provide a long-range conclusion, because extremely low soil permeability vastly lengthens the time needed for sludge to interact with groundwater. An exception is the case of direct fissure flow, the effects of which become apparent much more quickly.

a. Chemical trends in selected wells - The locations of wells and springs are shown in Figure V-2. The four wells chosen for illustrative purposes are W11, W14, W7, and W17. Well W11 should reflect seepage originating from the holding basins. Well W14 is located in field #9, which has received sludge at moderate rates since 1972, and may also be affected by Fields #6 through 8 (sludge application initiated in 1973) and #7 (1974). Well W7 is likely to be affected by fields #20 (1973) and #26, 28, and 30 (1974) These two wells should reflect the effects of sludge application. Well W17, located in an area receiving no sludge as of December 1976, is a background well. The constituents selected for analysis are those present in the digested sludge at levels sufficiently high to serve as a tracer material for for direct fissure flow: nitrite and nitrate nitrogen and iron (MSDGC, 1976). Table V-9 shows the respective concentrations in each well.

Well W11 shows no trends towards increasing nitrate, nitrite or ammonia concentrations. Iron levels have fluctuated and would appear to be showing an upward trend, but 1976 data are unavailable because of well relocation. In the absence of further data, this trend cannot be substantiated. It is highly unlikely, however, that substantial seepage would occur through the clay-lined holding basins.

Wells W14 and W7, potentially affected by sludge application, show no upward trends in either nitrite and nitrate nitrogen or ammonia nitrogen. The same is true for iron in well W14. Iron concentrations in well W7 show an upward trend while those in well W17, the "control," remain relatively constant. The upward trend began in 1972, however, and sludge application on the associated fields did not begin until 1973 or 1974. Iron increases are therefore most likely attributable to sources unrelated to the project.

These data indicate that sludge application has not significantly affected groundwater quality at the site. Because of the significance of potential groundwater contamination, certain aspects are examined in closer detail below.

Table V-9 The NO_2 + NO_3 - N, NH_3 - N, and Fe Content of Wells 11, 14, 7, and 17 for 1971-1976

(MSDGC, 1976 and Enviro Control, 1977)

		Well 11		Well 14		Well 7		Well 17	
Constituent	Year	Mean (mg/l)	Range (mg/l)	Mean (mg/l)	Range (mg/l)	Mean (mg/l)	Range (mg/l	Mean (mg/l)	Range (mg/l)
NO_2 + NO_3 - N	1971	0.07	0.03-0.15	0.08	0.0-0.19	0.1	0.0-0.25	0.41	0.04-1.68
	1972	0.0	0.0-0.02	0.01	0.0-0.07	0.16	0.04-0.28	2.5	0.0-0.11
	1973	0.07	0.0-0.42	0.03	0.0-0.07	0.73	0.18-1.61	0.40	0.03-0.73
	1974	0.04	0.0-0.14	0.03	0.0-0.06	0.26	0.01-0.54	0.21	0.0-0.79
	1975	0.04	0.0-0.09	0.04	0.0-0.11	0.27	0.06-0.76	0.23	0.9-0.63
	1976	--	--	0.02	0.0-0.06	0.06	0.0-0.2	0.13	0.0-0.2
NH_3 - N	1971	1.9	1.7-2.4	0.7	0.2-2.3	0.5	0.1-0.9	0.6	0.1-2.1
	1972	1.8	1.4-2.1	0.6	0.1-1.3	0.5	0.1-1.1	0.5	1.3-2.7
	1973	1.35	0.5-1.7	0.78	0.2-1.2	0.57	0.2-1.8	0.21	0.0-0.4
	1974	1.68	0.9-2.2	0.60	0.4-0.8	0.52	0.2-0.9	0.22	0.1-0.7
	1975	2.07	1.6-2.60	0.73	0.4-1.3	0.64	0.5-0.9	0.18	0.0-0.4
	1976	--	--	0.52	0.0-1.0	0.5	0.1-1.1	0.18	0.0-0.8
Fe (Iron)	1971	5.9	2.4-10.5	28.9	6.5-63.8	2.1	0.3-4.0	12.3	1.0-22
	1972	15.3	4.8-36.1	54.7	32.9-90.8	15.9	3.3-40.4	11.6	13.0-181
	1973	10.6	2.7-27.3	60.6	15.0-193.0	47.2	11.3-78.8	14.5	9.0-19
	1974	15.2	4.7-59.0	34.6	20.4-49.6	63.0	35.8-92.9	16.2	10-22
	1975	22.8	4.0-46.2	36.5	13.2-78.9	83.1	56.7-107.0	13.1	9.7-16.4
	1976	--	--	27.2	10.9-77.0	101.7	69.3-130.0	14.0	9.5-27.1

b. Nitrite and nitrate trends in all wells - The nitrite and nitrate nitrogen concentration in each well or spring was analyzed from August 1973 to April 1977. Only wells W8, W10, and W21 reported concentrations in excess of 10 milligrams per liter, which is recommended as the maximum level by the U.S. Public Health Service (U.S. Public Health Service, 1962, 1969). Well W8 has consistently low levels of nitrite and nitrate nitrogen, with the exception of a spike between January and May 1975.

Wells showing possibly increasing nitrite and nitrate nitrogen levels are W1, W4, W12 and W22. Of these, W1 and W4 are located upstream from the project site and are unaffected by project activities. Increases in nitrite and nitrate nitrogen levels in wells W12 and W22, and fluctuations in nitrite and nitrate levels at the other wells, do not seem to correlate with project activities. In addition, the levels are generally lower than 0.2 milligram per liter, except for well W10 which possesses consistently high values. These findings suggest that a large portion of nitrogen in the applied sludge is fixed by soil molecules, converted and released as ammonia gas, or taken up by crops for bio-synthesis. Apparently, little soluble nitrogen is leaching into the groundwater system. In addition to W11, wells W12 and W13, conceivably vulnerable to seepage from holding basins, have generally shown less than 1.2 milligrams per liter of nitrite and nitrate nitrogen. This further indicates that the clay linings in the four basins have been effective.

The possible effects of increasing application rates or accumulation of sludge in the fields on groundwater nitrogen levels cannot be assessed at this stage of project development. Data are not sufficient for analysis of trends, and long-term monitoring of groundwater quality is required to establish the relationship between project operations and the nitrite and nitrate nitrogen level.

c. Trace element and other concentrations - Variations in groundwater constituents are shown in Table V-10. The range of variation is given for seven calendar periods, either before or during the sludge application season. The well reporting the maximum level of a given constituent is indicated in parentheses.

The pH values, alkalinity, conductivity, and concentrations of total phosphorus, sulfate ion, calcium, potassium, sodium, aluminum, iron, magnesium, manganese, mercury, nickel, selenium and fecal coliforms remain close to the 1971 and 1972 baseline conditions (see Chapter III). Recent concentrations of cadmium, chromium, copper, lead and zinc are lower than the baseline concentrations. In 1971 and 1972, 40 percent of the wells tested contained excessively high levels of chemical constituents. When retested between 1973 and 1975, after the project had begun, the statistic was the same. Groundwater constituents are, therefore, probably influenced by sources unrelated to the project.

C. Air

Impacts on air quality may result from aerosolization and volatilization of sludge constituents, perhaps presenting odor problems or health hazards. Potential health hazards are discussed in section D, "Health Effects".

Table V-10 Concentrations of Various Constituents in Groundwater (MSDGC, 1972 a through 1975 g)

Water Quality Parameter and Unit		First Quarter 1973 (before sludge application)	August 1973 (during 1973 sludge application season)	April 1974 (before 1974 sludge application season)	June 1974 (during 1974 sludge application season)	August 1974 (during 1974 sludge application season)	April 1975 (before 1975 sludge application season)	July 1975 (during 1975 sludge application season)
pH		7.0-7.9	7.0-9.9	6.6-8.1	7.1-7.8	6.9-7.7	6.9-8.1	7.3-8.3
Total P	mg/l	0.04-0.95 (W7)	0.07-0.65 (W4)	0.04-0.87 (W24)	0-0.29 (W10)	0.02-1.80 (W1)	0.07-0.38 (W2)	0.05-0.73 (W2)
Cl^-	mg/l	2-392 (W21)	4-420 (W4)	2-390 (W21)	2-401 (W4)	0-381 (W4)	0-374 (W4)	0-404 (W4)
$SO_4^=$	mg/l	18-1,048 (W12)	6-1,546 (W12)	53-1,706 (W12)	0-1,293 (W13)	40-1,999 (W12)	0-1,439 (W9)	0-1,479 (W9)
Alkalinity (as $CaCO_3$)	mg/l	227-1,107 (W11)	150-1,120 (W26)	150-1,160 (W26)	210-940 (W11)	120-1,160 (W26)	210-1,300 (W16)	88-788 (W18)
Conductivity	umho	492-3,433 (W11)	425-3,450 (W4)	600-5,500 (W27)	460-3,900 (W12)	520-2,380 (W12)	420-3,200 (W12)	400-2,500
Ca	mg/l	58-534 (W12)	49-565 (W12)	34-549 (W12)	24-549 (W12)	52-395 (W9)	48-627 (W12)	38-405 (W9)
K	mg/l	0-19.1 (W21)	1-19 (W4)	1-19 (W21)	0-17 (W4; W21)	1-16 (W4; W21)	0-18 (W4)	0-19 (W4)
Na	mg/l	8-612 (W11)	13-620 (W26)	12-612 (W26)	5-630 (W26)	8-700 (W26)	7-630 (W26)	9-625 (W26)
Al	mg/l	0-4.9 (W11)	0-30 (W27)	0-10 (W23)	0-6.0 (W13)	0-7.0 (W23)	0-6.0 (W23)	0-3.0 (W23; W24)
Cd	mg/l	0-0.02 (W11)	0-0.02 (W13)	0-0.03 (W13)	0-0.03 (W13)	0-0.02 (W11; W13)	0-0.02 (W4; W13)	0
Cr	mg/l	0-0.01 (W12)	0-0.06 (W25)	0-0.04 (W25)	0-0.02 (W12; W13)	0	0	0-0.03 (W2; W8)
Cu	mg/l	0.01-0.09 (W13)	0-0.06 (W13)	0-0.12 (W22)	0-0.16 (W16)	0-0.16 (W16)	0-0.2 (W13)	0-0.22 (W12; W14)
Fe	mg/l	0.2-135 (W13)	0.1-135 (W9)	0.2-119 (W9)	0-123 (W13)	0.1-171 (W9)	0-107 (W7)	0.1-83.5 (W15)
Pb	mg/l	0-0.46 (W9)	0-0.40 (W13)	0-0.31 (W13)	0-0.76 (W13)	0-0.56 (W13)	0-0.12 (W12)	0-0.25 (W13)
Mg	mg/l	31-360 (W12)	0-410 (W12)	34-378 (W12)	28-472 (W12)	30-375 (W12)	32-430 (W12)	25-345 (W13)
Mn	mg/l	0.01-7.44 (W12)	0-8.05 (W12)	0-9.36 (W12)	0-7.63 (W12)	0.01-7.10 (W12)	0-8.95 (W12)	0.02-3.72 (W12)
Hg	ug/l	0-0.4 (W13)	0.2-0.9 (W4)	0-4.4 (W4)	0-0.9 (W1)	0-0.5 (W13)	0-0.6 (W26)	0-0.6 (W1)
Ni	mg/l	0-0.1 (W13)	0-0.2 (W7)	0	0-0.2 (W13)	0	0	0-0.3 (W8)
Se	mg/l	--	--	0	0	0	0	0
Zn	mg/l	0-46.5 (W7)	0-49.6 (W13)	0-30 (W13)	0-61.5 (W13)	0-61.5 (W13)	0-11.8 (W7)	0-19.2 (W13)
Fecal Coliforms	1/100 ml	0	0-2 (W23)	0	0-60 (W7)	0-14 (W20)	0-2 (W8)	0-350 (W20)

(W) = well with maximum concentration.
( ) = well possibly affected by sludge application.

This section discusses odor in terms of theoretical considerations, odor complaint data from the project site, and the relative odor potential of the sludge holding basins and alternative application methods.

D. Health Effects

Sludge solids may contain pathogens, chemicals and metals that are potentially harmful to humans and animals. Extended exposure to these components may result in adverse health impacts. While there are several routes by which humans or animals can be exposed to sludge, the main routes are direct ingestion or inhalation of airborne sludge particles. Indirectly, heavy metals and some chemicals may be ingested when plant tissues are consumed by animals. The U.S. Department of Agriculture, the Council of Agricultural Science and Technology and others have reported on the hazards and impacts of heavy metals and expected health impacts from sludge applications.

1. Direct Health Effects

Direct health effects can result from the inhalation of sludge aerosols, the severity of the effect depending on concentrations of hazardous materials in the sludge, the amount of sludge aerosolized, the extent to which the airborne particles are inhaled, and many other variables. As stated in the discussions of odor, sludge aerosolization does not occur with surface spreading (overland flow and infiltration-percolation) or surface penetration (soil incorporation and soil injection). Although white-capping in the holding basins can cause aerosolization, pressurized spraying offers the greatest potential for direct transfer of hazardous components to humans or animals.

Pressurized spraying has been discontinued as an application method in Fulton County, and it is unlikely that significant amounts of aerosols would result from white-capping in the holding basins. Therefore, significant inhalation of aerosols (and associated potential health effects) is not likely to occur at this stage of the project. Because pressurized spray has constituted a large proportion of past application methods, however, it will be discussed in this chapter. Mitigative measures will not be presented because, as long as spray application is not practiced, inhalation of aerosols will probably be negligible.

a. Background - Although very few pathogens survive wastewater treatment, salmonellas, *Mycobacterium tuberculosis*, and many enteroviruses (viruses of the gastrointestinal tract) may even survive chlorination in low numbers and it has been shown that the absence of coliforms does not necessarily indicate virus inactivation (Allen *et al.*, 1949; Sorber, 1973; Kruze *et al.*, 1970; D'Itri *et al.*, u/d). The microbial population of sludge is greatly reduced by holding for a few weeks, but is not eliminated completely. It should be emphasized here that high-rate anaerobic digestion followed by lagooning practices which are employed by the MSDGC, are considered by the USEPA to be sufficient for pathogen control.

Pathogens may be present in sludge in minimal numbers even after months of lagooning. A major factor influencing their presence and quantity is the community's discharges into the system, which may be expected to be highly variable. Sources are human and animal and they include slaughter houses, the meat products industry, poultry and egg processing plants, tanneries, and many others (McCoy, 1971). It is evident that the nature and concentrations of pathogens entering and potentially surviving treatment must vary widely from place to place and time to time. Evidence from places other than Fulton County are therefore of little predictive value, and samples taken in Fulton County at one point in time will not necessarily be valid for other times. For example, midday counts of E. coli were 5.5 in January 1970 and 0.18 in September 1970, and midnight counts were 0.3 in both months (McCoy, 1971). Futhermore, E. coli are the overwhelmingly dominant bacterial species in domestic waste; diseases of seasonal and epidemic character would show much wider fluctuation. It may be noted that bacteria, which are sizeable compared with the droplets, will not inhabit all droplets; this is also true, especially, for larger amebic cysts, helminth eggs, and so forth. Dissolved substances, in contact, are present in all particles. Treatment plants handling a substantial proportion of industrial waste are liable to have a considerable burden of toxic substances in the sludge. Thorne, Hinesly and Jones' data are reported in Table V-11.

Table V-11. Composition of Fresh, Heated, Anaerobically Digested Sewage Sludge (Thorne et al., 1975)

	Dry Sludge Basis		
	Concentration Range (ppm)*	Typical Concentration (ppm)*	Typical Amount (lb/ton)
Cadmium (Cd)	3 to 3,000	150	0.3
Chromium (Cr)	50 to 30,000	3,000	6
Lead (P)	100 to 10,000	1,000	2
Mercury (Hg)	1 to 100	3	0.006
Nickel (Ni)	25 to 8,000	400	0.8

*Mercury units expressed in ug/l

For comparison, data available from Fulton County reveal an average of about 450 ppm for cadmium, and a maximum concentration of 1,125 ppm.

It must be emphasized that the input rate for such materials at the treatment plant is likely to vary widely, even during stable conditions of industrial production with discharges occurring, for example, at one step in a batch process or during periodic cleansing. When processes change or new processes are introduced, further variations in the effluent may be expected. Consequently, a few grab samples widely separated in time may give a highly misleading indication of average concentrations.

b. Airborne Transmissions - Constituents of sludge can become airborne and be transmitted to downwind receptors. In the case of Fulton County, there were two main sources that were investigated. The first was the transmission of constituents when sludge was sprayed by rainguns on fields. The impact and probability of direct health effects would be indirect relationship to the amount of aerosolization and distance from the source. Downwind concentrations will depend on variables in transit. The concentration is inversely proportional to windspeed, which determines the downwind particle spread. The particles are also spread out vertically and across the wind by turbulent mixing of the air. Another factor is deposition. For example, a 50 micron particle of unit density has a settling rate of about 10 centimeters per second and will fall through 1 meter of still air in 10 seconds. However, some particles will remain airborne much longer in a turbulent atmosphere.

Another form of physical depletion, impaction on surfaces, is not a significant factor in the present context. For this to occur, particles must be relatively large, windspeed must be high, or the obstacle must be very narrow; otherwise, the particles simply slip by the obstacle in the streamlines. Therefore, vegetative barriers cannot be expected to effect any substantial depletion in particles of respirable size.

Pathogens are subject to another form of depletion which can be extensive. Most pathogens are affected by desiccation and exposure to the atmosphere, and are also highly susceptible to sunlight or even diffuse daylight. This response is extremely variable. Other sludge ingredients may have a large retarding or accelerating effect or loss of viability. (Webb, 1959, 1960a, 1960b).

Variables at the receptor are also complex. A breathing human is an active receptor (as opposed to a passive obstacle), "sampling" the air and trapping particles of different sizes in various parts of the respiratory tract. The rate of "sampling" depends upon the degree of activity and can vary by one order of magnitude or more. An average figure of 15 liters per minute, corresponding to light activity, will be used in this analysis. Efficiency of retention varies from 100 percent for larger particles to about 25 percent for those least retained. However, most of the total mass of airborne material will be in particles for which 100 percent retention is an acceptable approximation.

Account will not be taken of the effect of particle size on the infectivity of some microorganisms. The number of microorganisms required to infect exposed subjects will vary greatly with particle size. Experiments performed with bacterial agents in animals have shown that the infective dose is much less for 1 micron than 10 micron particles, the transition occurring at about 5 microns and corresponding with a transition from deposition in the lower to the upper respiratory tract (Harper and Morton, 1953; Druett et al., 1953). Particles less than 5 microns in diameter are frequently spoken of as being in the "respirable" size range, and many recent papers, including several on sewage aerosol hazards, are written as though larger particles were not hazardous. However, there is evidence that the difference is small in some cases (e.g., for Pasteurella pestis in the Rhesus monkey), and it may be supposed that enteroviruses, impacted in the upper respiratory tract and subsequently swallowed, can infect via the gastrointestinal tract. Furthermore, we are also concerned with toxic substances for which the portal of entry may bear little significance.

From data obtained at this site, stability classes, receptor response and calculated intake of sludge particles, it appears that sludge aerosol inhalation is not likely to present a health hazard in terms of heavy metals. It should also be mentioned that the World Health Organization's daily intake limits have been established for worst case conditions where a subject is likely to be daily exposed to aerosols.

The impact from airborne pathogens are much harder to assess. The survival rate of pathogens is quite unpredictable except in the most robust species. Environmental conditions would greatly determine the viability and infectability of bacteria or viruses. The best barometer of impact on human health is the lack of verifiable health problems at the site or generally at wastewater treatment plants across the country. (This discussion was included as background information. MSDGC no longer uses spray irrigation at the Fulton County project).

During the period of 1976 to 1979 USEPA did an extensive investigation of the health impacts associated with aerosols from wastewater treatment plants. This study was prompted by the construction of a large facility, the MSDGC O'Hare Water Reclamation Plant, in a densely populated area. After extensive testing described as "thorough, critical, of a sensitive nature, and representing the feasible limit of scientific and economic capability," there was no indication of a direct or indirect health hazard resulting from exposure to aerosols. (USEPA, 1979)

c. Human Health Implications - Any evaluation of direct health hazards at Fulton County must be based on indirect evidence. The most useful indirect information concerning the Fulton County project is the absence of reported health effects. As this situation continues, the probability of serious trouble clearly diminishes. Lack of evidence concerning health effects is apparently based on absence of conspicuous ill effects rather than an active medical search for indicators. For example, serological evidence of immune levels might point to subinfective exposure, medical records might show abnormal incidence of respiratory disease in the vicinity, or occupational health records might reveal cases where exposure at home had tipped the balance of response by augmenting occupational exposure to an industrial chemical. Despite these reservations, the missing evidence is encouraging and correlates with experience elsewhere (Viraraghavan, 1973; Sorber, 1973; Benarde, 1973; Krishnaswami, 1971; Dixon and McCabe, 1964; Anders, 1954; Browning and Gannon, 1963; Ledbetter et al., 1973; Illinois Advisory Committee, 1975).

Another possible mode of transmission that could affect both man and animals is by insect vector. Any operation resulting in standing water containing pathogen-contaminated sludge presents a potential hazard (Sorber, 1973). There are no data to support an evaluation of this risk for Fulton County, but it may be surmised that the risk is small or negligible. The initial concentration of any pathogen would not be high and would be likely to decay rapidly in exposed shallow water. In addition, the stagnant water is unlikely to remain for long periods of time, so the chances of infecting vectors are low.

E. Noise

The project is located in a remote rural area. The closest communities are Canton, Cuba, St. Davis, and Bryant, with a combined population of less than 15,000. The ambient noise level is similar to that of typical rural areas and is estimated to be not more than 45 adjusted decibels (dBa) 90 percent of the time, which is designated the 10-percentile noise level.

Sources of noise in the environment of the project include tractors on the adjacent farms and occasional motor vehicles on highways and local roads. Because the traffic is light, these sources do not contribute significantly to the ambient or background noise level. Sources of noise related to the project include pumps, tractors, and sludge sprayers. Three pumping or sludge distribution stations are located within the project property, and one booster station is situated at the Liverpool dock. The pumping stations on the project site are at least one mile from the nearest farmstead. However, the booster station at the Liverpool dock and barge pumps are within a half-mile radius of Liverpool, which had a population of 218 in 1970 (U.S. Bureau of Census, 1972). Tractors, trucks, and sludge sprayers are mobile noise sources. This equipment will generate noise detected by sensitive receptors only when in operation near the boundary of project property.

The typical ranges of sound pressure levels from pumps and vehicles are shown in Figures V-6 and V-7. As a conservative estimate, the noise level for an unenclosed pump is about 95 dBa 3 feet away from the pump, and about 80 dBa 25 feet from a tractor and sprayer. The noise levels at different distances from these sources are derived from the dissipation law of sound pressure and are shown in Table V-12. These values were calculated assuming the absence of sound barriers such as buildings, dense vegetation, and terrain with high relief. For comparison, examples of common indoor and outdoor noise levels are listed in Figure V-8.

Table V-12 Noise Level in dBa of Various Noise Sources as a Function of Distance (Enviro Control, Inc., 1976)

	Distance from Noise Source						
Noise Source	3 ft.	25 ft.	100 ft.	800 ft.	1,600 ft.	3,200 ft.	5,280 ft.
Pump without Enclosure	95	86	80	71	68	64	63
Tractor and Sprayer	—	80	74	65	62	59	57

Noise impacts from the pumping station are minimized because of a one-mile

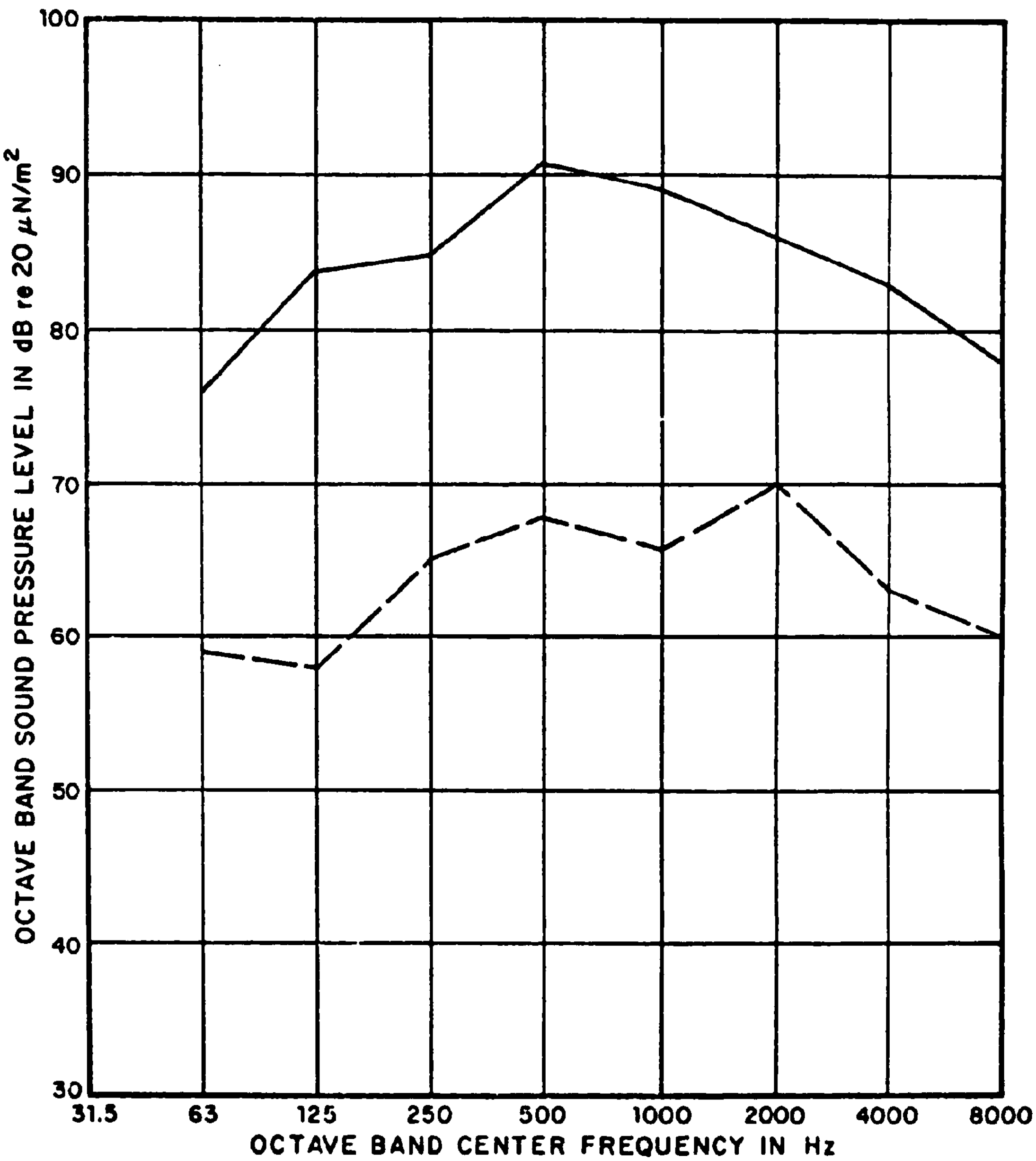


Figure V-6 Range of Sound Pressure Levels from Pumps (Measured at 3 ft.) (Curves Represent Upper and Lower Boundaries of Range), (U.S. EPA, 1971a).

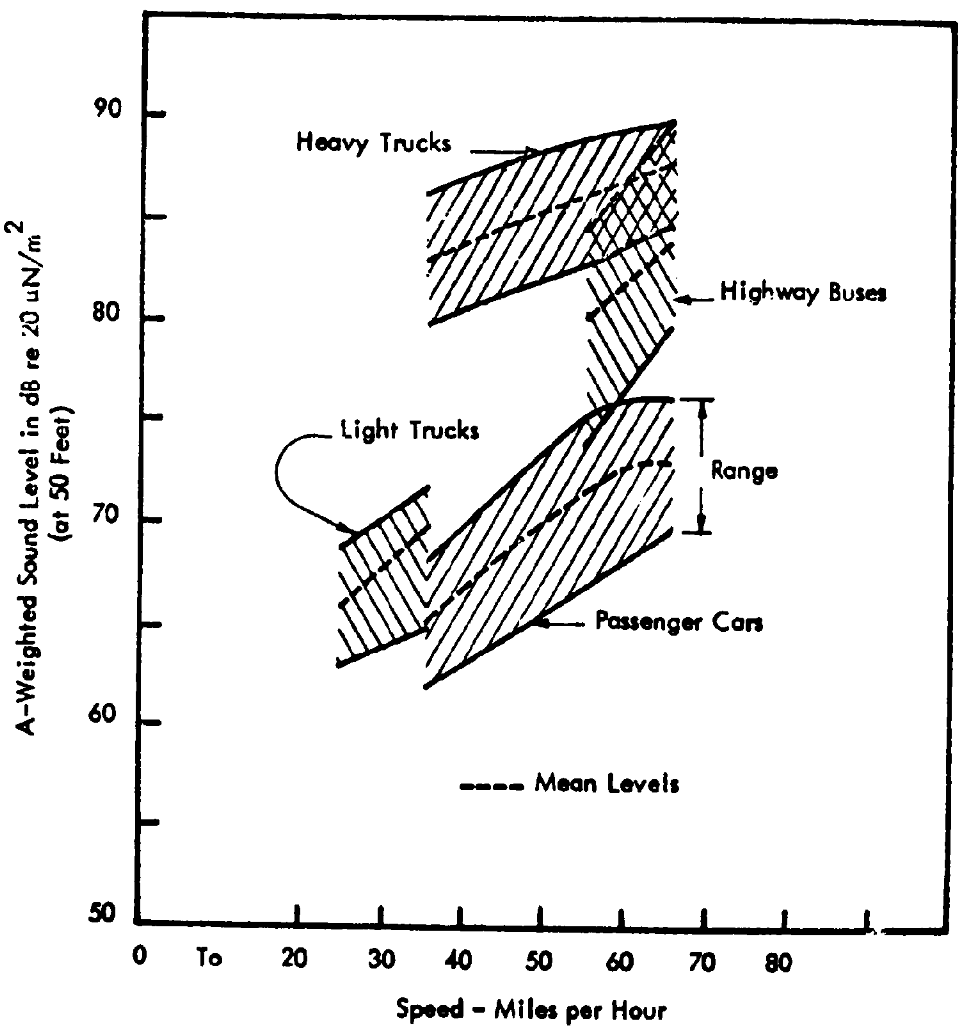


Figure V-7 Single Vehicle Noise Output as a Function of Vehicle Speed (U.S. EPA, 1971b).

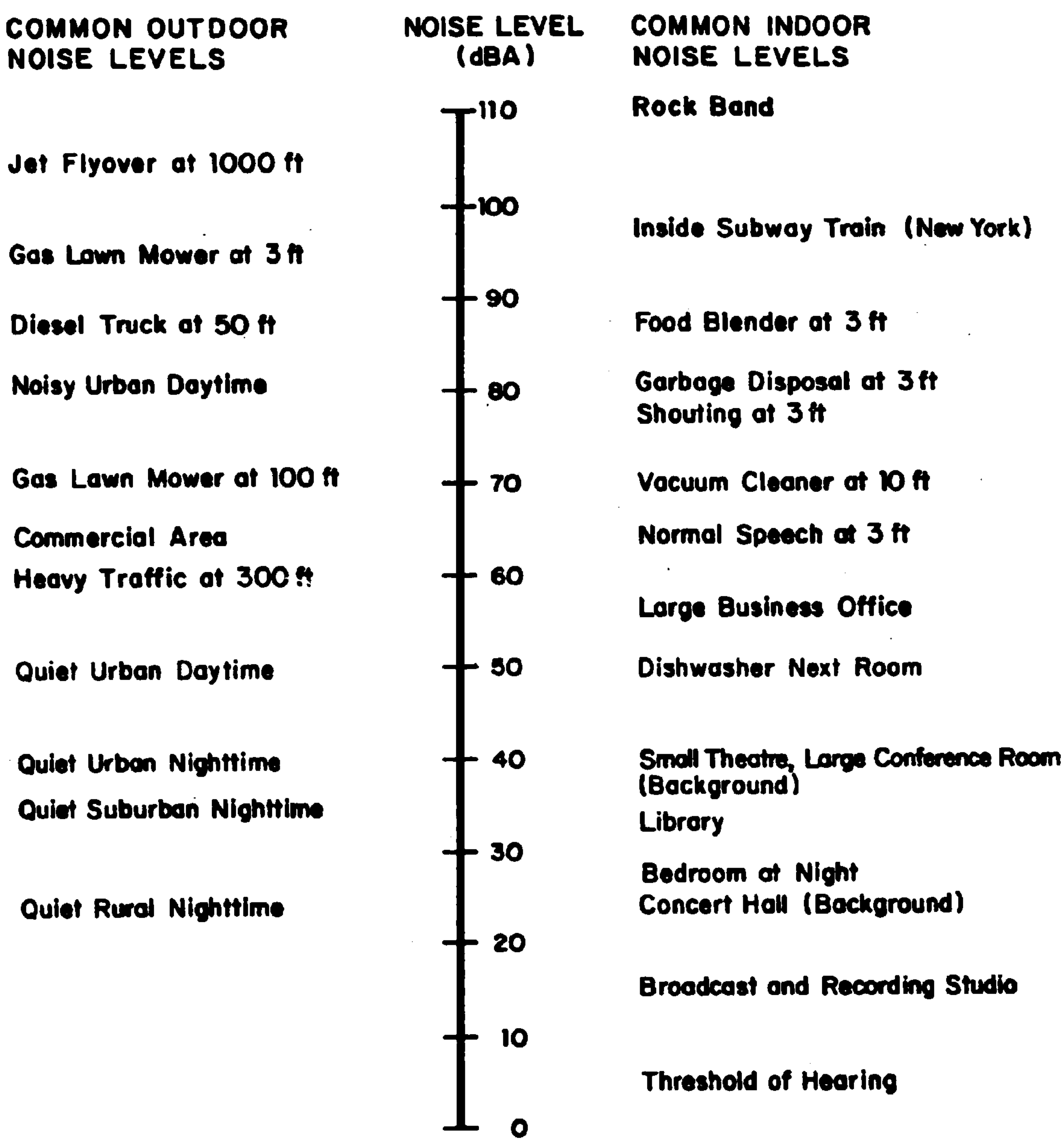


Figure V-8 Common Indoor and Outdoor Noise Levels (U.S. Department of Transportation, 1973) buffer distance between the station and the closest farm families. Considering further dissipation of noise by buildings, vegetation and topography, the noise level of pumps at a one-mile distance should be less than 60 dBa. This level is acceptable for residential areas, as recommended by the U.S. Department of Housing and Urban Development (1971 and 1972).

Noise generated by pumps at the Liverpool dock and by barge pumps will somewhat increase the ambient noise level around the community of Liverpool. Impacts from this intermittent noise cannot be quantified in the absence of noise data; however, they should not be severe.

F. Significant Socio-economic and Land Use Impacts

Since the project has been in progress for nine years, there are several factors that can be readily measured. Precise impacts of the project are described in the text below.

1. Socio-economic impacts

Baseline information was provided in an earlier chapter. This discussion will address population trends, employment and income land value, agricultural activity, and future mining activities.

a. Population - Recent national rural-urban trends predict future population growth in areas such as Fulton County. These demographic trends include both historic trends and more recent factors which are expected to influence future trends. Past declines in agricultural and strip-mining employment have been instrumental in causing decline in the overall population of Fulton County and increases in the populations of Canton, Lewistown and Farmington. Expected future declines in agricultural and strip-mining employment will continue to affect the future population size and distribution.

More recent trends, such as the spread of industry to the exurban fringe of cities, will increase employment opportunity in many rural areas. Some of this manufacturing employment will encourage in-migration of skilled labor. Less-skilled labor can come from the existing rural labor force. Expansion of industry to the west and south of Peoria can be expected to enhance employment opportunities for the current residents of Fulton County and increase the in-migration of skilled laborers and their families.

A national survey has indicated that many city residents prefer nearby, or even remote, rural or small town residence to living in a large city (Beale, 1975). Considerable demographic data have shown that, since 1970, nonmetropolitan areas are not only retaining people but are also receiving a net migration (Beale, 1975). Factors associated with migration to rural areas include the growth of state and community colleges and the development of rural recreation and retirement places, as well as the decentralization of manufacturing. Fulton County offers both recreational and retirement opportunities such as the Wee-Ma-Tuk Hills development adjoining the land reclamation project. Community colleges, such as the Spoon River Community College near Canton and adjacent to the project site, often cooperate with local businesses in providing appropriate skills for new enterprise.

This evidence clearly suggests that the population of Fulton County can be expected to grow. The major influences on the growth rate are the development of new manufacturing in Fulton and southwestern Peoria Counties and the accessibility of existing and potential residential areas to these manufacturing plants. When such factors affecting growth are considered, the total future population of Fulton County is expected to significantly exceed the population forecast by the Bureau of the Budget, State of Illinois. Future population is expected to be increasingly concentrated in Canton, Lewistown and Farmington. Substantial growth can also be expected in the northeastern quadrant of the County toward Peoria.

If the project is abandoned in its present state, current MSDGC employees would have to seek new employment. Manufacturing growth along the Illinois River should provide employment for many of the seasonal employees working on the Prairie Plan project. Most of these employees are either current residents of the area or utilize the project as summer employment. Some of these employees can be expected to relocate their families. Most of the 23 permanent MSDGC employees would be expected to relocate their families outside of Fulton County. The projected net impact is minimal because machinery performs more work.

Reclamation and reuse of the project area to produce crops or livestock would increase population only marginally, because it is estimated that 708 acres of pasture or 360 acres of row crops are needed to support one family (Schmitz, 1974 and Muehler, 1975). Conservation and recreation reuse would attract transient tourist populations. The existing recreational center is used by many local residents for summer trailers. If this area were enlarged a small additional population may be served.

b. Employment and income - Continued declines in employment can be expected in the agricultural sector. The most recent declines reflect the influence of advanced technology in replacing labor with capital-intensive methods of production. Such practices increased training and abilities of the resident labor force while importation of certain skilled labors occurred. Even though the number of employees in agriculture will decline, increasing skills will enhance average incomes.

Under expected future conditions of higher labor mobility and increasing skills, the median income in Fulton County is expected to gradually converge with that of the U.S. (U.S. Water Resources Council, 1974). The higher average income and purchasing power in Fulton County should increase the strength of its service and trade activities. However, higher local wages combined with low unemployment is not especially attractive to new manufacturing, although the proximity of underutilized urban labor markets and higher labor mobility should enable a new manufacturer to import labor or attract commuters. Most of the new industries can be expected to have small labor requirements and to be tied to the production of metal and machinery.

The land purchased by MSDGC originally supported an estimated 37 full and part-time jobs, mostly held by local residents (Kelly, 1974). While these jobs were lost after the purchase, the increasing amount of agricultural land needed to support a farm worker indicates that, without the MSDGC purchases, the land in the project area would have supported progressively fewer workers. The increased number of jobs created by the Sanitary District absorbed approximately 120 skilled and unskilled contract laborers who average 6 to 8 months of employment yearly. Most of the skilled labor came from a multi-county region surrounding and including Fulton County, but most unskilled labor originated within Fulton.

When the project site is fully developed, several additional full-time employees may be necessary to effectively manage the farming enterprises. However, the amount of seasonal and contractual laborers would decrease. Development of initial fields and basins is labor intensive, while land application and cropping decreases this need. If the MSDGC abandoned the site, it is expected that many of the full-time farm operating jobs would be lost. Attempts to farm the poor, unconsolidated soils would continue to provide a few jobs.

The area now provides a few less intensive economic activities such as recreation, hunting and fishing, and livestock production. This is not anticipated to change. These uses would generate little on-site employment and income. Visitors to the regionally attractive conservation or recreation sites created by the project would add some local income in tourist-related retail and service enterprises. However, poor access to the project area from larger population centers, due to distance and lack of a high-speed link, will limit this potential, until the proposed Interstate Highway (Peoria-Kansas City) is completed. The use of strip-mine soil for grazing would have a small multiplier effect on local employment and income. Feedlots could contribute to the expansion of nearby meat packing firms.

c. Land values - Future land values in the project area will be governed by the growth of Canton, competitive position in land speculation, and the economic intensity of future land uses. Expected future growth of Canton would slightly increase the value of all land within its geographic sphere of influence. Speculation in coal extraction and marketing might affect values in the project area should it become economically feasible to mine the thin seam of coal underlying the strip-mined surface layers.

The availability of competing land at least equally suitable for development is the major determinant of local land values. Large tracts of equally available and suitable land in Fulton County should keep land values low in the project area. Much of the project land is highly unsuited for building construction. Residential or industrial buildings may require expensive structural modifications where they are built on the disturbed, unsettled soil of a strip-mined site. If a priority is developed for class one agricultural land preservation, more emphasis on the use of strip-mined land will occur.

In Land Use Survey of Strip Mines, Fulton County, Illinois, unreclaimed lands are defined as "areas where no attempt has been made to reclaim stripped land to a productive use." Using this definition, unreclaimed lands have been estimated to be worth $259 per acre or $64 per acre less than reclaimed strip-mined lands which are used productively. Land reclamation and reuse could, therefore, theoretically add about $278,016 to the market value of the 4,344 acres of strip-mined land scheduled for sludge application (MSDGC Land Project Development Schedule, revised August 1974). For the period of sludge application, the 4,344 acres of stripped land and 1,181 acres of place land (formerly row-cropped), which comprise the current and planned sludge recycling fields, continue to be worth to the MSDGC the paid value of $378 an acre (Kelly, 1974). The last parcel of land that comprises the Fulton County site was purchased by MSDGC on March 20, 1975. Up to this date the total amount paid for land was $5,961,367.30. On January 1, 1978 the Fulton County Assessor valued the MSDGC holdings at $14,223,609.

d. Public finance - Two major influences are expected to significantly improve the ability of Fulton County to attract and accommodate future growth, and thereby expand local public finance. One is the Central Illinois Light Company (CILCO) power plant, now nearing completion. When the CILCO plant is operational, it will double the total tax base of Fulton County (Sandberg, 1975). The expanded tax base is expected to yield the local revenues necessary to enhance public facilities and services so as to facilitate growth. The other influence is Federal and State funding of public works, such as the currently proposed road improvements between Peoria and Canton, which are expected to substantially improve the regional attractiveness of Fulton County.

Contributions of the reclamation project to local public finance would be minor as compared to the projected huge tax revenues from the CILCO plant and potential outside public funds for road or other improvements. Discontinuing the project will result in lost county revenues. In 1975, the MSDGC paid to Fulton County roughly $180,300 in real estate taxes and $53,423 in personal property taxes. In 1977, these figures were $237,341.56 for real estate taxes and $109,976.86 for personal property taxes. In 1978, the MSDGC paid $243,245.52 for real estate taxes and $116,810.59 for personal property taxes. Most of this revenue would be lost if the project is abandoned and the land is not reused. According to a statutory requirement, those formerly strip-mined portions of the project area would be assessed at rates applicable to their uses prior to strip-mining. Other portions would be assessed as unproductive agricultural land.

Most feasible reuses of the land would produce much smaller public revenues than were gained from MSDGC tax payments. Even prime agricultural land in Fulton County (and very little of the project site can be considered as such) is assessed at only $380 to $570 (1975 estimates, Fulton County Tax Assessor). Public recreation or conservation uses would generate no tax revenues.

e. Agricultural activity - The soils and topography of northern Fulton County, and of West Central Illinois in general, are well suited for agriculture and support highly productive principal crops such as corn, soybeans, and hay. Future productivity of local agriculture will be influenced by the rich loess soils and the generally level topography, as well as by changing methods of agricultural production. Average farm size should increase while farming should continue to become more capital and less labor intensive, causing continued decrease in farm employment and population. At the same time, trends in farm production will increasingly favor the use of larger, more level fields farms.

The impact of the project on agricultural activity in Fulton County hinges on the potential productivity of the 4,344 acres of formerly strip-mined land used for sludge disposal. It is assumed that sludge application to the 1,181 acres of place land will only marginally affect the productivity of these presently fertile fields. Other portions of the project area are only marginally suited to agricultural uses. Calculations based on 1970 data show an average annual net return per acre from farmland in Fulton County of approximately $85 for row crops and $31 for pasture. These figures may be slightly lower as the 1980's begin. Feedlots have a considerably higher return. This suggests an ultimate agricultural value added per year by the project of approximately $200,000 to $300,000 (1970 dollars) due to reclamation and agricultural reuse. (1969 data show a county-wide produce value of $33 million on commercial-sized farms, or farms with sales of over $2,500 per year.) These estimates of dollar return should be viewed only as crude indications of the potential lost value of agricultural productivity should the project be abandoned or full reclamation not be achieved. The values of agricultural production fluctuate considerably from year to year.

In its present state, land in the project area could be used primarily for grazing and row-cropping. However, without reclamation utilizing sewage sludge, any row-crop production on formerly strip-mined fields would depend on liberal applications of costly chemical fertilizers, extensive soil conditioning, and rigorous conservation practices such as crop rotation. Continued sludge application can be expected to enhance the nutrient and organic content of the soil considerably, and this would favor more intensive row-crop farming over the grazing of livestock.

f. Mining and manufacturing - The future importance of strip mining in Fulton County may be determined by three factors:

Increasing national consumption of coal for power generation

Vertical integration of major coal consumers

Large amounts of strippable reserves in Fulton County.

Increasing coal consumption, interacting with air pollution regulations, land reclamation requirements, and future improvements in sulfur removal from coal or coal combustion gases, will govern demand for high-sulfur coal such as exists locally. The vertical integration of major coal consumers, such as mine ownership and operation by a power company, could make large amounts of capital available for the continued mining of Fulton County's coal reserves. Previously unmined, yet strippable coal covers over 54 percent of the County (Griffin and Chicoine, 1974).

Clearly, the enormous reserves, the availability of capital for their extraction and increasing use of high-sulfur coal would exert great pressure to further exploit this resource. Nevertheless, coal mining is not likely to be a future land use in the project area itself. The remaining thin, deeper seams of coal below the project site are not nearly as well suited for future extraction as are other reserves nearby.

The major industrial firms in Fulton County are the International Harvester Company and the Central Illinois Light Company. Other large industries include J. C. Schaefer Electric, Inc. and Astoria Fibra Steel, Inc. Much of the influence of industry on local employment is applied by firms located in southwestern Peoria County. New industries would be more inclined to locate along the Illinois River than at the project site where road access is comparatively poor and cheaper water transportation for high bulk, low-value cargo is unavailable. The water supply at the project site is inadequate to support many industries, and low local unemployment rates indicate a low labor supply. Industrial location, both along the river and at the site, is favored by large land holdings, low land prices, available railroad transportation, close proximity to central markets, and the availability of coal. Impetus for new industrial and commercial development will be redirected to the new Interstate Highway (Peoria-Kansas City) bisecting the County and tangent to the Prairie Plan site.

The provision of internal access roads and the leveling of strip-mined areas have lowered construction costs for industrial buildings in the project area. However, wastewater disposal problems and highly mineralized water supplies discourage industrial development there. Also, unstable soils add significant costs and uncertainties to the construction of building foundations, hard-surface roads, rail spurs, and underground pipelines. Thus, the project site is neither physically nor economically adaptable for future manufacturing uses. MSDGC does not, however, have industrial zoning classifications within any of its approved land use reclamation plans.

g. Retail and wholesale trade - Future retail and wholesale activities in and near Canton depend on the progress of road improvements. Non-neighborhood retail business and most wholesale activities in Canton could be affected adversely by increased accessibility of the Peoria market. Service activities should continue to increase in Fulton County, tempered by the location in Peoria of most highly specialized services.

Discontinuing the project would cause some temporary decline in the volume of local trade and services due to lost purchasing power of current employees of the MSDGC or its contractors. Reuse of the project land would be economically unintensive.

2. Land Use

The analysis of land use opportunities and constraints focuses upon the combined effects of socio-economic demand and physical land suitability on the future reuse of project land. Of course, land reuse is not assured by successful reclamation; there must be actual economic demand. Once demand by society is established, the available land must be physically capable of accommodating the desired land use.

Sludge application fields which were formerly strip-mined (4,344 acres) would be attractive for added row-crop farming. While the addition of nutrients and organic matter has been limited so far, the leveling of steep slopes, removal of large rock fragments from the surface, and the installation of erosion controls has increased the adaptability of these fields to row crops.

Cattle grazing is not an economically competitive use in those areas which were formerly row-cropped. Growing pasture, however, would be a more likely alternative than row-cropping on the 4,344 acres of formerly strip-mined land. The major benefits from the project for pasture use are the leveling of strip-mine spoil and the addition of nutrients and organic materials. Leveling makes it possible to use farm machinery to control tree growth instead of hand labor which is prohibitive in cost. Small portions of the project area are well suited for the development of feedlots. Major on-site capability for feedlots has been provided by systems installed to control and monitor pollution from stormwater runoff. Such systems are necessary for environmentally sound management of feedlots.

a. Potential for agricultural uses - Present and future feasible uses for agricultural land in Fulton County include row cropping, pasture, feedlots, and forest management. Available information suggests that the future economic demand for increased amounts of farmland will be small. Besides shifting toward larger individual farms and increasing mechanization, local agriculture is changing its composition. Dairy, winter wheat and poultry production have declined, while corn, soybeans, swine, and beef cattle production have increased. Increases in beef and pork production have been encouraged by expanding local and regional meat packing facilities, notably Oscar Mayer. A trend toward feedlot production can be expected to be matched by increasing production of corn for feed.

Steep slopes and severe problems of access in unreclaimed strip-mining areas have caused failure of previous local attempts to manage timber crops. The steep slopes of the strip-mined portions of the project area have been leveled and many access roads have already been built as a part of the MSDGC project. However, there would be a long time lag before the first timber harvest, and considerably more local land would have to be planted with trees to provide enough continuous supply to support a local lumber products industry. One attempt at beef ranching was also tried prior to the MSDGC project.

Continued sludge application followed by reuse of the project site could have a major beneficial impact during the entire application period. The project could serve as the principal site in the U.S. for evaluating the effects of various application methods in different agricultural activities. The experiment would be highly valuable in assisting other communities in designing and managing their sludge disposal systems. Continued sludge application would also affect the eventual reuse of the project site. The future productivity of the formerly strip-mined areas can be expected to increase significantly with the continued application of sludge, possibly making row-crop production economically feasible.

b. Residential uses - Future demand for housing in Fulton County will primarily reflect projected population increases and replacements of the existing housing stock. This housing demand will concentrate in central places (primarily Canton, Lewistown and Farmington) and in eastern portions of the County which have easy access to developing industrial employment in Peoria-Pekin and along the Illinois River. Although the population of Canton can be expected to increase, the size of this increase will be limited in two ways. First, employment centers and regional facilities in Peoria are presently relatively inaccessible to the Canton population. Second, the trend in suburban expansion of Peoria demonstrates that the outer ring of this expansion is not likely to reach Canton in the foreseeable future.

Two independent methods are used to calculate future housing demand. One is based on population projections; the other is based on trends in the issuance of building permits. Population projections by the State of Illinois Bureau of the Budget (1975) predict a countywide population of 42,031, for 1980 and 44,691 for 1990. Assuming 3.5 persons per household, this population increase would add nearly 460 by 1980 and a total of over 1,300 units by 1990. Considering all factors, the total number of new units might exceed 600 by 1980 and 2,000 by 1990. Building permit data substantiate these projections. Data from 1972 to 1975 show that building permits were issued for an average of 98 single-family homes and 48 mobile homes each year. The average number of building permits issued per month significantly increased from 1972 to 1975.

There are major constraints to residential uses in the project area. These relate primarily to water quality and the problems of building on unconsolidated materials. Local groundwater is too highly mineralized to be suitable for drinking water. The naturally clear, deep blue local lakes are attractive to residential development. However, this clarity results from deficiencies of nutrients necessary to support algae growth. Experience in Wee-Ma-Tuk Hills demonstrates that even well-maintained aerobic septic systems with a sand filter and chlorinated discharge cause nutrient over-enrichment and consequent aesthetic degradation of the lakes. These systems are the most feasible for the project area, yet they cost $1,500 more than a conventional anaerobic septic system (Muehler, 1975).

Building on the unconsolidated materials of strip-mine spoil adds other premium costs to home building. Settling problems force homes to be built on reinforced slabs that average $1,000 in cost above conventional foundations (Muehler, 1975). Potential settling also adds significantly to the cost of providing and maintaining pipelines and hard-surface roads. Despite such serious constraints, improvements made by the MSDGC to the formerly stripmined portions of the project site have increased its suitability for residential use. These improvements do not, however, counter-balance the constraints which, together with the availability of numerous competing home sites throughout the county, make future residential development highly unlikely.

c. Recreation and conservation uses - Poor accessibility will be a major limitation on the number of visitors to a recreation facility in the project area. Poor road conditions compound the difficulty in getting to the project site from interstate highways or major population centers. Of course, poor accessibility hinders but does not preclude large numbers of travelers. Past records have shown more than 100,000 visitors to Dickson Mounds State Park and 100,000 visitors attended the four-day Spoon River Drive Fall Festival (Bordner, 1975; Shields, 1975).

The attractiveness of a regional recreation facility in the project area would be enhanced by the diverse attractions in nearby Spoon River Valley, along the Illinois River, at Dickson Mounds State Park, and in numerous formerly strip-mined areas. They are often used for hunting, fishing, camping, and driving off-the-road vehicles such as trailbikes and snowmobiles.

Probable recreation and conservation uses in the project area include hunting, fishing, camping, native prairie and wildlife and an outdoor ecology laboratory. The MSDGC's past and future alterations of the project site can be expected to exert important influences upon each of these activities. Continued sludge application would add organic material and mineral nutrients in quantities sufficient for the growth of a greater diversity of plant species than are normally found in unreclaimed strip-mined areas. Increased plant diversity generally leads to increased diversity in wildlife.

The pH values, alkalinity, conductivity, and concentrations of total phosphorus, sulfate ion, calcium, potassium, sodium, aluminum, iron, magnesium, manganese, mercury, nickel, selenium and fecal coliforms remain close to the 1971 and 1972 baseline conditions (see Chapter IV). Recent concentrations of cadmium, chromium, copper, lead and zinc are lower than the baseline concentrations. In 1971 and 1972, 40 percent of the wells tested contained excessively high levels of chemical constituents. When retested between 1973 and 1975, after the project had begun, the statistic was the same. Groundwater constituents are, therefore, probably influenced by sources unrelated to the project.

Chapter VI
Alternatives to the Project

VI. ALTERNATIVES TO THE PROJECT

The Draft EIS presented a more thorough discussion of sub-alternatives to the complete system, such as dewatering, digestion, and drying systems. This discussion is not presented here. Only the volume reduction or disposal alternatives are presented. It should be kept in mind that digestion processes are not needed for incineration, but are mandatory for land application alternatives. It became necessary to update costs as presented in this Chapter. Periodicals and EPA manuals were reviewed to determine recent capital and operation and maintainance costs for various sludge disposal processes. However, the literature did not present costs in a manner that could be applied to update the costs used in the discussion below. There was no way to compare the costs accurately without making some assumptions and changing some of the sludge quantity parameters. In order to be consistent, costs used in the discussion below remain unchanged from the Draft EIS. Following each category of sludge disposal, the costs have been updated to 1980 by using the EPA Sewage Treatment Plant Construction Costs Index.

The ratio of the March 1980, EPA Construction Cost Index for Sewage Treatment Plants to the base year cost index was used in the cost updating process. As an example, the cost index for March 1980 is 357.5. The cost index for a 1972 cost is 172.0. The ratio of indices indicates the magnitude of cost increase to construct or operate wastewater treatment plants.

A. Disposal or Utilization Alternatives

1. Incineration

Dewatered sludge cakes from vacuum filters and centrifuges can be sterilized and reduced in volume by incineration. Incineration destroys organic matter in the sludge and dewaters the sludge by evaporation. The two types of incinerators most applicable to sewage sludge are multiple hearth and fluidized bed incinerators.

The multiple hearth furnace consists of a circular steel shell surrounding a number of stack-up solid refractory hearths. Partially dewatered sludge is continuously fed to the upper hearths, where the sludge is heated and vaporized at roughly 1,000 degrees F. Openings in each hearth allow sludge particles to crop to the next lower hearth. A high-temperature combustion zone between 1,600 and 1,800 degrees F is formed in the intermediate hearth, where volatile gases and solids are burned. The bottom hearth serves as a cooling zone. Fly ash is removed from the exhaust gases by wet scrubbers.

The fluidized bed incinerator consists of a combustion reactor or bed of fluidized sand which is supported by upward-moving air. Intimate contact between the sludge particles and oxygen is achieved by rapid mixing of the fluidized sand grains.

Because of the large surface area provided by the sand particles, heat exchange between gases and solids is extremely rapid. Sludge is burned in the combustion zone at 1,400 to 1,500 degrees F. Auxiliary fuel is usually required when secondary sludge is burned. However, after start-up, dewatered raw primary sludge may be burned without this supplementary fuel. The residual ash particles are removed from the reactor by the upward movement of combustion gases. Ash particles are removed from the gas phase by wet scrubbers.

From the study of a model city with 10,000 people contributing 2,530 tons of solids per year, the capital and operating costs for multiple hearth incineration are given in Table VI-1, Annual Capital and Operating Costs for Multiple Hearth Incineration (Quirk, 1964). The total annual capital, operating and maintenance costs for a plant handling more than 500 dry tons of sludge per day are less than $15 per dry ton, based on the 1972 dollar (Stanley Consultants, 1972). Utilizing the 1972 base index of 357.2, the 1980 cost would be $31.20.

Table VI-1. Annual Capital and Operating Costs for Multiple Hearth Incineration (Quirk, 1964)

(dollars per ton of dry solids)

	Incineration Without Deodorization	1980*	Incineration With Deodorization	1980*
Capital Cost	$ 9.15	29.73	$ 9.47	30.77
Operating Cost	$ 6.36	20.67	$ 9.50	30.87
Total Annual Cost	$15.51	50.40	$18.97	61.64

*To convert to 1980 dollars, multiply each number by $\frac{357.5}{110}$, or 3.25.

The annual capital and operating costs reported for fluidized bed incineration at Lynnwood, Washington, ranged from $26 to $35 for systems serving populations of 22,000 and 8,000, respectively (Alberson, 1965). At the East Cliff Sanitary District Plant, California, operating costs of approximately $25 per dry ton per year were reported (Sohr et al., 1965).

The cost index for 1965 is 112. Therefore the ratio with the March 1980 index of 357.5 is 3.19 yielding:

3.19 X $26 = $82

3.19 X $35 = $112

3.19 X $25 = $80

Factors affecting the cost of sludge incineration are:

* Nature of the sludge
* Amount and type of chemical used in sludge conditioning before mechanical dewatering
* Degree of mechanical dewatering
* Costs of fuel, water and power
* Extent of air pollution control required
* Size and design of the treatment plant

Environmental considerations for incineration are centered around air and water pollution. Air pollutant emissions include particles, odors, sulfur oxides, nitrogen oxides, and volatile trace metals such as mercury. Wet scrubbers are efficient in removing fly ash but ineffective in capturing hazardous sub-micron particles (diameters between 0.1 and 1.0 millionth of a meter can lodge permanently in the lung). The wastewater from the scrubbers requires treatment to avoid water pollution problems.

Odor problems associated with incineration are of constant concern. Incomplete combustion or partial breakdown of organic volatile molecules is the major cause of odor. Maintaining an exit temperature of 1,200 to 1,500 degrees F is effective in destroying odorants. This measure, however, requires auxiliary fuel and burners. High solids dewatered sludge cake (35 percent or greater solids) made by heat treatments and/or high pressure filtration requires no additional fuel. Volatile trace metals which escape the scrubbers have some adverse impact on the environment. Economical means for removal of these emissions are not available. The relatively high fuel consumption for incineration, as opposed to other sludge processing methods, creates an impact on the environment and non-renewable resources.

2. Heat Drying for Soil Conditioners

Heat drying removes moisture from sludge, thereby providing for efficient incineration. Heat drying also prepares sludge for conversion into fertilizer. Drying is necessary in fertilizer manufacture to permit grinding and to reduce the weight of the sludge.

Dewatered sludge is mixed with dry sludge to reduce moisture content and particle size. The mixture is then fed into a flash drying system. In the system, sludge is passed through a high-temperature-and-turbulence zone for a few seconds, reducing the moisture content to 2 to 5 percent. Heat-dried sludge is separated from the gaseous phase in a cyclone separator. Afterburners at a temperature of 1,400 degrees F or higher are frequently required to deodorize stack emissions.

A study of the economic aspects of heat drying in a medium size plant, handling 2,530 dry tons per year, revealing that the annual capital and operating costs approximate $37 per dry ton with stack gas deodorization and $29 per dry ton without deodorization (Quirk, 1964). These costs do not account for the sale of dried sludge as fertilizer or as a soil conditioner. The cost index for 1964 is 110.0. The 1980 cost would be $120 and $94, respectively.

Heat drying consumes more fuel than incineration processes. It also contributes to air pollution by emitting suspended particles, nitrogen oxides, sulfur oxides and trace metals. However, heat drying has less air pollution potential than does conventional incineration, which requires combustion temperatures. Cost of air pollution abatement of exhaust gases can be substantial.

3. Sanitary Landfill

Sanitary landfill can be used for disposal of sludge, grease and grit, stabilized or not, if a suitable site is available.

The landfill is most beneficial if it is also used for disposal of refuse and other solid wastes. Liquid sludge acts as a wetting agent which increases compaction of the landfill; sludge cake or incineration ash mixed with refuse increases the density.

Sanitary landfills can be divided into two major categories—area landfills, which are on relatively flat terrain, and depression landfills, which utilize natural or man-made depressions in the landscape such as a quarry or gravel pit.

Sanitary landfills have traditionally operated at low unit cost. Capital costs for landfill include investment in land, site facilities, and equipment. A general capital cost cannot be estimated because of the wide variability in land prices. Annual operating costs for sanitary landfills were reported to vary between $0.50 and $2.00 per wet ton (Stone, 1962). The cost index for 1962 is 107.0, yielding a range of $1.67 to $6.68 for the costs, updated to 1980. These figures are very low compared to other landfill data. Therefore, overall costs are largely determined by hauling costs and land prices. Excluding land investment, the total capital, operating and maintenance costs are estimated to range downward from $1.80 to $1.20 per wet ton of sludge per year for operations of 1,000 to 10,000 wet tons per day, respectively (Stanley Consultants, 1972). Increased emphasis on environmental effects may elevate costs of sanitary landfills. The cost index for 1972 is 172. The range, expressed in 1980 costs would be from $3.75 to $2.50.

Poor management of sanitary landfills can result in adverse environmental effects. Dewatered sludge and other solid wastes in landfills degrade chemically and biologically to produce solid, liquid, and gaseous products. Microbiological decomposition of landfill material initially occurs aerobically, and then anaerobically when oxygen is depleted. Characteristic waste products of aerobic decomposition are carbon dioxide, nitrate, and nitrite. Migration or leaching of nitrate and nitrite can cause groundwater contamination. Typical products of anaerobic decomposition are methane, carbon dioxide, water, organic acids, nitrogen, ammonia, inorganic salts, and hydrogen sulfide. Some of these products are odorous. Acidic products can lower the pH value of the landfill and cause mobilization of trace metals which may affect the quality of surface and groundwater. Nuisance conditions such as odors and flies can be minimized with daily coverage of the waste, but cannot be avoided altogether.

In most areas, available land conveniently located is becoming increasingly scarce and old sanitary landfills are now being used for development. In general, this reuse was not contemplated during the construction of the original fill. Uneven settlement and poor bearing strength of fill materials present foundation problems which significantly increase construction costs. Total failure of structures built on landfill sites has been reported. Therefore, it may be desirable to build landfills so that future development can be undertaken at reasonable cost (Sowers 1968).

The Northeastern Illinois Planning Commission has noted in their 208 studies that landfill sites in Northern Illinois will be practically non-existent within the next ten years.

4. Lagooning

Lagooning has been the most popular sludge disposal method for industrial wastewater treatment plants; lagoons are also used at municipal plants. Lagooning can be used as a contingency method of sludge handling and storage while other sludge processes are temporarily overloaded or out of service. Lagoons can be divided into three classes: thickening, storage, and digestion lagoons; drying lagoons; and permanent lagoons.

Digestion of sludge in the first type of lagoon is a lengthy process which creates multiple nuisance problems. Drying lagoons certainly compete with the use of sand drying beds. The sludge must be digested before entering the lagoon. Removal of dried sludge, which must be disposed of by other means, is necessary to maintain the effective capacity of a drying lagoon. Multiple units and supernatant decanting devices are required in the first two types of lagoons, as the supernatent is always returned to the head of the plant. A permanent lagoon, one from which the sludge is never removed, in an ultimate disposal site similar in function to sanitary landfills has proven to be the most economical method of sludge disposal where suitable sites still exist.

Variables in lagooning operations are land availability, climate, subsoil permeability, groundwater table elevation, sludge characteristics, and sludge loading rates. Land available adjacent to the treatment plant substantially reduces sludge hauling costs. Good climatic conditions, which enhance evaporation of sludge water, are necessary for efficient performance. Soil permeability and groundwater elevation affect lagoon performance by determining the rate of drainage and the potential for groundwater contamination. Raw sludge generally requires less lagoon capacity than digested sludge. One cubic foot of lagoon can handle 6 pounds of raw sludge per year as compared to 2.3 pounds of digested sludge per year. Construction costs of sewage stabilization ponds in the Midwest were reported to vary between $1,000 and $3,000 or more per acre. The cost index for 1972 is 172.0. The range expressed in 1980 costs would be from $2,080 to $6,240. Lagoons constructed in depression areas can be significantly cheaper (Howells and Dubois, 1959). Excluding land investment, the construction costs of lagoons were estimated to range downward from $28.62

to $12.70 a year per acre-foot for lagoon capacities of 10 and 100 acre-feet, respectively. The costs are amortized using a 7 percent discount rate over 20 years and are based on the 1972 dollar (Stanley Consultants, 1972). The cost index for 1972 is 172. The range expressed in 1980 costs would be from $59.52 to $26.42.

Literature reviews show that the operating and maintenance cost of sludge lagooning range from $1.00 to $3.50 per dry ton of sludge per year (Dubois, 1962, Caron, 1964, Burd, 1968). In 1972 dollars, the annual operating and maintenance costs were reported by Stanley Consultants to be approximately $5.00 per dry ton for a plant producing 100 dry tons of sludge per day. Costs will increase if the sludge is transported long distances for lagooning. The cost index for 1972 is 172 and the costs can be updated to $10.40, in 1980.

Lagooning of raw sludge creates nuisance problems such as poor odor emission and insect infestation. Nuisance problems associated with lagooning of digested sludge are less severe. To minimize these problems, adequate buffer distances must be provided between the lagoons and the nearest sensitive receptors. Seepage and percolation of sludge water through permeable soil can present groundwater pollution problems. Lining the lagoon can prevent groundwater contamination, but this will increase both initial and operating costs; artificial drainage may be required due to loss of subsoil drainage.

5. Ocean Dumping

Ocean disposal of industrial and municipal sewage sludge has been commonly adopted by municipalities close to the sea. Some of the largest cities in the United States, including Boston, New York, Philadelphia, and Los Angeles, dispose of their sludge in this fashion. Ocean disposal was an economical solution for cities located along the coasts. However, ocean dumping has created severe environmental and public health problems. This method will be phased out soon and no further discussion is provided here.

6. Fertilizer Production

Sewage sludge has been used as fertilizer and soil conditioner for many years. The use of liquid sludge has been rather limited because of handling difficulty, but dried sludge reduces this problem significantly. Preparation of these sludge products can be achieved by air drying on sand beds, mechanical dewatering, or heat drying, as discussed previously in this chapter.

The value of sludge fertilizer is determined by nitrogen, carbon, phosphorus, and potassium contents. Hence, the value of sludge as a fertilizer is limited because of low concentrations of nitrogen, phosphoric acid, and potash. However, the high content of organic material in sewage sludge provides for excellent soil conditioning. The phosphorus content of municipal sewage sludge was significantly increased with the use of phosphate detergents (Anderson, 1956). Of course, this may not be as true currently because of the development of low phosphate detergents. Of particular interest to agronomists is the carbon-nitrogen ratio pf sewage sludge. A study of sludge characteristics in five municipalities indicated that the nitrogen content ranged from 2.0 to 6.0 percent; carbon 21 to 47 percent; phosphoric oxide 1.0 to 11 percent; ash content 24 to 52 percent; and humus 33 to 41 percent (Anderson, 1956). In general, digested sludge has a lower fertilizer value because the nitrogen content is reduced 40 to 50 percent by the digestion process.

In the past, many treatment plants with heat drying equipment converted from fertilizer production to sludge incineration or landfilling, because the sludge fertilizer market could not be successfully developed. This trend has been reversed recently because of the high-energy demands of incineration and the scarcity of landfill sites. Based on potential sales revenues and the concept of recycling nutrients, fertilizer production may gain more public acceptance. For example, Milwaukee, Chicago and Houston have successfully marketed large quantities of heat-dried activated sludge for many years. The price has depended on the nitrogen content of the sludge and has varied from $12 to $18 per ton (Burd, 1968). The cost index for 1968 is 123.6. The range in 1980 costs is between $34.71 and $52.06.

Over 200,000 tons each year were sold by these cities for application to crops, golf courses, and park land. However, most cities have donated sludge dried on sand beds in order to dispose of it off the plant site.

The major environmental concerns over the utilization of sludge as fertilizer or soil conditioner deal with possible health hazards from pathogenic microorganisms and trace metals and non-point source water pollution. Pathogenic microorganisms are destroyed by heat drying, but pathogens in air-dried or mechanically dewatered sludge might contact food plants or fodder and be ingested by humans or livestock. Trace metals such as zinc, nickel, copper, cadmium, lead, chromium, and mercury may be selectively concentrated or biomagnified through the food chain, presenting health problems to domestic animals and man.

Uncontrolled application of dried-sludge fertilizer may also contribute to non-point source water pollution, which is extremely difficult to confine and regulate. When assessing the benefits of stabilized sludge used as fertilizer, potential consequences to the environment must be weighed. Perhaps controlled distribution, mandatory sterilization, and limitation of dried-sludge fertilizer application to plant species having low rates of uptake and concentration of harmful substances would render this waste product safe enough. The costs of pretreatment or advanced treatment of industrial wastewater, using carbon absorption or other means to remove heavy metals, might be offset by the increased value of safe sludge fertilizer.

7. <u>Composting</u>

Composting is defined as the aerobic thermophilic decomposition of organic wastes to a relatively stable humus by microorganisms. The product of composting can be used as a soil conditioner. Traditionally, composting has been used to stabilize solid refuse. Sewage sludge has only occasionally been used in solid refuse composting. Composting systems generally fall into three categories: pile, windrow, and mechanized or enclosed systems.

Composting consists of three stages; mixing, composting and maturing. Solid refuse is sorted by screening and magnetic separation, and is pulverized in a grinder. Sewage sludge is then mixed with the pulverized refuse. The mixture is placed in windrows, pits, or silos for decomposition and stabilization. The compost row or pile is normally turned daily for 2 weeks or longer with a composter, except during periods of rain. Under proper composting conditions, temperatures in the windrow range from 130 to 150 degrees F, falling into the thermophilic range wherein the rate of decomposition is the highest. The heat generated as a result of thermophilic microbial oxidation creates a convection current, supplying air to the microorganism. High temperature also can provide for efficient destruction of pathogenic organisms and weed seeds. For effecient composting, the optimum pH of the material should be neutral.

After decomposition, the compost row or pile is flattened for further drying. Material removed from the composting system is cured for at least 30 days, which provides further stabilization. Besides solid refuse, other bulking agents such as sawdust, shredded paper, or wood chips can be used for sludge composting.

The Agricultural Research Service at Beltsville, Maryland, has studied sludge composting for several years. The capacity of the compost site is approximately 100 to 150 wet tons per day. Their experience suggests that the major problems associated with the operation are adverse weather conditions and odors. The study concluded that the annual capital and operating costs for composting 200 wet tons per day of digested sludge with 20 percent solids is approximately $7.31 (1980: $12.03) per wet ton or $30.00 (1980: $49.50) per dry ton of sludge. The operating cost alone accounts for $4.10 (1980: $6.76) per wet ton or $16.80 (1980: $27.72) per dry ton. Wood chips contribute over $2 per wet ton to the costs, most of which is for hauling. The cost estimate does not consider benefits from sale of the product. Rodale and Scott reported that compost has been sold for $2.00 (1980: $5.78) to $90.00 (1980: $260.10) per ton (Burd, 1968). The smaller figure was the price of large quantities of raw compost; the large figure was the price for small specialty markets such as gardens and golf courses.

The environmental problems associated with composting are odors and attraction of insects. Odor nuisance seems to outweigh insect problems. If the compost system is too large, dense, or wet, anaerobic conditions may set in and produce undesirable odors. Enclosing the system is beneficial but increases cost. Distributing composting products as soil conditioners provides revenue, but may cause the same environmental problems as pertain to fertilizer production, discussed previously in this chapter.

8. Soil Reclamation

Application of liquid sludge to land is a practice dating back to antiquity, especially in England (Benarde, 1973). In the United States, disposal of sewage effluent or digested sludge on farmland has not been widely practiced, due partly to the past availability of inexpensive and conveniently handled inorganic fertilizer. However, higher costs and environmental risks with other methods of sludge disposal are making them less attractive. This fact prompts many wastewater management organizations to seriously consider the alternative of land application.

St. Mary's Pennsylvania, has disposed of digested sludge on hay fields, pasture, corn stubble and athletic fields. The application rate for pasture is about 64 wet tons per acre per year with 3.7% solids. Raw sewage from Muskegon, Michigan is pumped to a series of aerated lagoons. The effluent from the lagoons, whose quality is equivalent to that from secondary treatment, is sprayed on farmland. The projected capacity of the system is 43.4 million gallons per day (MGD), including an industrial flow of 24 MGD (Chaiken, Poloncsik, and Wilson, 1973).

Digested sludge has normally been utilized for land application, because raw primary and activated sludges decompose and create a nuisance. Liquid digested sludge can be applied to fields by spraying, soil incorporation, soil injection, ridge and furrow irrigation, and infiltration by shallow impoundment. Each method has specific advantages and disadvantages in terms of workability, reliability, and environmental effects. Transportation of sludge to the application site can be accomplished by tank truck, railroad tank car, enclosed barge, or pipeline, depending upon transport availability, site location, and cost-effectiveness. Detailed discussions of transportation are presented in the following section.

The rate of sludge application to land is determined by a number of factors, including climate, topography, hydrology, and soil and sludge characteristics. Literature review indicates that a wide range of application rates up to several hundred dry tons per acre per year have benefited soil and crop growth (Table VI-2., Digested Sludge Application Rates, Burd, 1968; Ewing and Dick, 1970). Upper limits are not yet recognized; ultimately they will be determined by the build-up of nutrients and heavy metals in the soils and future land use.

The land application process recycles inexpensive and useful organic and inorganic materials back to the land, conserves non-renewable resources such as inorganic fertilizers, and eliminates costly sludge thickening and dewatering. The capital costs for land application include land acquisition, access roads and fencing, site grading, sludge storage facilities, distribution systems, and application equipment. Operating costs include sludge transportation, sludge application and crop cultivation. Systems to monitor and control environmental effects further add to costs, and should be accounted for and weighed against those for other alternatives for sludge disposal or utilization. Table VI-3., Land Spreading Costs (Burd, 1968; Dalton et al., 1968), presents reported unit costs associated with land spreading of sludge.

Table VI-2 Digested Sludge Application Rates (Burd, 1968; Ewing and Dick, 1970)

Reference	Year	Type of Sludge	Approximate Solids Concentration (%)	Approximate Dry Solids Loading (ton/acre/yr.)	Remarks
Kershaw and Wood	1952	Digested primary and activated sludge	4.0	2.5*	England.
Merz	1955	Digested primary sludge	6.5	10-100	San Diego; 25 tons/acre equivalent to commercial fertilizer.
California State Water Pollution Control Boards	1957	Digested	--	100-300*	California; high to low rainfall areas, respectively.
Nusbaum and Cook	1960	Digested	--	1,000*	San Diego; land reclamation.
Wolfel	1964	Digested primary sludge	4.1	3.0*	Pennsylvania; well below commonly reported application rates.
--	--	Digested primary and activated sludge or trickling humus	--	2.0*	Nine Pennsylvania communities; well below commonly reported application rates.
Troemper	1965	Digested primary and activated sludge	6.0	61	Springfield, Illinois; average application rate.
Hinesly and Sosewitz	1968	Digested	3.0	8-29*	Chicago; soybeans and corn responded favorably.

*No indication of annual repetition, so units may be ton/acre.

Table VI-3. Land Spreading Costs (Burd, 1968; Dalton et al., 1968

Reference	Year	Approximate Operating Cost $/ton of dry solids	Remarks
Scanlon	1957	$7.50	New York, about the same as barging to sea.
Nusbaum and Cook	1959–1960	$10.00	San Diego, 21-mile haul.
Nusbaum and Cook	1960	4.00	San Diego, $1.50 for pipeline transfer.
Dalton et al.	1968	$20.00-23.00	Chicago Sanitary District preliminary estimate.
Burd	1968	$4.00-30.00	General range with $10/ton

The wide range in costs is due to the various hauling distances reported in each of the studies. The construction cost, amortized capital cost, operating and maintenance cost, and total cost, excluding land amortized at 7 percent over 20 years are presented in Figure VI-1., Surface Spreading Costs (Stanley Consultants, 1972), based on the 1972 dollar. For a project capacity of 1,000 dry tons per day, the total annual cost is approximately $7 per dry ton of sludge.

The major problem associated with land application is public acceptance. Potential environmental problems include transmission of odors and airborne pathogens, build-up of nutrients and heavy metals in the soils, surface water and groundwater contamination, and biomagnification of toxic substances in food chains or transfer of pathogens by ingestion, if agricultural produce is raised on the application fields. Proper choice and control of sludge application methods, rates and periods, and proper monitoring and pollution control should eliminate or minimize some of these environmental problems.

B. Transportation

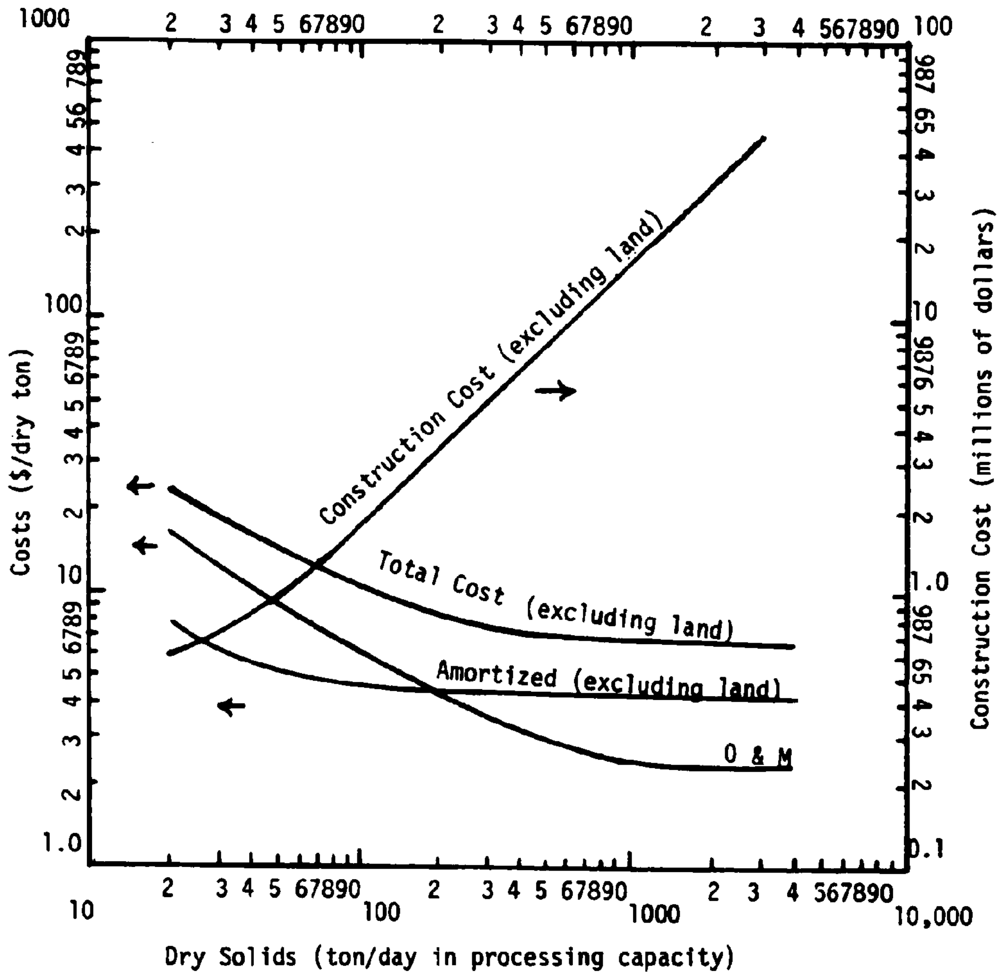
Sludge transportation is an integral part of sludge disposal or utilization. Transportation frequently exerts a significant influence upon overall costs. Optimization of sludge handling and disposal or utilization requires examination of the reliability, costs, and environmental effects of various sludge transportation modes. There are four identified: truck, rail, barge, and pipeline.

1. Truck Transportation

Hauling of sludge by truck offers the advantage of flexibility in routes and destinations. Liquid sludge can be hauled by trucks from one treatment plant to another for further treatment or disposal. Dewatered sludge is commonly hauled by trucks to landfill sites for disposal, or to stockpiles for subsequent utilization as fertilizer and soil conditioner. Hauling distance can range from a few miles to several hundred miles.

Economics of trucking sludge is determined by hauling distances and sludge characteristics. Unit costs increase with increasing solids content and hauling distance. A comparative study of the costs of transporting 3.5 percent solids by pipeline, tank truck and railroad tank car indicates that truck transportation is the most economical mode for distances up to 150 miles and for a treatment plant size of approximately 1.5 MGD. Truck hauling costs per wet or dry ton of sludge are presented as a function of sludge hauling distances and solids content in Figure VI-2., Truck Costs (Riddell and Cormick, 1968; Stanley Consultants, 1972).

The Blue Plains treatment plant in the District of Columbia in 1973 used its digested sludge for reclaiming marginal soils. Truck hauling and final disposal of sludge cake (20% solids) were handled by a private contractor at a cost of $6.85 per wet ton. In 1974, the contracted price was up to $8.25 per wet ton (Cassel and Mohr, 1974).



Notes:

1. Minneapolis, March 1972, ENR Construction Cost Index of 1827.
2. Amortization at 7% for 20 years.
3. Labor rate of $6.25 per hour.
4. Application rate of 25 dry tons per acre per year.
5. Sludge diluted to a solids content of 2% for spray distribution.
6. Storage lagoons, dilution wells, pumping station, piping and spray distribution equipment included.

Figure VI-1 Surface Spreading Costs (Stanley Consultants, 1972)

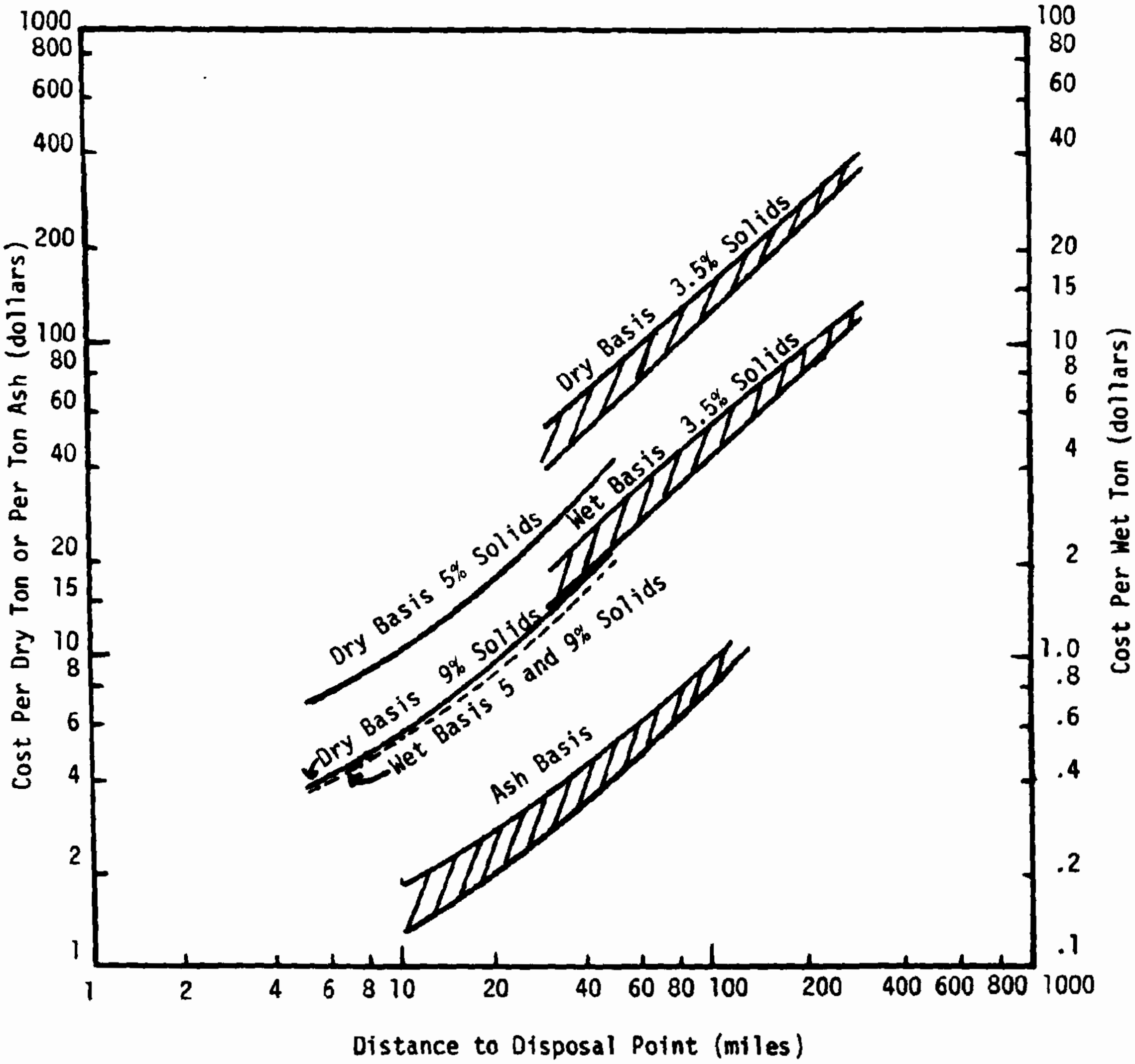


Figure VI-2 Truck Costs (Riddell and Cormick, 1968; Stanley Consultants, 1972)

Health hazards and odor nuisance associated with sludge hauling by trucks are minimized by the use of special trucks with a sealed tailgate and tarpaulin cover or, in case liquid sludge is hauled, a sealed tank. However, the noise and air pollutants generated by the trucks en route to disposal or utilization sites are generally unavoidable.

2. Rail Transportation

Railroads are an attractive mode for sludge transportation when tracks are near the origin and destination of the sludge and long distance hauling is required. Liquid sludge can be hauled by rail tank cars, and dewatered sludge in either open or closed hopper cars. Major structures required for railroad transportation are loading and unloading facilities.

Recently, some attention has been given to the unit train concept as a means of hauling sludge and refuse. The technology is available and under consideration by several metropolitan districts. The unit train in this instance might be comprised of 80 cars or vehicles. Each vehicle is a 20,000-gallon tank car with special fittings, and can handle a load of 80 tons of sludge. The train could make journeys of several hundred miles. Indoor or outdoor systems could load sludge either through the top of the tank or through a loading connection at the bottom. Completely automated systems could load 400,000 gallons of sludge into 20 cars in less than 3 1/2 hours with a three-man crew. By increasing pumping rates, the facility could load 500,000 gallons of sludge in 2 1/2 hours. A two-man crew could unload the sludge in approximately 2 hours. Based on a 200-mile journey, the 80-car unit train would have an overall turn-around time of 48 hours (Kostalich, 1973).

Based on a daily handling rate of 7,000 wet tons, the hauling cost for a unit train would be less than $2.00 per ton of wet sludge containing 6 percent solids (Kostalich, 1973). The unit cost of hauling sludge by a regular train is higher and depends on the rate structures, which vary with geographic location. On reviewing the hauling contracts for Philadelphia and San Francisco, unit costs were found to be $5.39 per ton and $6.25 per ton, respectively. The former figure includes final disposal; the latter does not (Stanley Consultants). The unit cost per dry ton of sludge as a function of hauling distance is given in Figure VI-3., Rail costs (Riddell and Cormick, 1968; Stanley Consultants, 1972). For distances greater than 150 miles, rail transportation is more economical than trucking for treatment plants of 1.5 MGD. Generally, the cost of rail transportation could be reduced in half if the unit train concept were utilized (Easton, 1970).

The environmental hazards of hauling sludge by rail are similar to those for truck hauling. However, in the event of an accident, environmental impacts could be worse because of the vastly increased amount of sludge.

3. Barge Transportation

Barging of sludge must be considered as an alternative mode of shipping when navigable waterways are available between origin and destination. Large quantities of sludge can be transported efficiently, and often barges can be rented.

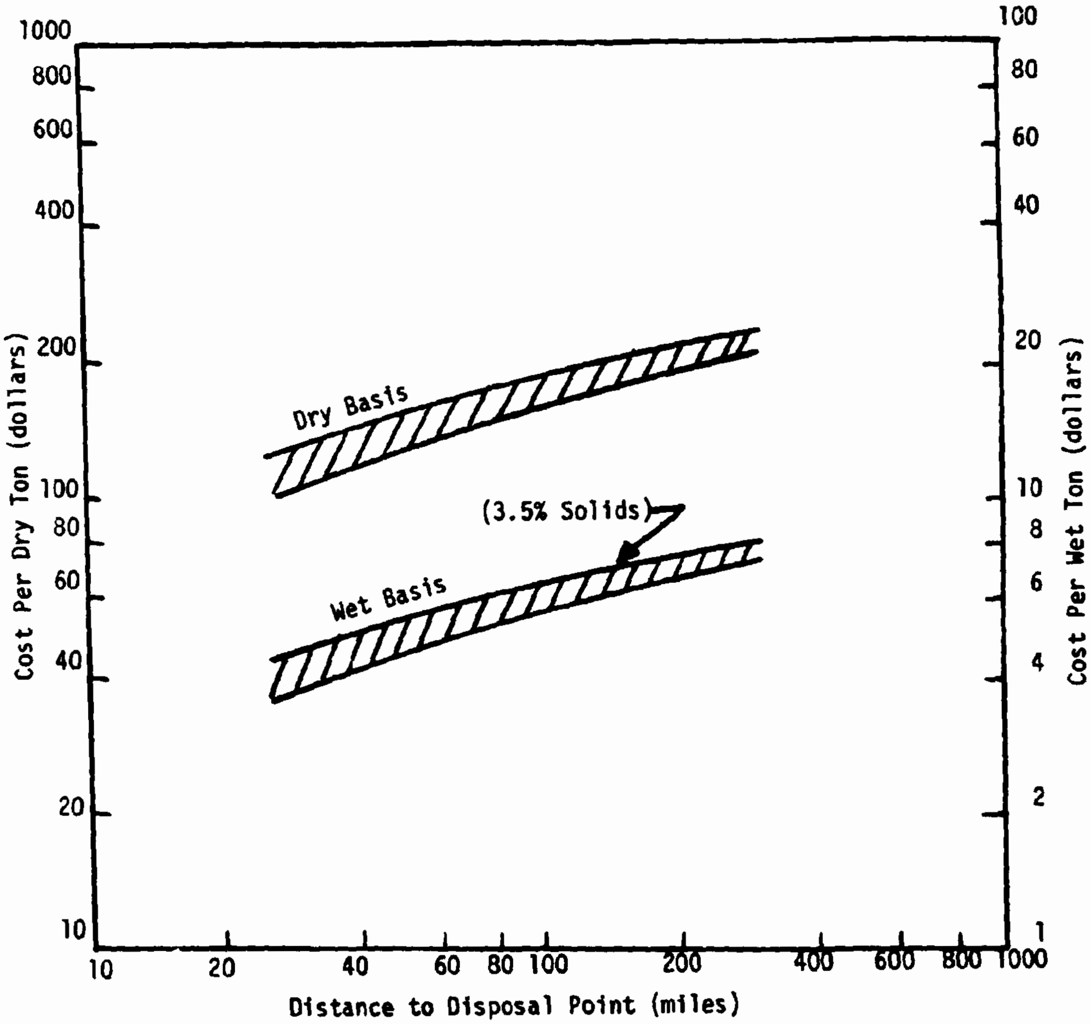


Figure VI-3 Rail Costs (Riddell and Cormick, 1968; Stanley Consultants, 1972)

The cost of barging 250 miles from Washington D.C., has been reported as $3.50 (1980: $10.12) per wet ton (Smith, 1968). The barging of sludge 133 miles on the Illinois River from Chicago costs $1.80 (1980: $5.20) per wet ton, based on a shipping rate of 9,000 tons per day (Stanley Consultants).

Environmental considerations in barging sludge are completely different from those for truck or rail hauling. Accidental spills of sludge from barges could cause severe short-term irreversible impacts such as fish kill or destruction of local benthos. However, the probability of this occurring is very small.

4. Pipeline Transportation

Pumping of sludge and waste slurries through pipelines has been practiced for many years. Short distance pumping of sludge exists in most sewage treatment plants. Transporting sludge pipelines has also become a popular mode for intermediate and long distances.

When assessing this alternative, the main factor to consider is the hydraulic characteristics of the sludge. Sludge containing 5 percent solids flows as Newtonian liquid, which is similar to water with respect to friction and power requirements. Sludge with greater than 6 percent solids possesses plastic properties, requiring a prohibitive amount of energy for long distance pumping (Sparr, 1971). A minimum flow velocity must be maintained to prevent solids from settling and to sustain the flow during turbulence. Other problems associated with sludge pumping are grease buildup and pipe corrosion. Degreasing the sludge prior to pumping and installing protective pipe lining could avoid these problems.

A study was conducted to determine the feasibility of pumping sludge from Cleveland via a 92-mile, 12-inch diameter pipeline for disposal on strip-mined land in southern Ohio, and of pumping sludge from the Washington-Baltimore area 80 miles by pipeline to an ocean outfall (Bechtel Corporation, 1969). Capital and operating costs in the first case were estimated to be $25 (1980: $67.35) per dry ton or $0.27 (1980: $0.73) per ton-mile, assuming 3.5 percent digested solids. The costs in the latter case were estimated to be $28 (1980: $75.43) per dry ton or $0.35 (1980: $0.94) per ton-mile. Based on a population of 2,000,000, digested sludge with 5 percent solids could be pumped 100 miles at a cost of $7 or $8 (1980: $20.95 or $23.92) per dry ton, or approximately $0.05 (1980: $0.15) per ton-mile, to reclaim marginal or strip-mined land (Rand Development Corporation, 1967). These costs do not include acquisition of easements along pipeline routes. The use of pipelines does not become economical for transporting sludge 25 miles away until the plant size reaches approximately 10 MGD. A 300-mile pipeline cannot be economically justified until plant size reaches approximately 25 MGD (Riddell and Cormick, 1968).

Short-term environmental effects during pipeline construction include air pollution from traffic jams caused by the disruption or interference of traffic, especially in urban areas. Proper insulation of lift and booster stations will minimize impacts on surrounding areas.

C. <u>System Alternatives</u>

Ten system alternatives for sludge processing and disposal were developed on the basis of experience gained from plant operations and research on various technical topics (MSDGC, 1973a, 1974a, 1974b, 1974c). Each system alternative has a planning period of 25 years, an average sludge production rate of 1,236 dry tons per day. Each alternative consists of a combination of several subsystems; namely, dewatering, stabilization, disposal and/or utilization and transportation subsystems. The system alternatives and sludge flows for each alternative are presented in Figure VI-4, System Operations and Sludge Flows (MSDGC, 1975a). The costs, system requirements, construction phasing, and life of facilities for each system alternative are summarized in Table VI-4 (MSDGC, 1975a).

The MSDGC considered the total scope of their disposal needs and decided that the best alternative was one that had flexibility within the system and more than one final option. Therefore, System 10 was chosen. Of the total 1,236 dry tons of sludge per day, 439 dry tons per day goes to the Fulton County project. While alternative 10 is not the least cost alternative, credit must be given on a wholistic basis for energy savings, reclamation of land that otherwise might not be in productivity, and employment of full and part-time persons to manage and operate the Fulton County site. The 1979 Operating Cost for Fulton County was $190.00 per equivalent dry ton.

This project can be considered a major milestone in reclamation of drastically disturbed land. The MSDGC has endeavored to involve different interest groups to the maximum possible in the design, operation, monitoring and redirection of the project. This highly dynamic project has been modified to utilize the most up-to-date equipment and techniques. Its basic premise was to take two difficult problems, unusable land and enormous amounts of municipal sludge, and realize the beneficial constituents of sludge for soil building and nutrients to return land into agricultural productivity. There was very little state-of-the-art when the project began, so the MSDGC had to experiment with application methods, piping systems and crop rotations. Their chief problem in early years was that they were not farmers. This led to criticism by some local citizens. While there still is some local opposition to the project, the County Board and most advisory groups support the project.

The project has provided opportunity for research by the University of Illinois, The County Extension Service, and Spoon River Community College. Much of the data on ingestion of pathogens and metals from sludge was conducted by the University of Illinois. Several researchers that have monitored the project since start-up are still associated with the project, providing the first long-term study data on sludge application projects. The Soil Conservation Service has provided timely input into the project.. Many of their conservation measures have been built into the project.

This does not mean that the project is without problems. Earlier noted erosion problems have been addressed in many cases. Gully erosion problems along the perimeter of some field may take longer to rectify. Most of these problems are contained within the site and don't necessarily add to the exist-

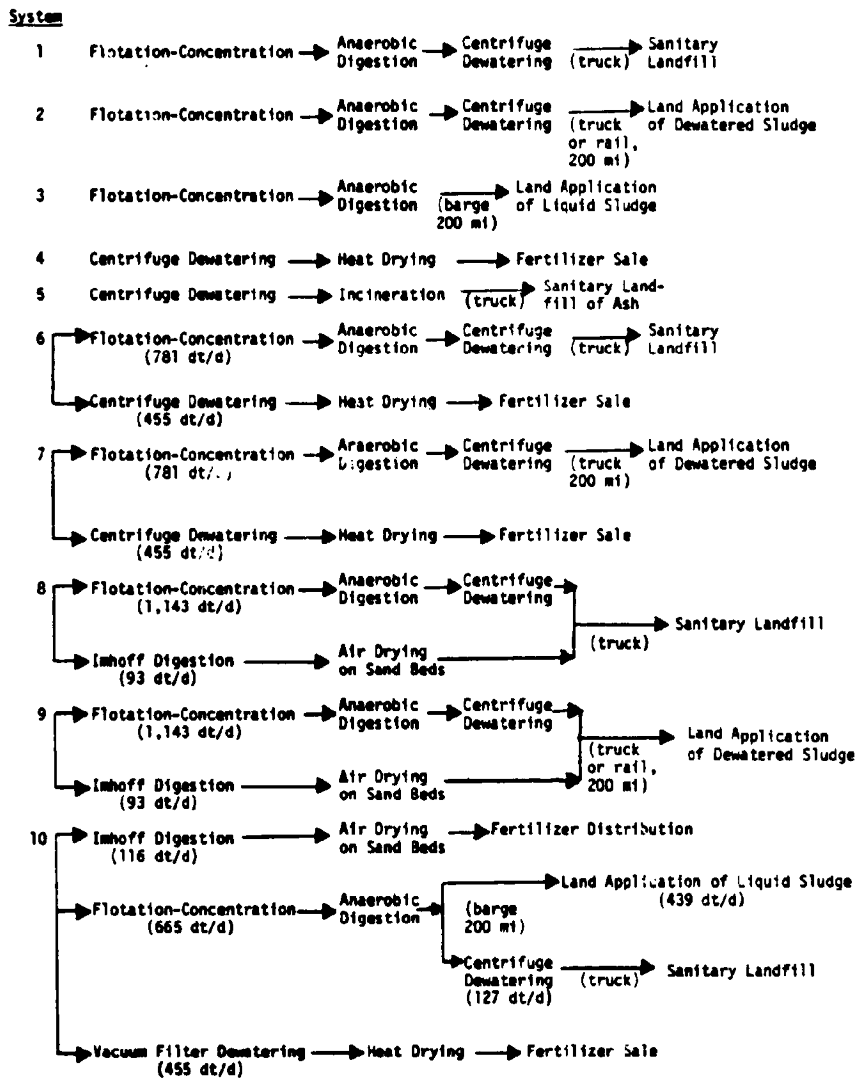


Figure VI-4 System Operations and Sludge Flows (MSDGC, 1975a)

Table VI-4 System Alternatives, System Requirements, Construction Phasing, and Life of Facilities (MSDGC, 1975a)

System	Costs (10^6 dollars/yr.) Amortized Capital ($)	O & M ($)	Total ($)	System Requirements and Constructin Phasing	Years (1975, 1980, 1985, 1990, 1995)	Life
1	5.62	26.05	31.67	7- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				4- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				37 - 21.9 dt/d centrifuges to supplement existing vacuum filtration facilities.		(10-yr.)
				10- 21.9 dt/d centrifuges.		(10-yr.)
				Additional 152 dt/d flotation-concentration facilities.		(20-yr.)
2	13.84	36.22	50.06* 47.70**	Same as System 1.		
				Land development (25,000 acres).		(12.5-yr.)
				Application equipment.		
3	10.45	34.53	44.38	7- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				4- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				Land development (25,000 acres).		
4	5.20	26.62	31.82	48- 21.9 dt/d centrifuges with flotation-concentration facilities.		(10-yr.)
				14- 21.9 dt/d centrifuges with flotation-concentration facilities.		(10-yr.)
				40- 12,000 lb water/hour drying lines.		(20-yr.)
				10- 12,000 lb water/hour drying lines.		
5	5.12	22.71	21.83	48- 21.9 dt/d centrifuges with flotation-concentration facilities.		(10-yr.)
				14- 21.9 dt/d centrifuges with flotation-concentration facilities.		(10-yr.)
				10- 33.0 ft. diameter fluidized bed incineration units.		(25-yr.)
				102 dt/d ash dewatering centrifuges.		
6	4.95	23.82	28.77	6- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				57- 21.9 dt/d centrifuges.		(10-yr.)
				11- 21.9 dt/d centrifuges.		(10-yr.)
				19- 12,000 lb water/hour drying lines.		(20-yr.)
				Additional flotation-concentration facilities.		(25-yr.)
7	8.50	29.00	37.50	Same as System 6.		
				Land development (10,200 acres).		(12.5-yr.)
				Application equipment.		
8	5.74	25.78	31.52	Rehabilitation of Imhoff tanks and sand drying beds.		
				7- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				3- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				37- 21.9 dt/d centrifuges to supplement existing vacuum filtration facilities.		(10-yr.)
				10- 21.9 dt/d centrifuges.		(10-yr.)
				Additional 152 dt/d flotation-concentration facilities.		
9	13.96	35.95	49.91* 47.54**	Same as System 8.		
				Land development (25,000 acres)		(12.5-yr.)
				Application equipment.		
10	3.67	31.43	35.10	3- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				2- 100 dt/d digester batteries with concentration facilities.		(25-yr.)
				27- 21.9 dt/d centrifuges.		(10-yr.)
				Land purchase and development (2,700 acres).		
				Application equipment.		

*Assuming truck transportation.
**Assuming rail transportation.

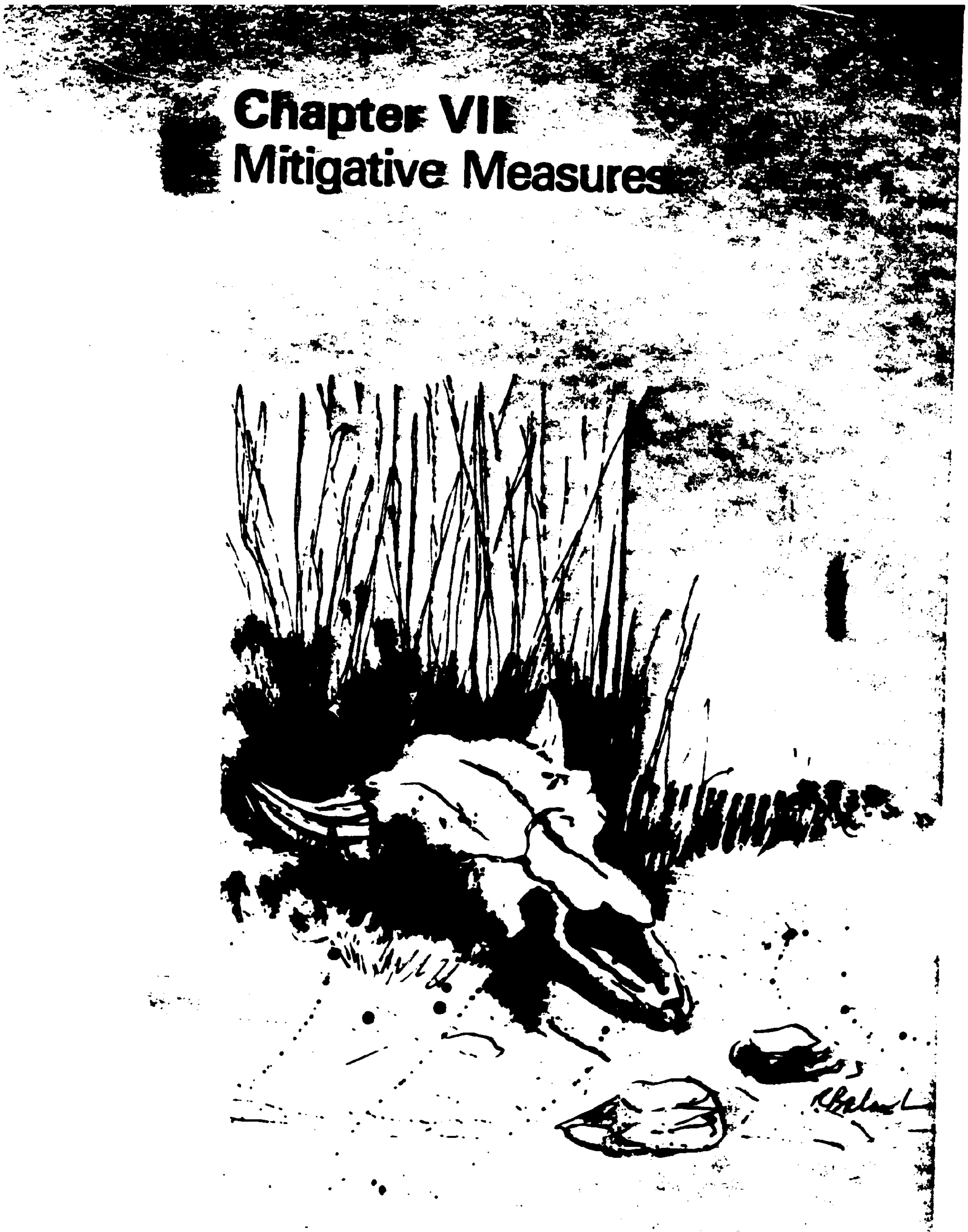
contamination from strip-mine runoff. This is evident from water quality investigations showing that water quality is better in Big Creek downstream of the project.

Local farmers have seen benefits from utilizing sludge as a soil amendment and fertilizer and have inquired about obtaining sludge for their own lands. With the rising costs of commercial fertilizers, sludge applications become more attractive. Also, the state-of-the-art is being improved, thereby reducing the relative risks associated with the project.

Reliability factors that were considered for the project included landfill availability in Northern Illinois, small scale land application on private lands, low sludge application rates and land requirements, fertilizer markets and energy requirements. On most of these factors, the Fulton County project rates very well. The establishment of a privately held site that is well monitored should allow the continuous implementation of land application. As further acreage is developed, weather-related problems would be reduced in that lower application rates on fields could be accommodated and a variety of field conditions would allow greater flexibility.

While some critics still remain, they have not provided a better alternative solution to the growing amount of sewage sludge. Given the full line of constraints associated with incineration and giveaway programs for large municipalities, the MSDGC project provides more benefits than risks. It is expected that as further data become available, the project will respond to techniques.

Chapter VII
Mitigative Measures



VII. MITIGATIVE MEASURES

A. Land

Two major areas of concern at the Fulton County project site are soil erosion and long-term soil contamination. Soil erosion depends to a great degree on the design of the fields as well as the level of maintenance of drainage control features. While available records suggest that considerable work is being done in regrading fields and revegetation, dikes and berms, field observations indicate that maintenance procedures are not entirely effective. The major impacts of erosion and siltation are on the internal basins. Very little runoff ends up in natural waterways. However, proper maintenance is recommended to ensure that this remains so. A positive aspect of the project is that the leveling activities have decreased the possibility of erosion in general areas.

Drainage control appears to be superior at the newer application fields compared to those designed and constructed initially. Grading of some of the newer fields has provided a shallow concave profile, creating backup reservoirs for use when the runoff retension basins are filled. Fields graded with a convex profile cause runoff to be channeled along the field perimeter, resulting in high velocity and scouring.

The MSDGC has sought a remedy by constructing additional siltation basins to retain silt-laden runoff. However, a lack of vegetation on control berms, drainage channels, and basin dikes has contributed to severe gully erosion, accelerating the rate of siltation and thereby reducing the added capacity for runoff control. This has increased the need for frequent desiltation operations. Available records however, indicate only sporadic cleaning of siltation basins. It is difficult to determine whether the apparent failure to clean existing basins is actual or merely reflects poor record-keeping. Also, field investigation demonstrated the existence on unrecorded, newly constructed siltation basins.

MSDGC records are sparse in documenting repairs to drainage pipes. Field observations indicated some instances of pipes being damaged by farm equipment and pipes clogged with silt, obstructing discharge from siltation basins into runoff retention basins.

With few exceptions, on fields where sludge is applied by disk incorporation, applications are made considerably above the nitrogen agronomic rate. Such high rates of application contribute to erosion of the soil in several ways. To incorporate large amounts of sludge, multiple passes (5 to 6) of the disk incorporator are required during the primary growing season, obviating the possibility of growing a crop. Thus the MSDGC has recently resorted to planting crops only in alternate years on most of these fields. In years when a field lies fallow and bare while sludge is applied periodically, soil erosion will increase considerably. Lack of a crop also prevents evapotranspiration. Recently, the MSDGC has planted a sacrifice crop at the end of the application year to help control erosion. This practice has been helpful.

Several unrecorded measures may combine to decrease the erosion and siltation effects at the project site. The MSDGC should document all redesign and new construction to credit their mitigative measures. When older fields were recontoured for tractor operations, the events were not recorded, nor were the cleaning of siltation berms and basins. It is extremely important to completely document such measures, especially if sludge will continue to be applied at rates higher than nitrogen requirements for crops. It must be kept in mind that one specific goal is to raise the organic matter content of the spoil lands thereby increasing agricultural productivity.

A rather persistent question arose concerning the introduction of heavy metals to the land. At the Fulton County site the soils are generally unconsolidated mixtures of former soils and parent materials. The basic constituents of the mine spoil include heavy metals and chemicals similar to constituents in sludge. It would be hard to assess the total impact of metal loading on the Fulton County site. However, if the MSDGC were not applying sludge to the soils the land would not have been reclaimed to any extent. The fact that MSDGC owns the land and controls access, reduces the possibility of contact with adverse conditions. Some experiments using acid-extractability to indicate long-term plant availability have shown that these metals can be available to plants for a considerable period of time. Fulton County data acquired using actual field dates seem to indicate that metal levels in crops do not reflect cumulative applications over a number of years. Further data should be provided to substantiate this finding.

B. Water

The analysis of water quality impacts in Fulton County is complex. Background investigations show that the quality of ground and surface water at the project site was exceedingly poor before project operations began. High background concentrations of sulfate, copper, manganese, iron, lead and total dissolved solids in surface waters (streams and reservoirs) are probably due to leaching of strip-mine spoil. The water quality of Big Creek, both before and after sludge application, has been strongly influenced by sources of pollution upstream from the project site, including effluents from the Canton Sewage Treatment Plant upstream. If low-level contributions of sludge constituents to surface water were to result from sludge application, it would most likely be masked by high background levels of metals and other constituents. While this situation may allow small contributions of sludge constituents to go undetected, it also vastly decreases the significance of potential contributions in terms of water quality deterioration.

A refinement of the sampling design should be considered to try to distinguish various sources of contaminant input to Big Creek. While this might be costly, it would help provide detailed answers to sources of total dissolved solids.

A comparison of violations of Illinois water quality standards in the stream and reservoir stations during early and recent project stages indicates that surface water quality has not significantly deteriorated. Trend analyses for nitrite and nitrate-nitrogen, total phosphorus, ammonia-nitrogen and fecal coliforms in stream and reservoir stations indicate no increasing trends with the exception of increasing nitrite and nitrate nitrogen in R3 and R12 which can be attributed to any of a number of sources. Nitrate levels in both reservoirs, although increasing, have consistently remained within drinking water standards. Fecal coliform concentrations in all reservoirs are generally low, indicating that the applied sludge has been low in fecal coliforms and/or that the runoff basins have been effective in retaining fecal bacteria. Fecal coliform counts have been high in most stream stations but have not been increasing and are probably not due to the project.

Lower fecal coliform levels in R3 than in Big Creek into which the reservoir drains indicates that sludge application on the 2000 hectares of land draining eventually into R3 could not be responsible for high levels of indicator organisms in Big Creek. Higher concentrations of sulfate and total dissolved solids in Big Creek station S2 over upstream station S1 can be attributed to a number of sources, none of which can be singled out.

Surface water quality at the project site depends in part on the design operation and maintenance of the runoff basins. Calculations show that basins for 21 fields are unable to contain runoff from a 24-hour, 100-year storm. When a storm of this type occurred, however, in July 1976, only three runoff basins could not contain the resulting runoff. Observations at the project site have shown the greatest shortcoming in the runoff basins' designs to be their inability to contain runoff from an intermittent, recurring rainfall (over a week) with an intensity of about one or two inches per day, when the soil becomes too saturated to accommodate recycled water from the runoff basins. Recycling of field runoff is necessary to create more storage space. This has in some cases led to emergency releases of runoff basin water before effluent quality standards are satisfied. Earlier concern over the adequacy of runoff retention basin storm capacities was relieved somewhat when inspection revealed that the MSDGC is adding storm runoff retention and silt storage capacity by construction of supplemental siltation basins as the need arises. Nevertheless, the available storm capacities of siltation and runoff retention basins depend not only on their design and degree of siltation, but also on the average drawdown or proportion of total capacity already utilized at the time of a storm event. Apparently no records are kept from which one can determine the average available capacities of these basins. Monthly Environmental Protection System reports do list the stage or level of a basin at the time of discharge, but they do not report levels for basins not discharged that month.

There is no evidence either on record or from observation that the prescribed routine practice of pumping the contents of partially filled retention basins back onto the application fields to increase available basin capacity has ever been employed. Emergency discharge of substandard effluent from filled basins to surrounding surface water might have been avoided if this practice had been employed.

While water quality control may be complicated by very high application rates and neglecting to pump back stored runoff from retention basins to application fields, any adverse effects are highly localized and confined to surface water within the project site. Flowing surface water, primarily Big Creek, is so contaminated from local sources of pollution other than the sludge disposal project that any project contributions of pollutants would be masked by the poor ambient water quality. This circumstance may extend to impounded surface water external to the project; algal blooms have been observed in local lakes or ponds.

Trend analyses for nitrite and nitrate-nitrogen, ammonia-nitrogen, and iron in four wells selected to represent background ground water quality, possible seepage from the holding basins, and possible groundwater contamination from sludge application indicate an increasing nitrate trend in one well which could not be attributed to project operations. No other trends in these four wells are apparent, and seepage has not occurred from the holding basins. Graphs of nitrite and nitrate nitrogen levels in all wells show increasing concentrations in W1, W4, W12 and W22; of these, W1 and W4 are located upstream from the project and are thus unaffected by sludge application. Increasing levels in W12 and W22, as well as fluctuations in the other wells, do not appear to correlate with project activities. Furthermore, with the exception of W10, nitrite and nitrate nitrogen levels are generally lower than 0.2 milligrams per liter (as opposed to the drinking water standard of 10 milligrams per liter indicating that little soluble nitrogen is leaching into the groundwater system.

Fecal coliform, trace element, and other chemical concentrations in wells remain close to baseline conditions.

Apparently, most groundwater constituents have been little influenced by project operations at this stage of project development. The variations in their concentrations are probably influenced by the geochemical characteristics of abandoned strip mines, such as heavy metals in exposed black shale. The variations in groundwater quality at most stations are comparable. Therefore, soils are either functioning well as a biochemical filter for the removal, conversion, and fixation of sludge constituents or are not permeable enough to allow sludge constituents to percolate into groundwater. It must be noted that the likelihood of this project significantly affecting ground and drinking water resources is extremely small because aquifiers providing drinking water are deep and are covered by impermeable strata. Water quality data are, however, insufficient for long-range projections of groundwater quality.

C. Air

The only two potentially significant odor sources at the project site are the sludge holding basins and sludge ponding in the application fields. Although the strength of odor emissions from surface-applied sludge is equal to that from the holding basins, the consequent odor problems are short-term because most odorants are released into the atmosphere within the first week. Surface penetration methods do not generate aerosols and evaporation of malodorants is small.

It has been shown that ammonia concentrations at the sludge holding basins, even during the most unfavorable meteorological conditions, are less than the threshold value reported by Leonardos et al. (1969). Confirmed sludge odors during months when no sludge was applied, however, suggest that odors were arising from the holding basins. Malodorants other than ammonia therefore reside in the sludge, which act synergistically to generate a sewage sludge smell.

Within the past several years, decreases in odor complaints can probably be attributed to the decrease and final elimination of spraying activities, and a reduction in the surface area of sludge storage lagoons. This reduction in stored sludge volume is attributed to continued sludge application while barge shipments from Chicago were tempor[illegible]ily halted, thus diminishing supplies on hand. New problems will result from sludge application if soil incorporation techniques continue to be used, provided that sludge ponding is kept to a minimum by better management practices.

D. Health Effects

Because spray application constituted a large proportion of past application techniques, the extent of aerosol inhalation was estimated from a dispersion model. The calculated respiratory intakes were found to be low when compared to World Health Organization (WHO)-recommended maximum daily intakes, suggesting that past inhalation of sludge aerosols was probably not dangerous. This is supported by the absence of reported health effects in Fulton County.

While some indirect health impacts may arise from the ingestion of plants or animals contaminated with sludge constituents, most of these impacts will be controlled by monitoring of crops produced. Secondly, dilution of crops into the market will reduce the impact to any particular animal or person. Crops could go into gasohol production.

The MSDGC should continue to monitor soils, plants and animals on the project site to provide information concerning heavy metal uptake. Special interest in cadmium and polychlorinated biphenyls by regulatory organizations warrants these continued studies.

In terms of human health, the future land use of the area would dictate the future impacts. Listed below are the worst and best cases concerning land use and human health impacts:

Worst Case

Sale of land to farm operators who live on the premises and raise their own food with no monitoring or controls. Rural housing development where residents garden with no monitoring controls.

Best Case

Land remains in hands of the MSDGC with rental to farmers, providing management and monitoring controls. Land developed for outdoor recreation, prairie preservation, and tree farms.

E. Recommended Mitigative Measures

1. Sludge Application Rates

MSDGC should develop a Facilities Operating Plan as outlined in 40 CFR 257.3-5(B)(1)(e). As promulgated, this cadmium management approach sets forth four requirements which will serve to minimize the increase of cadmium in the human food chain. First, only animal feed may be grown under this option. The likelihood of significantly increasing individual or general dietary cadmium levels through animal feeds is negligible. The second control to assure proper management of the facility is the requirement that the solid waste and soil mixture have a pH of 6.5 or greater at the time of solid waste application or at the time the crop is planted, whichever occurs later. This pH balance is important where cadmium application is unrestricted. The third requirement calls for the development of a facilities operating plan. The purpose of this plan is to demonstrate how the animal feed will be distributed and what safeguards are utilized to prevent the crop from becoming a human food source. The fourth requirement is a stipulation in the land record or property deed which states that the property has received solid waste at high cadmium application rates and that food chain crops should not be grown, due to a possible health hazard.

In lieu of growing the crops for animal consumption, the rising market for crop products for alcohol production may be the safest way of assuring that the crops do not enter the human food chain. Recently, the demand for alcohol for gasohol production has greatly increased. Furthermore, a distillery in Peoria may be a good market for MSDGC crop products. This corn, etc. would then be used as a renewable energy resource.

The MSDGC should plant cover crops as soon as possible after sludge application. Attempts should be made to increase the solids content of sludge applied to reduce the number of applications. This should lessen the soil compaction impacts. Further information should be provided concerning the criteria for reclaiming spoil. Test results for organic matter content in soils should be provided for analysis of the first five years of operation.

2. Land

Where feasible, fields that are graded to drain laterally across the principal slope into ditches along the perimeter should be regraded with a broad, shallow depression and retention dike at the base of the slope to add backup runoff retention capacity on the field itself, thus eliminating high velocity runoff, scouring, and gully erosion at the edge of the field. This is mainly for the older fields. New fields are better designed and do not show some of the aspects.

Terraces constructed across long slopes and maintained in permanent vegetation should be provided when practicable for greater erosion control; drainage channels or ditches, dikes, and berms should be permanently grassed to stabilize the soil.

Breached dikes or berms should be repaired promptly; barriers of rock, hay bales or other material should be placed in ditches or runoff channels containing high velocity flow to reduce scouring and gully erosion.

3. Water

The MSDGC should extend the current practice of building supplemental siltation basins, especially where soil loss and siltation of retention basins is severe and runoff retention capacity is marginal; also, there should be more frequent cleanout of silted basins and mowing of overgrown basins to preserve their function.

The prescribed practice of pumping from partially or nearly filled runoff retention basins back onto application fields should be employed where necessary to avoid emergency releases of substandard effluent; such recycling of runoff should occur before fields are saturated from rainfall and sludge application combined.

Discharge control gates should be kept closed during a period of runoff from a storm; prolonged periods when gates remain open should be carefully avoided.

Poor water quality flowing into the project site is not a license to further pollute. A refined water quality monitoring scheme is suggested to differentiate the pollutant contributions from project point sources (retention basin discharges), community point sources (Canton sewage treatment plant), and nonpoint sources (runoff over mine spoil). Stream monitoring stations in particular are too few to enable segregating these contributions, and community pollution of Big Creek, where most stream monitoring occurs, tends to mask the possible pollution of minor tributaries from project operations. Pollution sources and problem areas should be identified and mitigative measures taken to alleviate water quality problems.

Quality of runoff retention basin effluent must be upgraded and should be monitored by analysis of 24-hour composite samples or by averaging the values of samples taken at several intervals instead of using a single grab sample. The current IEPA requirement, which assumes relatively stable concentrations of biochemical oxygen demand, total suspended solids and fecal califorms, has been ineffective in preventing occasional release of contaminants whose concentrations can fluctuate widely in 24 hours.

Analysis of the nutrient concentrations in effluents from runoff basins should be performed to determine nutrient inputs into receiving waterways and reservoirs. These data will aid in estimating the eutrophication potential in receiving waters.

Since written records have not provided a complete picture of operations and maintenance activities, periodic inspection of the project site by the U.S. and Illinois Environmental Protection Agencies could establish a constructive basis for reducing undesirable impacts of the project on water and air quality through improved procedures for soil management and drainage control. An inspection team might include a soil scientist, agronomist, agricultural engineer, hydrologist, and pollution control engineer. A local soil conservationist and community health sanitarian could provide additional insights and constructive recommendations.

MSDGC should revise their groundwater monitoring program to determine the direction and rate of flow; therefore being able to determine if the sludge application is having an adverse impact on groundwater. A groundwater flow meter, recently developed, will somewhat simplify this analysis. Groundwater monitoring should continue to identify if a pollution "breakthrough" to an aquifer would occur.

4. Air

Periodic regrading to remove depressions due to subsidence of unconsolidated subsoil or mine spoil should be performed as necessary to prevent ponding of freshly applied sludge which presents a potential for odor emissions.

Occasional unavoidable ponding should instigate control methodologies for odor control. The MSDGC has applied 7437, an odor control product of Pollution Sciences, Inc., to ponding areas, and this practice should be further evaluated and continued if warranted.

Recognizing that the storage lagoons are an occasional source of odor, efforts should be made to limit the amount of sludge stored at the Fulton County site. Limiting sludge storage to the amount of sludge necessary for the staging of land application practices would reduce lagoon surface area and prevent odor-producing lagoon turnovers.

The MSDGC Comprehensive Permit is currently under appeal and there is currently an enforcement action concerning odor violations, pending before the Illinois Pollution Control Board.

We will work with the IEPA to optimize the operation and environmental compatibility of the Fulton County project.

The use of wind barriers such as tall, dense hedgerows or fences around the holding basin berms, or perhaps floating baffles within the basins if this could be developed to be economically feasible, could reduce surface turbulence and wave action which intensify odor emissions. The present requirement of a 4-foot freeboard from the sludge surface to the top of the berm provides wind baffling only for a short distance downwind.

5. Health Aspects

The feasibility of developing lands at the project site for outdoor recreation, prairie preservation, tree farms, or other uses that do not include growing crops in the human food chain should be carefully investigated. Multiple use planning consistent with Section 201(f) of the Clean Water Act, as amended, should be implemented.

Crops which are eaten raw should not be planted within 18 months of the last sludge application as required by 40 CFR 257.

Potential hazards to human and animal health will greatly depend on the types of crops grown on the fields. Crops should be carefully selected to avoid those which accumulate metals in edible plant tissues. In general terms, grain crops present a lesser heavy-metal hazard to the food supply than do forages, pastures and leafy vegetables (CAST 1976). MSDGC should develop plans to put their crops into gasohol production, if feasible.

Crop roots as well as aerial tissues must be analyzed to diagnose all plant toxicities (CAST 1976).

6. Plans and Records

Steps should be taken to ensure that all maintenance activities are recorded on a regular basis in accessible documents. Items to be recorded should include dates, locations and descriptions of repairs to fields and basins, berms and dikes, drainage ditches and pipes as well as routine reseeding, fertilizing and mowing. Observations of conditions requiring correction, such as soil subsidence and gulley erosion, accelerated siltation, overtopping or breaching of embankments, and overgrown or sparse vegetation should also be recorded. Where necessary, maps or diagrams should be provided to reference the locations of planned or completed activities.

Operations records also require improvement. For example, present records concerning the operation of runoff retention basins should be augmented to include periodic reporting of the state or level of all basins, discharging or not, so that available capacity may be determined in the event of a storm. All emergency discharges from retention basins should be recorded along with the results of a water quality analysis of the discharged effluent.

Recycling of substandard effluent by pumping back onto the fields, if practiced at all, should be recorded in times and amounts.

VIII. ENVIRONMENTAL CONSEQUENCES OF THE PROJECT

A. Unavoidable Adverse Impacts

1. Distribution Systems

In a project as large as the MSDGC Fulton County project, there are many unavoidable impacts. However, when the impacts are viewed in terms of viable options available and the relative risks of each alternative, the risks appear to fall into the acceptable range. Undoubtedly, some sludge generated in Chicago will spill into the waterways of the State of Illinois due to loading and unloading operations at the Chicago and Liverpool barge facilities. The magnitude and frequency of spills should be controllable to some extent. Sludge entering the waterways will have adverse impacts on fish resources, general water quality and benthos. These impacts should be short term and infrequent. Runoff from fields and overflow from retention structures on the project site may contaminate streams and lakes on the project site.

The pipeline from Liverpool to the site could break due to natural or human forces causing pollution of land and groundwater resources. The walls of the storage basin could be ruptured. The distribution pipe on the project site has been vandalized in the past. This could happen again.

2. Recontouring

Recontouring the land to improve the capabilities of existing fields or new fields to receive sludge would generate short-term disruption in traffic flow along local roads. These construction activities produce noise that would disrupt the existing conditions. However, most noise would be in the interior of the site and therefore would not greatly impact humans other than construction and farm operators.

There would likely be a loss of potholes and surface waters if recontouring continues. Soil erosion and siltation would occur until cover materials could be established. The MSDGC has used some soil conservation practices in the past, strict adherence to these same fundamentals in the future would decrease the severity of new site development. Redeveloping the strip-mined land would also decrease land available for wildlife. Although there are no endangered species on the site, several rare plants and many of the animals could be further displaced.

3. Human Health

Although the risk is extremely small, both livestock and human health could be adversely impacted by continued operations. This could be either direct, such as the death of a farm worker in a tractor incident, or indirect by ingestion of pathogens related to sludge.

Further odors could arise from the project site that would adversely affect human activities such as church, recreation and farming.

B. Relationship Between Short-term Use and Long-term Productivity

The MSDGC project has had a very positive impact on Fulton County. It has induced employment, raised tax money and abated runoff from strip-mined areas that may have resulted in better stream water quality. The project has resulted in establishment of row crops on the site. However, much of the terrain was so disturbed that much of the site has not been recontoured. Land has also been set aside for conservation, recreation and environmental protection. The long-term effects of the project will be enhanced soils, decreased dependence upon chemical fertilizers for row crop production, and enhanced land use with improved employment and tax base within the County. For Chicago residents the project is an innovative, productive method to utilize sludge solids. It will help to decrease our dependence on oil and natural gas supplies for incineration and fertilizer production.

C. Irreversible and Irretrievable Commitment of Resources

The project has committed many person-years of construction, monitoring and operational time. The MSDGC has committed millions of dollars to the operation and research of this project. This has led to major modifications to improve operations and environmental controls. A huge commitment of vehicles, piping and fuels for construction and operation have been made. This commitment for fuels has decreased now that farming operations are the predominant activity. The land may be held into perpetuity by MSDGC for the now existing usage.

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GLOSSARY

absorption: The penetration of one substance into or through another.

adsorption: The attachment of the molecules of a liquid or gaseous substance into or through another.

aerobic: Refers to life or processes that occur only in the presence of oxygen.

agronomy: The principles and procedures of soil management and of field crop and special-purpose plant improvement, management and production.

anaerobic: Refers to life or processes that occur in the absence of oxygen.

aquifer: A geologic stratum or unit that contains water and will allow it to pass through. The water may reside in and travel through innumerable spaces between rock grains in a sand or gravel aquifer, small or cavernous openings formed by solution in a limestone aquifer, or fissures, cracks, and rubble in such harder rocks as shale.

bacteria: Any of a large group of microscopic plants living in soil, water or organic matter, important to man because of their chemical effects as in nitrogen fixation.

berm: Refers to a narrow ledge or shelf used to control the runoff of water from a field.

benthos: The plants and animals that inhabit the bottom of a water body.

biochemical oxygen demand (BOD): A measure of the amount of oxygen consumed in the biological processes that decompose organic matter in water. Large amounts of organic waste use up large amounts of dissolved oxygen; thus, the greater the degree of pollution, the greater the BOD.

biota: The plants and animals of an area.

BOD_5: See "biochemical oxygen demand." Standard measurement is made for 5 days at 20 degrees Centigrade.

calcareous: Resembling, containing, or composed of calcium carbonate.

cation: A positively charged atom or group of atoms, or a radical which moves to the negative pole during electrolysis.

cation exchange capacity (CEC): The sum total of exchangeable cations that a soil can adsorb.

coliform bacteria: Members of a large group of bacteria that flourish in soil, in the feces, and/or intestines of warm-blooded animals, including man. Fecal coliform bacteria enter water mostly in fecal matter, such as sewage or feed-lot runoff. Coliform bacteria 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 fecal coliform bacteria in water, therefore, is used as an index to the probability of the occurrence of such disease-producing bodies (pathogens) as Salmonella, Shigella, and enteric viruses. These pathogens are relatively difficult to detect.

coliform organism: Any of a number of organisms common to the intestinal tract of man and animals whose presence in wastewater is an indicator of pollution and of potentially dangerous bacterial contamination.

compost: Relatively stable decomposed organic material.

curie: A measure of radioactivity.

deciduous: The term describing a plant that periodically loses all of its leaves, usually in the autumn. Most broadleaf trees in North America and a few conifers, such as larch and cypress, are deciduous.

dissolved oxygen (D.O.): The oxygen gas (O_2) dissolved in water or sewage. Adequate oxygen is necessary for maintenance of fish and other aquatic organisms. Low dissolved oxygen concentrations sometimes are due to presence, in inadequately treated wastewater, of high levels of organic compounds.

dredging: To remove earth from the bottom of water bodies using a scooping machine. This disturbs the ecosystem and causes silting that can kill aquatic life.

ecosystem: An ecological community together with its physical environment, considered as a unit.

effluent: Wastewater or other liquid, partially or completely treated, or in its natural state, flowing out of a reservoir, basin, treatment plant, or industrial plant, or part thereof.

erosion: The process by which an object is eroded, or worn away, by the action of wind, water, glacial ice, or combinations of these agents. Sometimes used to refer to results of chemical actions or temperature changes. Erosion may be accelerated by human activities.

evapotranspiration:

Discharge of a water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soil surfaces and by transpiration from plants.

fecal coliforms: See "Coliform Bacteria."

forage: Food for animals.

gob: The refuse or waste left in a mine from which coal has been worked away.

groundwater: The supply of fresh water under the Earth's surface that forms a natural reservoir.

groundwater runoff: Groundwater that is discharged into a stream channel as spring or seepage water.

leaching: The separation or dissolving out of soluble constituents from a rock or sediment by percolation of water.

lagoon: A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater.

littoral zone: Of or pertaining to the biogeographic zone between the high and low water marks.

loess: A buff to gray, fine-grained, calcareous silt or clay, thought to be a deposit of wind-blown dust.

malodorant: A substance causing bad odor, stench.

mho: Unit of conductance reciprocal to the ohm.

milliequivalent (meq): One-thousandth of a compound's or an element's equivalent weight.

normality (i.e. normal solution, abbr. N): Measure of the number of gram-equivalent weights of a compound per liter of solution.

percolation: The downward movement of water through pore spaces or larger voids in soil or rock.

permeability: The property or capacity of porous rock, sediment, or soil to transmit a fluid, usually water, or air; it is a measure of the relative ease of flow under unequal pressures.

plankton1c: Of or pertaining to plant and animal organisms, generally microscopic, that float or drift in great numbers in fresh or salt water.

polychlorinated biphenyls PCB's): A group of toxic, persistent chemicals used in transformers and capacitators. Further sale or new use was banned in 1979 by law.

runoff: Water from rain, snow melt, or irrigation that flows over the ground surface and returns to streams. It can collect pollutants from air or land and carry them to receiving waters.

silt: A sedimentary material consisting of fine mineral particles intermediate in size between sand and clay.

siltation: The deposition or accumulation of stream-deposited silt that is suspended in a body of standing water.

sludge: A semiliquid waste with a solid concentration in excess of 2500 parts per million, obtained from the purification of municipal sewage.

slurry: A thin mixture of a liquid, especially water, and any of several finely divided substances such as clay particles.

spoil: Dirt or rock that has been removed from its original location, destroying the composition of the soil in the process, as with strip mining or dredging.

strata: Beds or layers of rock having the same composition throughout.

stratification: Separating into layers.

strip mining: A process that uses machines to scrape soil or rock away from mineral deposits just under the Earth's surface.

supernatant: Floating on the surface.

suspended solids: Undissolved particles that are suspended in water, wastewater or other liquid, and that contribute to turbidity. The examination of suspended solids plus the BOD test constitute the two main determinations for water quality performed at wastewater treatment facilities.

synergism: The action of two or more substances, organs or organisms to achieve an effect of which each is individually incapable.

terracing: Dikes built along the contour of agricultural land to hold runoff and sediment, thus reducing erosion.

thermophilic: Requiring high temperatures for normal development, as certain bacteria.

topography: The physical features of a surface area including relative elevations and the position of natural and man-made features.

toxic substances: A chemical or mixture that may present an unreasonable risk of injury to health or the environment.

trophic: Of or pertaining to nutrition or to the nutritive processes.

vertebrate: All animals with backbones, from fish to man.

volatile: Evaporating readily at normal temperatures and pressures.

LIST OF PREPARERS

Name	Organization	Project Assignment	Education	Experience Years
Jack Evan Braun	USEPA	Project Officer/ Author	M.S. (Biology)	5
Douglas Ehorn	USEPA	Project Officer/ Advisor	M.S. (Biology)	8
Gregory Vanderlaan	USEPA	Project Advisor	M.S. (Environmental Studies)	4
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Joel Soden	WAPORA	Air Scientist	M.S.	5
Robert Cutler	WAPORA	Senior Air Scientist	M.S., P.E.	10

(Some preliminary work on this Final EIS was performed by Enviro Control, Inc., Rockville, MD)

Project History

The Draft Environmental Impact Statement was published in June 1976. Many unanswered questions existed in that document and many comments were received during the public review period. During the preparation of the Final Environmental Impact Statement, we have tried to incorporate the many changes in sludge management regulations and have made the best effort possible to improve the quality of this document over the Draft Environmental Impact Statement. Many of the new requirements developed through the implementation of the Resource Recovery and Conservation Act have also been taken into consideration in this document.

APPENDIX A: IEPA Water Pollution Control Permit

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
WATER POLLUTION CONTROL PERMIT

Permit Number: 1974-DB-444-OP

DATE ISSUED: March 7, 1974
PROJECT LOG NUMBERS: 3686-73, 3687-
3688-73, 174-7
175-74

SUBJECT: FULTON COUNTY - Metropolitan Sanitary District of Greater Chicago Sludge Disposal Project - Comprehensive Operating Permit

PERMITTEE TO OPERATE: Metropolitan Sanitary District of Greater Chicac
100 East Erie Street
Chicago, Illinois 60611

Permit is hereby granted to the above designated permittee to operate water pollution control facilities described as follows:

The sludge transportation system, sludge storage facilities and sludge application fields previously approved under Permits #1971-DA-4', #1971-DA-487-1, #1972-DA-215, #1973-DB-1460-OP, #1973-DB-1460-OP-1, #1973-DB-1492, #1973-DB-1492-1, #1973-DB-1682, #1973-DB-1682-1, #1973-I 1752, #1973-DB-2185 and #1974-DB-45-COP.

This Operating Permit expires on March 7, 1975.

The Application for Operating Permit and supporting documents approved by this Permit were prepared by Metropolitan Sanitary District of Greater Chicago and are identified in the records of the Illinois Environmental Protection Agency, Division of Water Pollution Control, Permit Section by the log numbers designated in the subject above.

This Permit renews and replaces Permit Numbers #1971-DA-470, #1971-DA-487-1, #1972-DA-215, #1973-DB-1460-OP, #1973-DB-1460-OP-1, #1973-DB-1492, #1973-DB-1492-1, #1973-DB-1682, #1973-DB-1682-1, #1973-DB-1752, #1973-DB-2185 and #1974-DB-45-COP, which were previousl;

READ ALL CONDITIONS CAREFULLY: (continued on Page 2)

STANDARD CONDITIONS

Pertaining to both construction and operation permits.

1. If any statement or representation is found to be incorrect, this permit may be revoked and the permittee thereupon waives all rights thereunder.

2. During or after the construction or the installation of the sewage works, any agent duly authorized by the Environmental Protection Agency shall have the right to inspect such work and its operation.

3. The issuance of this permit (a) shall not be considered as in any manner affecting the title of the premises upon which the sewage works are to be located, (b) does not release the permittee from any liability for damage to person or property caused by or resulting from the installation, maintenance or operation of the proposed sewage works; (c) does not take into consideration the structural stability of any units or parts of the project, and (d) does not release the permittee from compliance with other applicable statutes of the State of Illinois, or with applicable local laws, regulations or ordinances.

4. Treatment works will be operated or supervised by a duly qualified sewage works operator certified under the Regulations of the Environmental Protection Agency.

5. The treatment works or wastewater source covered by this permit shall be constructed and operated in compliance with the provision of the Environmental Protection Act and Chapter 3 of the Rules and Regulations as adopted by the Illinois Pollution Control Board.

6. Plans, specifications and other documentation submitted shall constitute a part of the application and when approved shall constitute part of the permit.

7. This Permit may not be assigned or transferred without a new permit from the Illinois Environmental Protection Agency.

Pertaining only to construction permits.

1. There shall be no deviations from the approved plans and specifications unless revised plans, specifications, and application shall first have been submitted to the Environmental Protection Agency and a supplemental written permit issued.

2. The installation shall be made under the supervision of an inspector, who is familiar with the approved plans and specifications provided by and approved by the owner, and said inspector shall require that construction complies with the plans and specifications approved by this Agency.

3. Unless otherwise stated by Special Condition, construction must be completed in three years for treatment works and two years for sewers and wastewater sources.

4. Unless otherwise stated by Special Condition, the issuance of this permit shall be a joint construction and operation permit provided that:

a) All standard and Special Conditions, are complied with,

b) This Agency is notified within ten (10) days, respectively, of the start of construction and the date of testing and start-up of full operation.

c) The submission of operating reports of the treatment works covered under this permit shall be at a frequency specified by this Agency.

d) The operation permit shall expire one year from the date of start-up of operation.

e) At least 90 days prior to the expiration date of the operation permit, the permittee shall apply for a renewal of the operation permit.

This permit is issued in accordance with the Illinois Environmental Protection Act of 1970 and the Chapter III Water Pollution Regulations adopted by the Illinois Pollution Control Board in March of 1972.

TRW:CWF:il
cc:Grants & Tax, Region II & III
Fulton Co. Health Dept., Fulton Co.
Bd. of Supervisors, MSDGC-R.Rimkus
H.McMillan
J.Braxton

DIVISION OF WATER POLLUTION CONTROL

William H. Busch
Manager, Permit Section

issued for the herein permitted facilities.

The Standard Conditions of issuance of this Permit are itemized on Page 1. (Special Conditions applicable are itemized below).

This Permit is issued subject to the following Special Conditions. If such Special Conditions require additional or revised facilities, satisfactory engineering plan documents must be submitted to this Agency for review and approval for issuance of a Supplemental Permit.

SPECIAL CONDITION #1: Upon termination of the sludge transportation activities, the Sanitary District shall be responsible for the proper removal and disassembly of non-permanent equipment for which this permit is issued.

The proper disassembly includes, but is not limited to, the cleaning of the pipeline so no sludge residue will escape to any area other than the properly permitted holding basins.

SPECIAL CONDITION #2: This permit is issued on the basis that any surveillance activity by the staff of this Agency does not relieve the applicant from sole responsibility for establishing and continuing a surveillance program for monitoring and detecting any discharge of waters which do not meet the applicable provisions of the Environmental Protection Act or the Rules and Regulations of the Pollution Control Board.

SPECIAL CONDITION #3: The sludge transported to the Fulton County site shall be adequately digested and suitable for land application based on the parameters presented in Table 2 of the report entitled "Quality of Digested Sludge Suitable for Land Application" prepared by the Research and Development Department of the Metropolitan Sanitary District of Greater Chicago, dated July 23, 1973.

SPECIAL CONDITION #4: This Permit does not relieve the District of sole responsibility for the existing discharges to the waters of the State which may have occurred through mining activity or any other past activity in this area, which do not meet the applicable provisions of the Environmental Protection Act or Illinois Pollution Control Board Rules and Regulations.

SPECIAL CONDITION #5: The District shall maintain a minimum of four (4) feet freeboard in the lagoons at all times.

SPECIAL CONDITION #6: The District must submit to this Agency, in addition to the quarterly reports currently submitted, a monthly report. The operational information to be contained in the monthly report must be satisfactory to the Agency and the report must be submitted in triplicate within 20 days of the end of the month covered by the report.

March 7, 1974

FULTON COUNTY - Metropolitan Sanitary District of Greater Chicago
Sludge Disposal Project - Comprehensive Operating Perr

SPECIAL CONDITION #7: Up to date sampling data and operational information to be used in the monthly reports must be available for inspection by this Agency's personnel at the Fulton County Site.

SPECIAL CONDITION #8: If for any reason the District abandons this project, it is required that the sludge holding basins be emptied of sludge and the sludge be disposed of in a manner which will not cause pollution.

SPECIAL CONDITION #9: The effluent discharged from any retention bas approved under this Permit must meet the applicable effluent requirem for discharge to the waters of the State as required by Illinois Pollution Control Board Rules and Regulations Chapter 3. The point of discharge to the waters of the State is considered to be the overflow structure of each of the retention basins.

SPECIAL CONDITION #10: This Permit is issued with the condition that the following contaminant concentrations are considered to be background values and the numerical effluent standards shall be considere met at the designated effluent sampling point described in Special Condition #9 when the background concentration plus the allowable regulatory concentration is greater than the measured concentration for the appropriate parameter:

	Total Suspended Solids	BOD	Fecal Coliform
	-------------------	-------------------	FC/100 ml
arithmetic mean	61.7	2.75	-
std. dev.	87.3	1.48	-
geometric mean	-	-	94.3

SPECIAL CONDITION #11: In order to provide storage for the capture c a 100 year frequency storm, the District shall remove waters from the retention basins as soon as practicable after a storm. This Agency shall require that records be kept of precipitation and the approxima amounts of runoff pumped back to the fields or discharged and that these results be submitted along with the monthly operation reports.

March 7, 1974

FULTON COUNTY - Metropolitan Sanitary District of Greater Chicago
Sludge Disposal Project - Comprehensive Operating Permit

SPECIAL CONDITION #12: The District shall maintain at least one control plot on which crops are grown without the application of sludge in order to provide a continuing source of data regarding the runoff from such fields. The runoff from the control plot shall be monitored and the results submitted to this Agency as a part of the monthly operation reports.

SPECIAL CONDITION #13: The District shall restrict its procedures of land application to subsurface injection or ridge and furrow application whenever practical.

SPECIAL CONDITION #14: The District shall monitor the metals content of the crops harvested from the sludge application fields and shall submit the results to this Agency in the monthly operation reports.

SPECIAL CONDITION #15: This Permit includes the construction of the supernatant piping around the sludge holding basins.

Appendix B

Comments Received on the Draft EIS

The following pages include a reproduction of the written comments that were received on the Draft EIS. Many of these comments have been incorporated into this Final EIS.

Appendix C contains our responses to these comments.

ILLINOIS Wildlife FEDERATION
13005 S. WESTERN AVE BLUE ISLAND ILLINOIS 60406
P. O. BOX 116 PHONE 312 388 3995

ITEM 41

August 17, 1976

Mr. Gary Schenzel, Acting Chief
Planning Branch
Region V
United States Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

RE: Remarks Concerning Fulton County Sludge Disposal and Land Reclamation Draft to the Public Hearing - August 17, 1976

Dear Mr. Schenzel:

As president of the Illinois Wildlife Federation, and having been involved with the Metropolitan Sanitary District of Greater Chicago's desire to dispose of its sludge since MSDGC's first attempt in 1967 to acquire land in Kankakee County, Southern Will County, and Grundy County, I would like to make the following non-technical and non-scientific remarks.

1. The University of Illinois was awarded a grant to conduct a study in Will County to determine the feasibility of the plan. In reading the draft I do not find the results of this study. This study should have been used so that the facts gathered on a test in Illinois using sludge from MSD, rather than a study in some other state or county with many different characteristics.

2. It is a matter of record with the Fulton County Board that this program was to be a five-year experimental program, and that if there were any undesirable effects on the environs in this area, or if there were any ill effects on the environment, the program would be discontinued.

3. It is a matter of record in this draft that it is difficult to maintain quality control of sludge when waste water treatment plants are subject to the disposal of heavy metals, and all of the byproducts of pesticides and herbicides, and all the rest of the undesirable and long-lived man-made chemicals. Industrial wastes cannot be eliminated from MSDGC collection system.

4. It was suggested by the writer at special meetings by the MSDGC that they use the 30,000 acres of land in the Cook County area owned by the Cook County Forest Preserve District for sludge disposal. I feel this is still a viable consideration.

5. I have visited the Fulton area and am familiar with the operation.

6. Run off from the application area is documented as a problem to the natural waterways in the area. The effluent from this area must meet the mandates in the USEPA Regulations. As stated on 1-9 the concentrations of certain metals and other chemicals have exceeded the Regulations.

7. Base line ground water showed excessive concentrations of dissolved minerals, three times the U.S. standard. With increased application the condition can be expected to increase.

8. Fish and wildlife in this area have not been studied through the National Fish and Wildlife Service, and as stated on 1-10 it can be expected that fish and wildlife will pick up toxic substances through the food chain.

9. Of major concern are the concentrations of heavy metals, air pollution from sludge malodorants, surface and ground water contamination, and human health effects from pathogens, as documented by actual violations of our environmental standards.

10. Run-off basins that were to have been constructed and to have controlled the 100-year storm were not feasible, so no run-off control is presently in operation. Thus the nutrient levels in receiving streams will cause euthropication and will threaten aquatic life.

11. With the combination of natural heavy metals and sludge leaching its heavy metals, an increase of these metals can be expected to increase to a point that use of local wells will be prohibited.

12. Use of a forage crop will cause a significant problem in animals.

13. Effect on bud life-eating worms, who will have high concentrations of cadmium, can be expected to be effected.

14. As stated on Page I25 and I26, sludge standards cannot be maintained or assured, and as stated a procedure should be implemented to guarantee only good quality sludge to be shipped to Fulton County, and elimination of direct drawdown of the digester at the W.S.W. Plant.

In conclusion and summary:

The Prairie Plan and Sludge Disposal should not be put together as a plan.

The Fulton County experimental plan should be monitored by an outside, independent testing laboratory.

This EIS should not be accepted until after a full five-year experimental period.

Evaluation of this document indicates there are more detrimental items to be considered than beneficial.

Strip mine reclamation into usable recreational land does not need sludge, as is documented by the 25 privately owned recreation areas in the Braidwood-Coal City area of Will and Grundy Counties, catering to 50,000 members.

The National Fish and Wildlife Service should have some input into this subject because of the far-reaching implications in the wildlife food chain and the nutrients that enter our streams.

The EIS should be retitled and exclude the land reclamation concept, because the addition of and concentrations of heavy metals could mean land destruction.

Respectfully Submitted,

Frank B. Goetschel, President
Illinois Wildlife Federation

FG/lj

W-2

COLLEGE OF AGRICULTURE DEPARTMENT OF AGRONOMY URBANA, ILLINOIS 61801

August 16, 1976

Mr. Gary Schenzel, Acting Chief
Planning Branch
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, IL 60604

Dear Mr. Schenzel:

I submit the following comments on the Draft Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County, Illinois. These are concerned primarily with Section II Background and Introduction. Section II quotes liberally from Agronomy Fact Sheet SM-29: Utilization of Sewage Sludge on Agricultural Land.

There are a few direct quotations with the source acknowledged. There are many paragraphs in Section II with wording quite similar to that in Fact Sheet SM-29 of which I am one of the authors. This Fact Sheet was revised in February 1976 to correct some errors in Table 1 and to include 1975 yield data of University of Illinois research. I am attaching 2 copies of the February 1976 version and have marked the pages in Section II of the draft EIS where wording is similar.

One error in copying from SM-29 was noted. In the last paragraph on page II-1 the following appears: ".....a rate equivalent to a modern irrigation, ..." The first paragraph of SM-29 states: "....a rate equivalent to a moderate irrigation (about two inches),......" If the authors of the EIS made the conscious substitution of "modern" for "moderate", they should be more specific as to what is the amount of a "modern" irrigation.

Page II-5 of the EIS states in the next to last paragraph: "With sludge application, there is the option of going directly into row crop production after the levelling of strip mine spoil banks." Page I-13 states: "The future fertility of these fields can be expected to increase significantly with the continued application of sludge, possibly making row-crop production economically feasible." One of these statements is quite positive, the other conditional. If the page II-5 statement were changed to read: "..... there may be the option......" it would be more nearly correct and the two would be more consistent. I do not believe it has yet been demonstrated that row crop production on the strip mined lands receiving sludge is economically feasible. If there have been satisfactory row crop yields where freshly levelled spoil banks have had sludge applied, I am not aware of such. I believe this will be established if "normal" spring weather is experienced and if adequate levels of crop and soil management are achieved. So far as I am aware, this is still ahead of us, not behind us.

Page 2
Mr. Gary Schenzel
August 16, 1976

On page I-1 it is stated that 45,000 acres or 60% of the land in Fulton County has been strip-mined. On page IV-51, strip mined lands are reported to be 21,600 acres unreclaimed and 15,500 acres reclaimed, or a total of 37,100 acres stripped in the county. Table IV-22 lists total county land as 561,152 acres. Thus I compute 8.0% or 6.6% of the county has been stripped, depending on which acreage figure is used for stripped lands.

On page II-30 it is stated that MSDGC produced 1250 dry tons of sewage sludge per day in 1973. At the hearing in Canton, I believe the MSDGC statement indicated 750 dt/d. The MSDGC draft document, "Environmental Assessments of the Prairie Plan"- Fulton County, Illinois (no date indicated, probably 1973) states in the introduction that MSDGC collects 820 dry tons of organic solids per day. Commissioner Alter in Compost Science May-June 1975 reports 563 dry tons of solids produced daily. It would be helpful if MSDGC could be more consistent in reporting how much sludge it produces per day. Is the 1250 tons per day reported in the EIS the correct figure for the present time?

I hope these comments will be useful to you in preparing the final EIS for the Fulton County Project.

Sincerely,

M. D. Thorne

M. D. Thorne
Extension Agronomist

MDT:slm
Enclosure
cc: T. D. Hinesly
R. L. Jones
R. W. Howell
S. R. Aldrich
D. M. Vanderholm

UNIVERSITY OF ILLINOIS · COLLEGE OF AGRICULTURE

AGRONOMY FACTS

SW-29

Utilization of Sewage Sludge on Agricultural Land

Digested sewage sludge is a valuable resource that can be utilized in the production of crops on agricultural land. As it comes from the sewage treatment plant, it can be considered as a dilute liquid fertilizer [illegible] composition. [illegible] Sludge will also add appreciable quantities of organic matter, which may improve the physical, chemical, and biological properties of soils. Sludge may be dewatered to varying degrees and may become a bulky solid fertilizer of relatively low analysis.

Sewage sludge is frequently a surplus commodity in municipalities. In some cases, it has accumulated in amounts large enough to pose storage and disposal problems. Environmental and economic restraints limit disposal methods. Utilization on agricultural land appears to be an attractive solution from the viewpoint of [illegible] the municipality, also as a source of plant nutrients and organic matter for agriculture.

Several [illegible] problems are associated with the utilization of sewage sludge on agricultural land, as described in the subsequent sections of this paper.

CHARACTERISTICS OF SEWAGE SLUDGE

The term, "sewage sludge," as used in this report means heated, anaerobically digested sludge. It is a stabilized material with an earthy odor and does not contain raw, undigested solids. Liquid sewage sludge is brown to blackish in color and contains dissolved, colloidal, and suspended solids. Its physical, chemical and biological properties depend to a great extent on the source of the waste, the type of treatment given the waste, and the type of handling the sludge receives. The number and types of industries in the community, the kind of plumbing used, the efficiency of waste treatment facilities, and many other factors influence the composition of the sludge.

Liquid sewage sludge may vary from less than 1 percent solids to over 10 percent. As they come from sewage treatment plants, most sludges are 2 to 5 percent solids.

Sewage sludge that has been stored in holding lagoons for a long time may have lost sufficient water by decanting processes to permit it to be handled as a solid. However, this material may still have a moisture content of 50 percent or more. Sludges can be dried artificially to have low moisture contents. Milorganite is a trade name for one such material, sold for use in greenhouses and in gardens.

The solid portion of sewage sludge is composed of about equal amounts of inorganic and organic material. The inorganic portion is largely silt- and clay-size particles, and contains numerous elements, mainly nitrogen, phosphorus, sulfur, chlorine, carbonate, and metal salts. The organic portion is a complex mixture of digested sewage constituents that are resistant to anaerobic decomposition, compounds synthesized by microbes during the digestion process, and dead and live microbial cells. The organic material contains organic carbon, nitrogen, phosphorus, and sulfur. The carbon/nitrogen ratio of digested sludge varies from 7 to 12, but is usually about 10.

Table 1 gives a range of chemical composition values for sludge and specifications for a "typical" liquid, digested sewage sludge as it comes from the digester. These values are given as a general guideline. The composition of individual sludges can vary appreciably from the values shown. The specific sludge to be used should be analyzed to ascertain its exact composition.

All the nitrogen in sewage sludge is not available for crops during the year of application. Ammonium nitrogen is lost into the air if liquid sludge is spread on the soil surface, forms puddles, and is allowed to dry there. If liquid sludge is incorporated into the soil promptly after application to the surface or if it is injected directly into the soil, most of the ammonium nitrogen is adsorbed by the soil. The ammonium nitrogen is changed into the nitrate form in the soil, where it may be absorbed by the crop or may be subject to leaching. The organic nitrogen in sludge must be mineralized before it can be assimilated by crops.

University of Illinois research indicates that about a fourth of the organic nitrogen in fresh, liquid sludge incorporated into soil becomes available for plants during the year of application. This slow release of nitrogen has definite advantages for some uses and disadvantages for others. Sewage sludge loses most of its ammonium nitrogen in the drying process, so most of the nitrogen in dried sludge is organic in form.

The University of Illinois conducted research with dried sewage sludge for a number of years, beginning in 1956. *Agronomy Fact Sheet SF-59*, issued in 1959, states: "Results to date indicate that dried sludge may be expected to cause corn yield responses similar to those obtained with commercial fertilizer of 5-3-5 grade. This suggests that rather large amounts of sludge would be required and transporting it long distances would be questionable economy for field crops unless it ... long-lasting residual benefits.

Table 1. Composition of Fresh, Heated, Anaerobically Digested Sewage Sludge

Element	Concentration range	Typical sludge (dry basis) Concentration	Typical sludge (dry basis) amount
	percent	percent	pounds/ton
Elements essential for plants			
Nitrogen-organic	2 to 5	3	60
Nitrogen-ammonium	1 to 3	2	40
(Nitrogen-total)	(1 to 6)	(5)	(100)
Phosphorus as P	0.8 to 6	3	60
(Phosphorus as P_2O_5)		(6.8)	(137)
Potassium as K	0.1 to 0.7	0.4	8
(Potassium as K_2O)		(0.5)	(10)
Calcium	1 to 8	3	60
Magnesium	[illegible] to 2	1	20
Sulfur	0.5 to 1.5	0.9	18
Iron	0.1 to 5	4	80
	ppm	ppm	
Sodium	800 to 1,000	2,000	4
Zinc	50 to 50,000	5,000	10
Copper	200 to 17,000	1,000	2
Manganese	100 to 800	500	1
Boron	15 to 1,000	100	0.2
Elements not essential for plants			
Cadmium	3 to 3,000	150	0.3
Lead	100 to 10,000	1,000	2
Mercury	1 to 100	3	Trace
Chromium	50 to 30,000	3,000	6
Nickel	25 to 8,000	400	0.8

NOTE: Values vary according to source, treatment, and other factors. Sludges held in storage lagoons for long periods may be considerably lower in nitrogen content.

Sewage sludges may contain relatively large quantities of minor and trace elements, as indicated in Table 1. Some of these elements are essential in plant and animal nutrition, but nearly all can be toxic at some concentration. Zinc, copper, nickel, cadmium, mercury, and lead may occur in quantities sufficient to affect plants and soils. The availability of a metal in the soil is influenced by soil properties such as pH, organic matter, content of other metals, type of clay mineral, cation exchange capacity, by the variety of crop grown, and many other factors. The absorption of metals is usually lowest at a nearly neutral pH, so keeping the pH near 7 will help prevent problems that might arise from excessive metals in sludge.

APPLICATION METHODS

The large amount of water that must be handled in order to provide the plant nutrients required for a growing crop imposes some limitations on the use of liquid sludge and on the methods of application. Sludges with not more than 10 percent solids can be handled as a liquid, pumped through pipes, and carried in tank trucks, railroad tank cars, and barges. There are some limitations on the types of pumps used; but generally, sludge can be handled by the same types of equipment as used for liquid manure. If sludge is stored in lagoons or tanks, solids will settle to the bottom and special provision for agitation will be needed in order to pump it from the lagoon again. Sludges with more than 10 percent solids have a very high viscosity, and specialized equipment will be needed. Sludge that has been dewatered may be handled in the same manner as solid manure.

Liquid sewage sludge can be spread through some large-diameter irrigation nozzles. It can be applied in furrows through gated irrigation pipe. Most irrigation-supply companies now offer some equipment that will handle sludge satisfactorily. Even though liquid sludge usually contains more than 90 percent water, it is not a satisfactory source of supplemental irrigation water, but may be applied in conjunction with irrigation. If more than a few inches of sludge are applied annually, the crop's needs for nitrogen and phosphorus will be exceeded. In addition to being a waste of plant nutrients, this would increase the chances for polluting surface and ground water, and could result in toxicity to the crop from excess nutrients or salts. Sludges with a solids content in excess of about 1 percent will dry quite slowly on the

soil surface. It may be possible to dilute sludge with additional water, reducing the amount of nutrients added per application.

Liquid sludge can be spread on the soil by tank trucks. The distance of the haul has some obvious limitations, because of the large weight of water to be handled. In some large scale operations now underway in Illinois, sludge is pumped through a flexible hose to an injection plow travelling through the field. At the plow, the sludge flows through a manifold which connects with outlets by each plowshare or disc. Thus, sludge can be incorporated into the soil immediately.

Caution must be exercised in applying sludge to sloping land to make sure the runoff water does not contaminate streams, ponds, or other water bodies.

APPLICATION RATES

These are specified in terms of inches of liquid (as for rain or irrigation water), tons of liquid per acre, or tons of dry solids per acre. A layer of liquid sludge 1 inch deep amounts to about 27,000 gallons (100 tons) on each acre covered. If the sludge has 3-percent solids, 3 tons of dry solids will be added to each acre by each 1-inch application. At 5-percent nitrogen and 3-percent phosphorus, this sludge will supply 300 pounds of total nitrogen and 180 pounds of phosphorus per acre. If the sludge had 5 percent solids, the 1-inch layer over an acre would still weigh about 100 tons, but would contain 5 tons of dry solids and furnish 500 pounds of total nitrogen and 300 pounds pounds of total phosphorus per acre.

What application rate, repeated year after year, would be needed to provide the nitrogen required for a high-yielding crop of corn on Illinois soils?

Assume, again, a sludge with 3 percent solids and a composition as indicated in Table 1. A 1 inch layer would supply 300 pounds of total nitrogen, 180 pounds in organic form and 120 pounds in ammonium form. Also assume that the sludge is spread on the soil surface and plowed under as soon as it has dried enough to permit incorporation.

We might expect only half the ammonium nitrogen to be retained. If the sludge is injected into the soil, more nitrogen will be saved; if it dries completely on the surface before plowing, less will be saved. In addition to the ammonium nitrogen, about a fourth of the organic nitrogen is mineralized each year and thus becomes available.

Thus, the first year of application, for each 1 inch of sludge applied we would have

120 x 0.5 = 60 pounds of ammonium N available
180 x 0.25 = 45 pounds of organic N available
Total 105 pounds of N available per acre

Under a high level of management, 2 inches of this sludge would probably be needed the first year and 210 pounds of nitrogen per acre would be available. In succeeding years, increasing amounts of nitrogen will be available from the 2-inch application, because the organic nitrogen in the sludge added the first year will continue to decompose. After five years of successive and equal annual applications, the amount of nitrogen released from the organic fraction each year is about the same as the total organic nitrogen added in the sludge. Thus, 1 inch of such sludge would provide:

120 x 0.5 = 60 pounds of ammonium N available
180 x 1.0 = 180 pounds of organic N available
Total 240 pounds of N available per acre

Consequently, after five years of application, only 1 inch per year would be needed.

If sludge of the composition indicated in Table 1 is applied at the rate of 6 dry tons per acre, 822 pounds of P_2O_5 (phosphate)--equivalent to nearly 1,800 pounds of 46-percent superphosphate--and 60 pounds of K_2O (potash) per acre will be added. This is likely to be more phosphorus and less potash than needed. If the application rate is specified to provide the optimum phosphorus rate, nitrogen and potash may both have to be supplemented. However, if the 6-ton rate is used, the excess phosphorus is not likely to create a serious problem, at least for many years of repeated applications. The factor limiting long-term application rates of sewage sludges may be the level of phosphorus concentration. However, discontinuing applications would probably soon alleviate phosphorus toxicity problems, should they appear.

The content of trace metals, including heavy metals, in the sludge may also limit the long-range usage of sludge on agricultural land. With regard to their metals content, some equations have been proposed for computing the total quantities of sludge which may be applied. Such quantities are directly proportional to the cation-exchange capacity of the soil, and inversely proportional to zinc, copper, and nickel contents of the sludge.

Using one of these equations, an Illinois soil with a cation exchange capacity of 27 milliequivalents per 100 grams can accommodate 21 annual applications of 2 tons of the "typical" sludge per acre. So it would appear that if annual application rates are limited to those sufficient to provide nitrogen for grain crops (sometimes called "agronomic rates"), there seems little cause for concern about detrimental trace metal accumulations in soils or plants from the use of most municipal sludges over a period of many years.

Sewage sludge appears to be well adapted for utilization on lands previously disturbed by strip mining and on which the topsoil has not been replaced. Most of these areas have soils high in potassium but low in nitrogen, phosphorus, and some micronutrients. Thus, sludge should be an excellent nutrient source. These soils are generally low in organic matter, and sludge can also provide that. The application of sewage sludge may provide the option of going directly into row-crop production after levelling of "spoil banks." The maximum rate at which sewage sludge can be safely applied on such soils is unknown. There is a lower likelihood of phosphorus toxicity symptoms developing from heavy application rates, since such soils are so low in phosphorus.

The Prairie Plan project in Fulton County used sludge applications as high as 25 dry tons per acre in 1974, anticipating similar applications in 1975. The yields of corn and soybeans were low, and there was no adequate evaluation of the effect of sludge on yields. The area was subjected to adverse weather in 1974, including a wet spring, a drought in mid-summer, and an early frost.

Runoff and ground water are being monitored for nitrogen, heavy metals, and fecal coliform levels. Analyses of soils and crops are also being made. From these studies and from our research at Elwood, an adequate warning should be available if problems develop. Even if the heavy application rates cannot be maintained indefinitely, the safe, long-term application levels on these soils may be higher than similar treatments on undisturbed soils.

Application rates for sludge on agricultural soils must be specified according to the analysis of the sludge being used. The analysis should be provided by the sewage-treatment plant from which the sludge is obtained. If an analysis is not provided or if the figures given are to be checked, analyses can be made by one of the laboratories listed at the end of this paper. Sufficient sampling must be done to measure variability in composition over a reasonable period of time. Various commercial and public laboratories use different procedures. Remember this when comparing data from one sludge to another, or one laboratory's results with that of another. Laboratories may also use different statistical treatments of analysis data. You may find some using arithmetic means and standard deviations, others geometric means and standard deviations; and sometimes, the median 50 percent value will be used as a mean. These are not strictly comparable, and you need to know what method of reporting is used.

CROP RESPONSE

In 1967, Dr. T.D. Hinesly and his associates at the University of Illinois started research with liquid, anaerobically digested sewage sludge. This research has included intensive laboratory and field lysimeter studies, as well as yield responses of various crops in field experiments at the Northeast Agronomy Research Station near Elwood. Dr. R.L. Jones is the other major University staff member now associated with this project. The yields of corn grown for eight consecutive years are given in Table 2, and the yields of soybeans for seven consecutive years in Tables 3 and 4.

Table 2. Corn yields as Influenced by Sewage Sludge Applications at the Northeast Agronomy Research Center Near Elwood

	Sludge applied: Total liquid in eight years (inches) 0	17.25	34.5	69	Maximum solids/year
	corn yields, bushels per acre				*tons/A.*
1968	66	96	114	112	23
1969	143	149	150	151	21.6
1970	88	119	122	138	23.5
1971	97	104	110	126	57.3
1972	143	137	143	141	11.4
1973	64	96	107	122	27.7
1974	55	51	61	82	21.8
1975	130	149	151	150	14.5
Average	98	113	120	128	25.1

Corn was grown in 30-inch rows, with plant populations ranging from 18 to 25 thousand per acre. Sludge was applied in furrows between the corn rows, starting after corn was about 6 inches high. The check plots (0 sludge) were not fertilized in 1968, but received 200 pounds of N and 270 pounds of P_2O_5 per acre each year thereafter. All plots received 200 pounds of K_2O per acre each year, beginning in 1969. The treatments were 1/4 inch, 1/2 inch, or 1 inch of sludge, applied as frequently during the growing season as the drying of the sludge would permit. The sludge varied from 1.9- to 3.4-percent solids, with an average of 2.9 percent.

Corn yields have generally increased in direct proportion to the amount of sludge added. This study is on Blount silt loam, which is poorly drained and relatively low in organic matter. The organic-matter content

of the surface soil has been raised by an amount related to the quantity of sludge applied the preceding year. The only evidence of an increase in organic nitrogen below 12 inches came in 1972 following the unusually heavy sludge application of 57 tons per acre in 1971. By 1973, however, this had disappeared. The soil pH dropped from 5.6 to 4.9, following the application of 16.75 inches of sludge during the first two years. Consequently, limestone was added in fall of 1970 at rates calculated to raise the soil pH to at least 6.

Soybean yields have generally increased with the amount of sludge applied. Two series of soybean plots were installed to evaluate phosphorus sludge interactions on soybean yields. Soybeans were planted on ridges; the furrows were irrigated with sludge in the same manner previously described for corn. All plots received a broadcast application of 240 pounds of K_2O per acre per year.

In 1972, a severe depression of soybean growth was noted in the plots with the highest rate of sludge. The problem was more severe on plots receiving an additional 240 pounds of P_2O_5 per acre. Consequently, only one sludge application was made that year. Phosphorus toxicity symptoms were visible and the phosphorus content of tissues indicated that this was the major problem. Excess soluble salts were also found to be present, no doubt contributing to the problem.

When the excess salts were leached out by rainfall, the phosphorus toxicity problem was alleviated. Yields on the high sludge plot recovered in 1973 and sludge applications were resumed, but only on plots receiving additional phosphorus fertilization. The phosphorus toxicity symptoms appeared only when rates much higher than those needed to supply nitrogen or phosphorus for the crop had been applied.

Table 3. Soybean Yields Resulting from Sewage Sludge Applications at the Northeast Agronomy Research Center Near Elwood

	No additional phosphorus fertilization — Total liquid in seven years (inches) — Sewage sludge 0	7.8	15.5	31	Water[a] 31	Maximum solids/year
	soybean yields, bushels per acre					*tons/A.*
1969	34.0	45.0	48.2	50.0	43.4	19.1
1970	29.9	41.1	45.0	42.4	33.3	26.5
1971	26.8	28.7	31.3	31.7	22.3	60.2[b]
1972	30.3	38.0	40.8	13.8	24.4	2.2
1973	25.0	28.2	29.8	31.4	16.4	0
1974	22.0	25.9	26.6	26.7	19.9	-0-
1975	40.6	35.3	43.7	40.9	27.6	-0-
Seven-year average	29.8	34.6	37.9	33.8	27.5	15.4

[a]Water was applied at the same rate and time as the maximum sludge application.
[b]Five of the thirteen inches of sludge applied after harvest.

Table 4. Soybean Yields Resulting from Sewage Sludge Applications at the Northeast Agronomy Research Center Near Elwood

	Additional 240 pounds of P_2O_5 per acre added — Total liquid in seven years (inches) — Sewage sludge 0	11.5	23	46	Water[a] 46	Maximum solids/year
	soybean yields, bushels per acre					*tons/A.*
1969	37.8	44.6	46.8	52.1	51.8	19.1
1970	29.5	39.2	38.4	47.6	34.6	26.5
1971	22.8	27.8	31.0	31.5	25.9	60.2[b]
1972	35.7	44.3	42.3	3.1	29.4	2.2
1973	22.1	24.4	30.9	29.3	18.1	6.1
1974	21.4	25.5	29.7	31.5	25.9	26.2
1975	36.0	42.1	49.7	45.3	31.1	21.9
Seven-year average	29.0	35.5	38.4	34.3	31.6	23.2

[a]Water was applied at the same rate and time as the maximum sludge application.
[b]Five of the thirteen inches of sludge applied after harvest.

As can be seen in Tables 3 and 4, the sludge applications averaged 35 tons per acre per year for 1969 through 1971 at the highest rate of application. No phosphorus toxicity symptoms or yield reduction were found when sludge applications were one-fourth this amount, even where additional inorganic phosphorus fertilizer was applied.

Soybean yields on plots irrigated with well water but receiving no sludge have sometimes been lower than check-plot yields. The reason is unknown. This is not typical of the response expected from soybean irrigation in Illinois, but the reason for this erratic behavior has not yet been found.

A small field experiment on the University of Illinois [illegible] sludge, manure, and inorganic fertilizer [illegible] inches of liquid digested [illegible] bushels in 1975. Plots receiving [illegible] 136 bushels in 1974 and 203 bushels in 1975. [illegible] use of an organic fertilizer [illegible] on these soils to know whether additional productivity [illegible] ations, and, consequently, may have a low capability for holding metals [illegible] could occur with sludge from repeated applications. Also, nitrogen [illegible] greater extent with a resultant increase in pollution [illegible]. These things are being studied.

ADDITIONAL LONG-TERM BENEFITS

Sludge provides a source of organic matter that may be beneficial [illegible] soils [illegible] strip-mined lands can be particularly low in organic matter. At Elwood, three [illegible] applications totaling about 75 tons per acre produced [illegible] organic matter increases in the surface layers of three soil types in field lysimeters. The increases were greatest [illegible] and extended to the 12- to 18-inch layer in the sand but not in the heavier soils. The increases in organic matter content appeared to be directly related to the amount of sludge applied the preceding year.

Organic matter is beneficial in holding plant nutrients in the soil complex and in facilitating their slow release. Improved water-holding characteristics, structure, and tilth are generally found to result from an increase in the soil organic matter content when it is at a low level. Many soils in Illinois have a relatively high organic-matter content, and minimal benefits from additional organic matter could be anticipated on them. One should keep in mind that the plow layer of soil weighs about 1,000 tons per acre; consequently, the percentage of organic matter could not be expected to increase appreciably from annual applications of a very few tons. On the other hand, organic matter provides maximum benefit as it is decomposing. Its moisture- and nutrient-holding ability is many times that of inorganic soils per unit of weight. Thus, benefits from applying sludge could be expected, particularly on soils low in organic matter, even though the percentage of organic matter does not increase appreciably.

POSSIBLE PROBLEMS

ODORS. Odors from sludge can create problems under certain circumstances. Anaerobically digested sludge is usually described as having an "earthy" odor or one similar to that of crude oil. However, persons living adjacent to areas where sludge is applied to land or is held in lagoons frequently complain of objectionable odors. If the sewage has not been properly processed, the resulting odors may be very noticeable.

Sometimes odors similar to ammonia are reported. When sludge is held in lagoons, the upper layers of liquid become rather high in ammonia and some is lost into the atmosphere. The Metropolitan Sanitary District of Greater Chicago has returned to Chicago some supernatant liquid from the top of their holding lagoons in Fulton County in order to alleviate this problem.

There is a considerable difference of opinion at present about the severity of odors. Interestingly, many persons living in rural areas seem to find odors from sewage sludge to be significantly more objectionable than odors from manure. Many who live in cities find manure odor highly objectionable, but they may have little opportunity to compare this odor with that of sludge.

Thus, odors can be a problem, at least in operations in which liquid sludge is spread on large tracts of land and/or stored in lagoons. Minimizing the surface area of such lagoons and the length of time sludge is held in them may help alleviate the problem. Also, injecting the liquid sludge into soil with a special disc or moldboard plow should be preferable to sprinkling it on the surface.

SOLUBLE SALTS. Sludge high in the salts can cause problems if applied in large amounts. High salt concentrations in the upper layers of the soil can retard seed germination and plant growth. The soil structure might be adversely affected, reducing water intake and aeration. However, sludge generally has a low ratio of sodium to calcium and magnesium, indicating a low adsorption of sodium. The sodium that is adsorbed by soils tends to be leached out again in humid areas where there is an annual net movement of water down through the soil profile. Thus, there seems little reason for concern about soluble salts in Illinois if the sludge is applied at agronomic rates.

TRACE METALS. Many of the concerns about possible, detrimental effects from long-term applications of sludge to the soil have centered around the trace metals in sludge. These elements remain bound in the soil, and any problems they create are difficult to correct. The elements of most concern are zinc, copper, nickel, and cadmium; but such concern extends to mercury, lead, boron, chromium, cobalt, selenium, and molybdenum. The fear is that repeated applications of sludge might build up concentrations of these elements in the soil to levels that would be toxic to crops; also, that metals absorbed by plants which are then eaten by man or animals could enter the food chain at undesirable levels.

University research has concentrated on determining total and one-tenth normal, hydrochloric acid extractable concentration levels of trace elements in soils treated with various loading rates of digested sludge. These are efforts to follow the transfer of trace elements into the food chain.

Illinois studies to date indicate that there is little reason for concern about detrimental trace metal accumulations in soils or plants when most municipal sludges are applied on agricultural soils at agronomic rates. As would be expected, those metals that occur in sludge at higher concentrations than in soils increased in total and one-tenth normal, hydrochloric acid extractable levels in surface soil as sludge was applied. The zinc and cadmium contents of corn leaf, grain, and mature plant residues were especially increased. The zinc and cadmium contents of soybean tissues and seed were similarly increased. However, none of the increases resulting from agronomic rates of sludge would cause problems with plant growth or with animals consuming the foliage or seed. Increases in the cadmium and zinc contents of foliage were greater than the increases in the seed. Consequently, if problems were to develop from applications over a great many years, such problems might be expected first in the foliage and possibly in animals consuming the foliage. However, only ruminant animals consume large amounts of forage and their digestive systems apparently are less effective in absorbing metals than are those of single stomached animals. The metal levels observed so far would not be likely to present a serious problem.

Our research will continue, monitoring soil and plant contents of trace elements in order to become aware of any such problems should they develop. There is concern that trace elements may become more available with time as organic matter from the sludge decomposes or as the pH level drops with repeated applications of sludge if a proper liming program is not followed. Observations to date, however, indicate that metals will rapidly decrease in availability when sludge applications cease.

PATHOGENS. There has been serious concern that sewage sludge might contain disease producing organisms, and that animal and human health problems might result from sludge utilization. Thus, University of Illinois studies have been concerned with this problem. Viruses are unlikely to survive a period of 15 days in a heated anaerobic digester, at least in a condition capable of causing an infection, as determined in 1970. Much the same situation was found in 1973 for several kinds of zoonitic parasites.

NITRATES. In the studies in field lysimeters at Elwood, drainage water from check plots has been found to have about the same nitrate content as that from the lowest sludge application plots (averaging about 6 tons of dry solids per acre per year). Inorganic nitrogen fertilizer is applied to the check plots in an amount approximately equivalent to that on the lowest sludge plots. Thus, it appears that the rate of nitrogen transformation to nitrate and the movement through Blount silt loam is the same regardless of source.

PHOSPHORUS. Phosphorus added to soils as a constituent of sludge appears to be highly available to crops. Hence, it is possible for available phosphorus to accumulate in soils to toxic levels for sensitive crops if sludge application rates are high. Also, the levels of phosphorus concentration in drainage water may possibly increase to the point that they pose a eutrophication threat when drainage water is returned to nonflowing surface waters. Again, these problems are not expected to result as long as agronomic rates of sludge application are not exceeded.

EPA REGULATIONS

Approval by the Illinois EPA is necessary for any application of sewage sludge on agricultural land. Generally, this approval is secured by the sewage-treatment facility from which sludge is obtained. Approval is being given for applications at agronomic rates. Producers who intend to use sludge on land should check to see that such approval has been received.

SUMMARY

Heated, anaerobically digested sewage sludge can be used on agricultural land to provide nitrogen, phosphorus, and perhaps trace elements. An analysis of the sludge should be obtained in order to know the nitrogen and phosphorus content and that of minor and trace elements. Research at the University of Illinois and elsewhere indicates that crop plants can utilize the nutrients in sludge and that few, if any, crop-production or environmental problems are likely to result from low rates of application. The nitrogen content of fresh, liquid digested sludge will determine the application rate. If, however, sludge is applied on the same land over a period of many years, the phosphorus and/or the trace element content of the sludge may determine the long term application rate.

LABORATORIES THAT WILL PERFORM SLUDGE ANALYSES

Arro Laboratories, Inc.
P.O. Box 686
Caton Farm Road
Joliet, IL 60434
(815) 727-5436

Olson Laboratories
68 Monterey Street
Box 594
Freeport, IL 61032
(815) 232-9110

NU AG
P.O. Box 239-U.S. 51 South
Rochelle, IL 61068
(815) 562-6060

Rosner-Hixson Laboratories
3570 N. Avondale Avenue
Chicago, IL 60618
(312) 588-8500

Analytical Bio-Chemistry Laboratories, Inc.
P.O. Box 1097
Columbia, MO 65201
(314) 474-6050

Environmental Instrument Systems, Inc.
116 S. Hill Street
South Bend, IN 46617
(219) 287-7151

National Laboratories, Inc.
622 Ingle Street
Evansville, IN 47708
(812) 422-4119

Northern Laboratories, Inc.
301 E. Lincolnway
Valparaiso, IN 46383
(219) 464-2389

O.A. Laboratories, Inc.
335 Sadlier Circle W. Drive
Indianapolis, IN 46239
(317) 353-8021

Ten Tech
Environmental Consultants, Inc.
52580 U.S. 31 North
South Bend, IN 46637
(219) 272-5272

United States Testing Co., Inc.
Cotton Exchange Building
Memphis, TN 38103
(901) 526-4231

Contact the laboratory of your choice for sampling, storage, and shipping instructions and for charges. ***Do not send samples to a laboratory without first contacting that laboratory for instructions.***

M.D. Thorne	T.D. Hinesly	R.L. Jones
Extension	Soil	Soil Mineralogy
Agronomy	Ecology	and Ecology

The Illinois Cooperative Extension Service provides equal opportunities in programs and employment.

E.P.A.

We feel there should not be federal funds used to enlarge the present M S D project until the odor problem has been corrected such as reducing the size of the holding basins

We live app. 1 mi south of Spoon River College and app. 1 mi east of the holding basins. The sludge odor effects our family living - working outside when farming and particularly our sleeping at night.

As far as the health Dept. taking samples the past 4 years is a farce. What they do does not help our odor problem one bit for as long as the problem exist (large holding basins full the year around - more

like a disposal plant than a Prairie Plan).

As far as reading the impact statement I do not fully understand it.

Also of much concern is the Shields Chapel church in the vicinity and also the parsonage. These are affected the same.

We are very concerned about water pollution such as our wells - also a spring in our pasture where our cattle drink - this drains from under M. S. D. land where sludge is applied several times each year. Last year had 1 cow and 1 bull die and this year 1 cow die while in the pasture. Never lost any after changed cattle to another pasture.

We are also concerned about property value - we feel no one would want to buy property with these problems

We wonder about the effect of our health living, sleeping & eating in this enviroment year around

We also have a tremendous increase of traffic including large trailer tractors who do not observe stop signs or speed limits

! We live on a gravel road where the dust is terrific and just paid 80.00 to oil in front of our house. Our County supt - Sandberg said there was no tax available?

Would you please think very strongly before using Federal Funds to increase more problems on Fulton County

Dale Vaughn
R.7 Canton

IPS4 #4

STATE OF ILLINOIS
EXECUTIVE OFFICE OF THE GOVERNOR
BUREAU OF THE BUDGET
SPRINGFIELD 62706

August 10, 1976

Mr. Gary Schenzel, Acting Chief
Planning Branch
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

RE: Draft Environmental Impact Statement - Sludge Disposal and Land Reclamation in Fulton County, Illinois, DEIS #76-06-251

Dear Mr. Schenzel:

Pursuant to the National Environmental Policy Act (NEPA) and the established rules and procedures for its implementation and in accordance with OMB Circular A-95 (revised) and the administrative policy of the State, the Illinois State Clearinghouse is transmitting the attached comments on the referenced subject. The subject has been reviewed by the appropriate State agencies and the attached comments are for inclusion and discussion in the final Statement.

It is requested that a copy of the final Statement be sent to the State Clearinghouse and to the commenting agency(s). Thank you for your cooperation.

Respectfully,

T. F. Hornbacker
State Clearinghouse Coordinator

TFH:mc
Attachment
cc: Anthony Dean, IL Department of Conservation

STATE OF ILLINOIS

DEPARTMENT OF CONSERVATION
405 STATE OFFICE BUILDING
400 SOUTH SPRING ST
SPRINGFIELD 62706

ANTHONY T. DEAN
DIRECTOR

WILLIAM A. WATTS
ASSISTANT DIRECTOR

CHICAGO OFFICE--ROOM 100 160 N. LA SALLE ST. 60601

TO: Terry Hornbacker

FROM: Anthony T. Dean

DATE: August 5, 1976

SUBJECT: REVIEW OF THE DRAFT E.I.S. FOR SLUDGE DISPOSAL AND LAND RECLAMATION BY THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO IN FULTON COUNTY (DEIS #76-06-251)

The draft EIS did a good job of outlining the environmental issues of the Metropolitan Sanitary District of Greater Chicago's land reclamation and sludge program in Fulton County. However, the following environmental issues need more attention or a detailed investigation as to their impact on the fish and wildlife resources of the region:

1. A detailed study is needed to identify the sources of heavy metals and their fate in the various food chains. Fish flesh should also be analyzed for various contaminants. Big Creek should be the target of this study.

2. Land reclamation (drainage, leveling and sludge application) should be evaluated as to its affect on the giant Canada goose population of the project area. Many acres of marsh type habitat have been lost by the land reclamation activities of MSDGC. Habitat diversity lost through reclamation activities was not adequately covered in the draft EIS statement.

3. Effects of sludge application on wild birds and mammalian species needs more investigation since it is stated in the draft EIS that available research data indicates a potential hazard exists.

As of August, 1975, the MSDGC owned 15,528 acres of strip mine lands in central Fulton County. These lands currently contain a magnitude and diversity of surface water resources consisting of lakes, ponds, marshes and streams. The draft EIS does not call attention to the loss of valuable water resources through the land reclamation plans of MSDGC. In our opinion,

Recycled Paper

these losses and their implications should be fully discussed in the final EIS.

We also note the draft EIS indicates there are three endangered plant species which probably exist in the project area. We feel this information should be verified, and, if these plants do occur, the final EIS should discuss alternatives for preservation or mitigation of these species.

ATD:meh

August 14, 1976

Gary Schenzel
Actin, Chief
Planning Branch
United States, Environmental Protective Agency
Regin V
230 South Dearborn St.
Chicago, IL. 60604

Dear Mr. Schenzel:

I would like to have the following comments included in the public hearing regarding the application of sewage sludge in Fulton County by the Metropolitan Sanitary District of Chicago.

As a physician and pathologist, I wish to make the following comments. This is a large and ambitious project, one of the largest in the world. The sludge is obtained by a digestion method notgenerally used in many large operations. All previous studies regarding application of sewage sludge to land, use sludge obtained by other methods. I think you are probably aware of the various procedures. The sludge being applied in Fulton County is even more unique in that it is comprised of approximately 50% industrial waste with all of the inherent toxic products. This, to name a few, includes all of the heavy metals, possibly asbestos, organic compounds too numerous to mention, PCB's and other known as well as unknown carcinogens. It is also been demonstrated and accepted by your agency that various pathogenic biological organisms could be present in sewage sludge in spite of the digestion process.

While it has never been demonstrated that sewage workers have an increased incidence of illness or disease, it is also true that I have never seen a controlled study or more importantly a prospective study much less a controlled prospective study on the effects of the exposure of humans to sludge. The question of this effect on humans cannot be fully answered until such a study has been done. Is such a study warranted? To answer this, I would only point to the relationship of smoking and cancer, especially lung cancer. It was only after extensive studies of human populations that the very direct and very significant link was demonstrated. The same story and course of events has been repeated with numerous chemical agents beginning with the diazo dyes, benzidine and many other organic chemicals, too numerous to mention. The same is true with biological organisms, including bacteria and especially viruses. Since we presently have difficulty with viral cultures, the true extent of this aspect has not been fully investigated.

At the present time there are many many tools available to monitor populations in a controlled prospective study. Since this is an experimental project by every criteria, these studies should be done. There are people who are directly exposed to sludge on a daily basis. This includes aerosols as well as direct skin contact and other indirect contact as well. I would therefore propose that these workers plus matched controls be serially monitored for heavy metal buildup, immunoglobulin levels, antibody development and certain infectious agents including viruses as as well as bacteria. I would also propose that they be monitored for frequency and type of illnesses, including the incidence of cancer, cardiovascular disease and pulmonary disease.

I would readily point out that these tests and procedures are fully developed and readily available. They should be performed and if properly designed, these studies would not be prohibitive in terms of cost. It would provide answers to questions which will be asked repeatedly in the future. Why not get the answers now and avoid injury to people in the future.

Industrial manufacturers are required to prove the safety of their product. I see no reason why the Metropolitan Sanitary District should not also prove the safety of their product. I see no reason why sewage sludge operation and disposal project of this magnitude with a potential effect on 50,000 people in the area, should not be subjected to requirements similar to those in industry.

It is therefore, my studied opinion that this is a poorly designed, hap hazardly monitored project designed not to determine the effects of the exposure to sludge on people.

Marvin E. Schmidt, M.D.

MES/lg

ITEM 15

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P.O. Box 678, Champaign, Illinois 61820

August 23, 1976

Mr. George R. Alexander, Jr.
Regional Administrator
Attention: Planning Branch - EIS
Preparation Section
U. S. Environmental Protection Agency
Region V, 230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Alexander:

The draft environmental impact statement for the Sludge Disposal and Land Reclamation in Fulton County, Illinois, dated June 1976, prepared by the U. S. Environmental Protection Agency, Region V, has been reviewed. Following are the comments from the Soil Conservation Service for your consideration.

Page 1-1A, line 4 - reads 60 percent. This figure should be 6 percent.

Page 1-1A, last paragraph reads - "Construction work began in January 1971. Since that time, the project site has been contoured and terraced to create fields suitable for sludge application." Suggest it read "Since that time, the project site has been graded and reshaped to create fields suitable for sludge application." We do not believe it is being contoured and terraced to the best of our knowledge at least under U. S. Department of Agriculture definition of such practices.

Page 1-8-2 - Geology and Soils - Second paragraph, second sentence reads - "This material is essentially impervious, but is subject to erosion if exposed on slopes steeper than 20%." Loessial soils in the project area according to the soil survey have permeability rates varying from moderately permeable to moderately slowly permeable. Erosion can take place on slopes much flatter than 20% and slopes steeper than 20% can be very stable depending on the vegetative cover or the conservation practices applied.

Page 1-10, item 5, Socio-Economic and Land Use Conditions, second sentence reads - "According to present trends, demand for farmland in Fulton County has been decreasing, ...etc." This is a questionable statement. The demand for farmland is not decreasing, however the incentives to go to other uses is likely to be the reason for the change. The next sentence is very questionable also.

Page 1-19, first paragraph indicates runoff basins are not always designed to handle a 25 year storm runoff. This should be the minimum for such improvements.

Page 1-26-2 Mitigative Measures - Consideration should be given to avoid working fields when muddy. This may be affecting the permeability of the soil resulting in more ponding.

Page 1-29, second paragraph - This refers to the use of wind barriers to reduce surface turbulence and wave action on the storage reservoirs. The Soil Conservation Service can provide technical guidance on species, spacings and locations of such plantings.

Page 1-29-3, Monitoring and Research Programs - We certainly concur in the recommendations for an expanded program of monitoring and research.

Page 1-31 - Suggest adding the evaluation of the effectiveness of soil and water conservation practices be included in the research and monitoring program.

Page II-22 states "Cropping practices shall be such that soil loss does not exceed tolerable limits as defined by the Universal Soil Loss Equation for that soil type." To date this standard is not being fully implemented. The Soil Conservation Service through the Fulton County Soil and Water Conservation District can provide technical assistance in planning the needed conservation practices to meet this requirement.

Page III-2, paragraph 2 indicates the project site has been contoured and terraced ....etc. According to the U. S. Department of Agriculture, Soil Conservation Service definitions, the site is not terraced. Consideration should be given to applying the needed conservation practices according to the Soil Conservation Service technical guide standards and specifications of the Soil Conservation Service field office technical guide.

Page III-19 - Environmental Control and Monitoring Systems - The second sentence refers to terracing of fields. Again we wish to refer to the term terracing. To our knowledge terraces have not been installed as one of the practices to help reduce water runoff, erosion or control of effluents. The practices are also mentioned in B-1, second paragraph.

Page IV-13, last paragraph, third sentence - Due to the leveling and grading for site preparation, many slopes are long. If erosion is to be controlled the application of conservation practices such as contouring, terracing and other conservation practices should be considered to hold soil losses within tolerable limits.

Page IV-19, first paragraph is incorrect. Suggest it read "Area 2 is the area in which no strip mining activities has been undertaken. Approximately 4 to 8 feet of loess, which is comprised primarily of silt-sized particles, covers the glacial soils. These soils have permeability rates varying from moderately permeable to moderately slowly permeable. These soils are subject to erosion unless they are protected with adequate vegetative cover or appropriate conservation practices. A groundwater table ....etc."

Page IV-19, last paragraph, second sentence should read "However, the U. S. Soil Conservation Service District Conservationist, through the Fulton County Soil and Water Conservation District, provided highly useful information concerning the agricultural capability of the soils."

Pages IV-20-22, item 1, Surface Water Hydrology - This section does not give consideration to the affects of surface cover or heavy equipment compaction on permeability rates.

Page IV-48, F.1.a - Land Use Pattern - The first sentence states "The only available county-wide inventory of land use was made in 1968 (Harland Bartholomew and Associates, 1969). For your information the "Illinois Soil and Water Conservation Needs Inventory" was published for the Illinois Conservation Needs Committee in 1970. Many U. S. Department of Agriculture agencies, state agencies and other organizations plus interested persons participated in the inventory. This report includes land use figures.

Page IV-58, G.2 - Land Resources, third sentence should include all factors in the soil loss equation which includes rainfall, soil erodibility, slope length, steepness of slope, management and erosion control factors. This information may be obtained from Mr. Keith Mueller, District Conservationist, Soil Conservation Service, in a document entitled "Resource Conservation Planning Technical Note IL-4, Universal Soil Loss Equation dated September 16, 1974.

Page IV-60, third paragraph, last sentence - You may wish to include domestic grasses such as smooth brome grass, orchard grass, fescue and reed canary grass where erosion is the significant problem. These should not, however, have been included in the Prairie Restoration designated area.

Page VII-35-4, last paragraph - Mitigation of Adverse Effects - The use of wind barriers such as tall, dense hedgerows around the holding basins is discussed. The Soil Conservation Service can provide technical assistance through the Fulton County Soil and Water Conservation District on adapted species, spacing, layout of plantings and discuss the effects which could be expected.

Page VII-42 & 43 - Surface Spreading - Very little use if any surface spreading on vegetated land is being used. This method could be an excellent approach to rapid utilization of sludge nutrients.

Page VII-45-5 - Mitigation of Adverse Effects - This section includes many good methods of reducing odors and erosion. To be completely successful we would recommend a complete conservation plan be developed with the assistance of the Fulton County Soil and Water Conservation

District. This plan could include soils information, cropping patterns, field arrangement, woody and vegetative plantings, erosion control practices, seeding rates and dates, recommended methods of sludge application and other guidance to reclaim the land. Consideration should be given to such things as drainage, irrigation, lengths of surface runs, rotating crops to provide adequate acreage for sludge application throughout the growing season. Consideration should be given to developing water budgets on fields to be irrigated with sludge.

Page VII-63, second paragraph, last sentence - This sentence indicates retention basins for 18 fields do not have capacity to contain a 25-year storm runoff. All retention basins should have a minimum storage to contain a 25-year storm runoff. They should have adequate drawdown facilities to maintain the needed retention capacity.

Page VII-64-5 - Mitigation of Adverse Effects - A number of the reservoirs and streams monitored have substantial areas contributing runoff that are not under Metropolitan Sanitary District ownership or control.

Page VII-67, first full paragraph, line 5 states "low levels" - suggest it read "lower levels."

Page IX-4-a, - There is no mention of the effects from numerous tillage operations and many are done when the soil moisture content is high.

Page IX-7, second full paragraph - The estimates of normal yearly soil loss figures are very questional. A loss of 1.5 tons per acre seems rather low. Soil losses can be estimated by using the "Universal Soil Loss Equation" referred to in our comment for Page II-22. The last sentence refers to catch basins and soil conservation practices. The listing of the conservation practices being used would be helpful in evaluating the control.

Page IX-35-b - Birds and Mammals - Large flocks of migratory and local geese and ducks spent many days resting on the sludge lagoons. During the spring of 1976 a flock of 20 to 30 Coots spent approximately two months (March to May) on the holding basins swimming on the sludge or resting on the shoreline. They seem to prefer this to the many lakes and monitoring basins. This section does not make clear what affect the sludge project has on the mosquito population.

If you have questions concerning soil and water conservation practices or conservation planning, don't hesitate to get in touch with Mr. Keith E. Mueller, District Conservationist, Soil Conservation Service, 612 South Main Street, P.O. Box 26, Lewistown, Illinois 61542, telephone 309-547-2779.

We appreciate the opportunity to review and comment on this project.

Sincerely,

Daniel E. Holmes
State Conservationist

SOIL ENRICHMENT MATERIALS CORPORATION
20 North Wacker Drive, Suite 2020, Chicago, Illinois 60606

Telephone 372-6434

July 2, 1976

Mr. George R. Alexander, Jr.
Regional Administrator
U.S. EPA
230 S. Dearborn Street
Chicago, Illinois 60604

Subject: EIS for Fulton County
Sludge Project

Dear Mr. Alexander:

Thank you for sending to me a copy of the subject EIS. Being in the sludge business ourselves, we were interested in reading it. We have done research on heavy metal uptake ourselves, for example, and it is interesting to note the comparison with the results reported in your statement.

We are also in the rail hauling business, and so were interested in your rail haul diagram on page V-38. You may be interested to know that our 1975 experience with rail haul can be summarized as follows:

Quantity moved:	50 million gals. = 210,000 tons (wet)
Average solids content:	13.9% (based on samples taken from top of rail car)
Cost of rail freight:	$420,000
Cost of tank car rental:	$110,000
Distance moved:	150 miles
Cost per wet ton:	$2.52
Cost per dry ton:	$19.06

These figures are very much different from those shown in your Statement. We assume that you merely copied figures given to you by others, but we do believe that they are misleading.

Perhaps the current indictments regarding the sludge hauling by barge indicate why some persons are interested in showing rail haul costs to be substantially greater than they really are. Also, note that we averaged 13.9% solids in the rail haul for all of 1975. Some cars were as much as 18% solids. This heavy

material is of course very difficult to pump (our pipeline was about 1 mile long), but the extra cost is more than offset by the savings in transportation costs. We were astounded at the 3.5% solids figure given on page V-38.

Is the 3.5% figure the average of what has been hauled to Fulton County in your opinion?

Very truly yours,

William J. Bauer
President

RECEIVED
JUL 6 1976
EPA REGION 5
OFFICE OF REGIONAL ADMINISTRATOR

Copy: Mr. Wilbur Zinn
WJB/jp

ITEM 90

LASL: H-8
MS-490
P. O. Box 608
Los Alamos, NM
87544
July 11, 1976

Mr. Valdas V. Adamkus
Deputy Regional Administrator
for Region V
U. S. Environmental Protection Agency
230 South Dearborn
Chicago, Illinois 60604

Dear Mr. Adamkus:

I am writing to you about the Draft Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County, Illinois. There are some obvious errors, uneven treatments, and imprecisions of language that need correcting before the final draft is issued. I will cite a few examples of the most serious shortcomings; there are many more.

My research work at The University of Texas at Austin, where I am a professor, has involved airborne emissions from wastewater treatment for more than 15 years. I have been involved in the Chicago wastewater business for about 5 years, during which time I have corresponded at length with Alderman Ward of Des Plaines and Dr. Lue-Hing of the Sanitary District. This correspondence by mail and phone and in person has extended to concerned citizens of the city and to consulting with Southwest Research Institute on the Salt Creek Project (near O'Hare Airport).

Apparent errors in the dispersion calculations and in the conclusions drawn from them include the following:

pp. VIII-7 to 15--The 1% aerosolization assumption was omitted; therefore, the calculated exposure concentrations for toxic materials are too high by a factor of 100. The conclusions about toxic materials (p. VIII-13 & p. I-22) are erroneous.

pp. VII-33 and 34 (Figures VII-14 and 15)--The key of at least one of the figures is wrong in quantity; they are both wrong in terminology. My calculations show isopleth values significantly different from those in the figures (see appended calculations).

p. I-16 and p. VII-35--The statement that the dilution at 4 miles is 2 to 4 times is in error. See the appended calculations that indicate 7.5 to 73 times.

7/14/76 - cc: Longest--ACTION

Needed changes in the particle settling calculations include the following:

p. VII-40 (Figure VII-16)--Residence times were apparently calculated for constant size droplets; this is especially important because conclusions were drawn from these curves. The droplets undergo evaporation as they fall; therefore, they fall with a changing velocity. Also, the figure is not labeled properly; the ordinate should be Time (sec), the abscissa Initial Diameter (micrometers), and the curves should show which are mass half-lives and which residence times.

pp. VIII-5 and 6--A 50-μm particle of unit density settles at 7.57 cm/sec or a 57.5-μm particle settles at 10 cm/sec (see appended calculations).

Relative solubilities of various gases are given on page VII-16. Sulfur dioxide is listed as highly soluble and ammonia as intermediate in solubility. Ammonia is about 4 times as soluble as sulfur dioxide on a weight basis and 15 times on a volumetric basis.

Contradictions appear in several places, including:

p. ix--The first sentence of the Foreword contradicts itself.

p. I-15--Chromatographic analyses showed 71% probability that odors came from the basins.
p. VII-23--The fingerprinting (chromatographic analyses) of odors was unsatisfactory.
p. VII-32--The wind directions for the complaints indicate 71% probability that the odors are from the basins.

p. VIII-3--"Evidence from places other than...of little predictive value,..."
p. VIII-21--"Useful evidence may be found, especially in foreign journals." Should it not be in the purview of this EIS to do the survey rather than recommending it?

Other errors that I see and my reasons for calling them errors include the following:

p. VIII-3--"...many pathogens survive..." This statement is simply not true regardless of the qualifying introductory phrase. Perhaps, wording such as not many pathogens get through; those that have been found include...

p. VIII-4--"...show much wider fluctuations." You must specify on a percentage basis or the meaning says that the fluctuations are greater than 5.32×10^6 organisms, which I doubt.

p. VIII-5 (mid) and p. VIII-7 (top)--"No great significance is attached to size..." The argument is presented that in some cases the microorganisms that are rejected from the respiratory tract and swallowed may cause infection. Even if that is the case, the gut is certainly more hostile to the microorganisms than is the lung. Numbers are important to starting an infection and the numbers surviving the gut are reduced.

p. VIII-6--The argument that depletion by impaction is not a significant reduction goes counter to the evidence. It is true that the efficiency of impaction on a single leaf is not very high and for the reasons cited; however, there are many leaves present and the small removal by a single pass will add up to be quite significant. Furthermore, the small particles are effectively removed by Brownian impaction if the time for diffusion is sufficient.

p. VIII-15 (2nd ¶)--"... proportion...that remain infectious ...could be very large..." I doubt that a large proportion could survive since in studies many thousands or millions of organisms must be used in order to find enough for counting. Also, see p. II-8 for that part of sludge from a heated anaerobic digester.

p. VIII-19 (2nd ¶)--"...the evidence indicates the level of risk to be low rather than nonexistent." The evidence indicates that the risk is no more than very low and may be nonexistent.

The last statement above indicates the imprecision of the language. The statement of the same idea on p. I-22 is better, but it still leaves something to be desired.

The unevenness of treatment is best exemplified by the dispersion presentations. On pp. VII-30ff only a skimpy, unfollowable listing is given; on pp. VIII-7ff a quite detailed and complete tabulation of even the intermediate numbers is shown.

I believe that some of the recommendations on pp. VIII-21 and 22 would be expensive to implement and are unwarranted in the absence of data showing a valid need for the changes. Additional monitoring falls in this category.

I hope that you will accept these points in the spirit that they are intended, as constructive criticism. My desire is to see the proper interpretation of the existing information on the EIS subject--my own work and that of others. The EIS needs to be of high quality and accuracy if it is to do any good.

Sincerely,

Joe O. Ledbetter

Joe O. Ledbetter

Enclosure

jay

EIS Dispersion Joe Ledbetter

pp. VII-30 & 35 Odors Reference Turner

Area Source: 260 acres of [illegible] Basins
Assume [illegible] 3265 ft [illegible]
1026 [illegible]

Check [illegible] SE Wind [illegible] (NW [illegible])

Figure VI [illegible] | Figure VII-15, p. VII-34
W[illegible] [illegible] Most [illegible] Case
[illegible] Distance [illegible]

[illegible]

4290 342/1290 [illegible]
6170 310/[illegible]
9900 47./1155 [illegible]

These [illegible] values are [illegible] lower than [illegible]
[illegible]

Maybe dilution factors (DF) could be [illegible];
the DFs [illegible] 560, [illegible]
[illegible]

4 mi = 6.4 km

395/1504 375/6.95 0.13 570/[illegible]34 109/6.9 [illegible]
DF = 7.58 DF 13.9

East Case: E[illegible] [illegible] DE DF

NICHOLAS J. MELAS
PRESIDENT

THE
METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO

100 EAST ERIE ST., CHICAGO, ILLINOIS 60611   751-5600

JOANNE H. ALTER
Chairman
Committee on Lake Diversion
Committee on Research and Development

September 20, 1976

Mr. Douglas Ehorn
U.S. Environmental Protection
  Agency
230 North Dearborn Street
Chicago, Illinois 60601

Dear Mr. Ehorn:

At the EIS hearing for Fulton County held in Chicago on August 17th, Mrs. Martha Strode stated she did not believe Spoon River College was cooperating with MSD.

I enclose the attached information for your files.

Enjoyed seeing you in St. Louis.

Sincerely,

Joanne H. Alter
Commissioner

JHA:y
Encl. 9/14/76 Daily Ledger clip:
"SRC students test sludge
on crops"

B-18

SRC students test sludge on crops

Canton Daily Ledger
9/14/76

BY DENNIS GODFREY
Of The Ledger Staff

AS PART OF the vocational agriculture training program, Spoon River College is spreading Metropolitan Sanitary District of Chicago sludge on a small plot of ground near the college.

The sludge is being used as fertilizer on a small area planted with corn with the purpose to provide independent tests on how the application affects the plant.

Brian Telander, head of the vocational agriculture department, said the tests are to determine what kinds of minerals, and nutrients are passed from the sludge into the corn stalk and into the grain.

"We're not pioneering anything," Telander said. "Everything we are doing has been done by the extension service and others."

The only difference is that the college is having the soil, the stalks, and the grain tested by a research lab completely independent of other research that has been completed.

The research began last spring when soil samples from part of a 40 acre piece of land the college uses for crop projects for students were taken. The samples were sent to the research lab for extensive tests to find what was in the soil.

"We tested for exotic micro-micro nutrients and other things that you would never do on a farm," Telander said. The purpose was to know what kinds of things could be transferred to the plant independent of any applications to the soil.

On a half acre plot on the 40-acre site, a berm was constructed to prevent runoff, then a third of the plot was treated with nothing but water. Another third was treated with an average application of two inches of sludge, the amount normally considered the correct amount for crop fertilization. The final third was treated with four inches of sludge, or twice the normal agricultural application.

THE PLOT WAS then planted with corn.

"We'll go in this fall and take yield averages," Telander said, "but we're not as much interested in the yields as we are in the tissues tests of the plant and the corn."

There will also be soil tests samples taken to see how much difference there is compared to before any application of sludge was made.

The significant results, Telander said, this year will probably only be in the amounts of heavy metals contained in the stalks and the grain that can be directly attributed to sludge. The soil tests probably will not be important this year

SEE: STUDENTS, page 3

Students study sludge

●from page 1

because there is not yet the sludge buildup from multiple applications.

"The fear is not in one year," Telander said, "but rather what happens when the sludge has been in the soil three or four years."

It is interesting that the study is conducted on land actually belonging to MSD. The college has been given the land for a low cost lease for several years for the purpose of agricultural projects. This is the first year that there has been a sludge test on the land. The land has not been strip-mined although it is near other land that has.

"MSD has no control over the project," Telander said. "The only thing they have asked is that we split our sample with them so they can conduct their own tests."

IT WILL PROBABLY be about January before any test results are known.

Telander said even after the results are known, questions about the danger or benefit of sludge applications will remain.

"The unresolved question is what level of each of these elements is safe"," Telander said. Other questions are whether the elements are safe when combined with other things and whether it is safe to feed the materials grown with sludge to animals then feeding the animals to humans.

"The thing is there may be one level that's safe for an adult male, another for a pregnant female and another for a child. There are a magnitude of problems concerned," Telander said.

The sludge project is the only SRC agriculture program that comes close to being purely for research. All other farmlands used by the college are for students to use to learn farming techniques or for the demonstration and adjustment of agriculture equipment.

"We try to give some solid theory to our students along with some practical experience so when they get out on their own they flounder a little less," Telander said.

ITEM #10

NICHOLAS J. MELAS
PRESIDENT

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

100 EAST ERIE ST., CHICAGO, ILLINOIS 60611 751 5600

Bart T. Lynam
General Superintendent
751 5722

August 13, 1976

Mr. Gary W. Schenzel
Acting Chief, Planning Branch
United States Environmental
Protection Agency
230 South Dearborn
Chicago, Illinois 60604

Re: Executive Summary of The Metropolitan Sanitary District of Greater Chicago Response to the Environmental Impact Statement for the Fulton County Land Reclamation Project (Prairie Plan)

Dear Mr. Schenzel:

The Metropolitan Sanitary District of Greater Chicago (District) has prepared a detailed response to the Draft Environmental Impact Statement (EIS) which your agency has prepared for the Fulton County Land Reclamation Project (Prairie Plan) presently being conducted by the District. The detailed response is attached. This letter is designed to summarize the major responses the District has compiled in the detailed document, but should not preclude an in-depth review of the entire document by your staff. It is the judgement of the District that the EIS must be considerably revised before it can be disseminated in its final form.

The USEPA statements in the EIS regarding the utilization of municipal sludge for fertilizing row crops and reclaiming barren land are in general favorable. Recycle of municipal sludge is recognized as a viable and indeed environmentally acceptable method of sludge disposal for municipal agencies. The District has been one of the leaders in this field and as such is gratified that the EPA recognizes this concept. Clearly, with the increasing amounts of sludge which will be produced by improved sewage treatment, more municipalities will be adopting this method of sludge utilization.

However, the EIS contains errors, false conclusions and needless recommendations which will be misleading and damaging not only to this project but the nation's policy for recycle and land treatment. Summarized below are eight major areas of concern to the District.

I. Environmental Monitoring

The EIS states that the existing District environmental monitoring and research programs are inadequate to assess environmental impacts. The EIS authors go further to suggest additional monitoring and research and that such an expanded program be reviewed by an independent agency (unnamed).

The District has the most extensive monitoring program ever attempted for a sludge application site. The EIS does not recognize nor discuss many important aspects of this program despite the fact that every opportunity was given the authors to investigate the program. The existing program is discussed in detail in the attached statement and is designed to monitor the effects on soil, plants, surface and groundwater, air and indigenous animals.

We reject the concept that the project requires an independent agency for review of all data. Presently, the project is monitored by the Illinois Environmental Protection Agency (IEPA), Fulton County Health Department (FCHD), United States Geological Survey, and the University of Illinois (U. of I.). Periodic reviews of the environmental monitoring data have been made by the Food and Drug Administration and the United States Department of Agriculture. Also, the District and the University of Illinois have been active in disseminating such information in the technical literature.

We believe that the existing environmental monitoring program can determine any potential harm to the environment.

II. Alleged Odors

The EIS states that there is insufficient dilution of alleged odors at the Fulton County site. This is concluded by means of calculations made regarding atmospheric dilution of alleged odor emissions at the site. In addition, odor complaints phoned in to the FCHD are used to state that the probability of an odor complaint being tied to the District project is greater than 70%.

The calculations used to arrive at the atmospheric dilution at the site were found by the District to be erroneous. Dilution, four miles from the District sludge holding basins was calculated in the EIS to be 2 - 4. In fact, the dilution at four miles was 7 - 75.

Analysis of complaints to the FCHD neglected to include the fact that only about 2% of the complaints are confirmed by the FCHD. The statements about probability source were based on wind directions compiled by the FCHD at verified odor sites. Wind direction measurements have a variance of 22.5 to 45° from the reported direction. If this fact were included, one could easily indicate a nearby agricultural feed lot.

The District objects to the conclusion that there is an odor problem, as written in the EIS, and asks that this be corrected or deleted from the EIS.

III. Metals in the Food Chain

The EIS strongly suggests that there is a significant health hazard due to metal accumulations in the crops grown on sludge amended soil. However, little experimental evidence is presented to support this suggestion.

The U. of I., the District and the USEPA have participated in a joint research venture to study, among many things, the metal uptake of crops grown on sludge amended soil. The data from this program conducted since 1967, has been made available to the EIS authors, the USEPA, and has been published in the technical literature. This data has shown, contrary to what is stated in the EIS, that metal accumulations are not the limiting factor in sludge application. In fact, metal levels in crops have been found not to be related to accumulative sludge application.

The recently released USEPA technical bulletin on Municipal Sludge Utilization published on June 3, 1976 contains no limitations on sludge metal levels nor limits sludge applications based on such metal levels. Clearly, it is inconsistent to indicate metal level problems if the Agency has not included such limitations in the above mentioned bulletin.

IV. Sludge Quality

The EIS compares certain sludge quality parameters with then existing FCHD regulations. It is concluded from such

a comparison that the District sludge shipped to Fulton County is inadequately stabilized.

However, the comparison with FCHD regulations is inconsistent with District sludge quality data. The only values not consistent with the FCHD regulations were sludge alkalinity. Recently, the FCHD has amended its sludge regulations and lowered its alkalinity criteria. No further values are anticipated which would not be consistent with these new regulations.

The use of the FCHD regulations for sludge quality to condemn District sludge quality is inconsistent with the fact that the FCHD has never cited the District for sludge quality violations.

The EIS after reviewing the FCHD regulations and District sludge quality concludes that additional lagooning at the District's W-SW plant is needed prior to shipment to Fulton County. In fact, the District has been lagooning sludge prior to shipment to Fulton County. However, due to the northern Illinois climate, it is not possible to provide lagoon sludge to Fulton County during the winter season.

We reject the above recommendation in the EIS as not based upon valid data and ask that it be corrected in the EIS.

V. Field Runoff Basin Capacity

The EIS states that the District field runoff basins are undersized and cannot retain the 100 year storm. In addition, siltation is stated as sufficient to even further reduce this capacity.

The calculations used to determine capacity assumed that this soil has no adsorption capacity during storm events. This is an unrealistic assumption. According to accepted engineering principles, the field runoff basins were designed to accept the 100 year storm. Additional capacity was provided for possible siltation. This capacity exceeds recently published requirements for agricultural feedlots.

All of the above calculations and field runoff basin capacities were submitted to the IEPA and permits were issued by this agency without any question on this phase of the project.

The District rejects the conclusion that the field runoff basins are inadequately sized and asks that this be corrected in the EIS.

VI. Surface Water Quality

The EIS states that the surface water on the District's Fulton County site has levels of contaminants above state standards and that this is a result of discharges from sludge amended soils.

It is true that surface water quality at Fulton County for some constituents exceeds State of Illinois standards. However, there is no evidence in the EIS linking such water quality with District operations. The surface water at Fulton County is influenced mainly by the previous stripmining operations. Also, there are discharges from sewage treatment plants, sanitary landfills, septic tanks, feedlots and agricultural nonpoint sources which influence surface water quality.

The most compelling evidence which shows no degradation of surface water quality at the site is the quality of Big Creek which flows through the District property. As noted in the EIS, water quality in Big Creek leaving the District's site is consistently of better quality than water entering the site. The obvious conclusion is that District operations do not contribute to surface water degradation as suggested by the EIS.

In addition, the EIS goes on to assess the water quality of discharges from District captive runoff basins. They compare such water quality with what is purported to be the IEPA standards for these basins. After this evaluation, it is concluded in the EIS that excessive violations have occurred and that this represents the major reason for surface water quality degradation at the site.

However, the EIS authors did not utilize the proper standards which are enforced by the IEPA in permit conditions for the Fulton County site. Use of the proper standards would have revealed that on rare occasions are the IEPA standards exceeded.

The District rejects the statements in the EIS on surface water quality and asks that they be amended in the document.

VII. Alleged Pathogens from Sludge Spraying

The EIS suggests that there is a significant health hazard due to pathogens being present in aerosols created by sludge spraying. No documented evidence is given to support this suggestion.

The District has compiled for the records, a literature survey which deals with this topic. This is contained in the detailed attached document. The survey concludes that there is no health hazard from sludge spraying.

The District now has a contract with the USEPA which is investigating the aerosolization of bacteria and viruses from sludge spraying. This contract is being conducted in cooperation with Illinois Institute of Technology Research Institute.

The conclusions in the EIS are unjustified and certainly premature until the study is completed. We ask that the statements in the EIS be amended and corrected in the document.

VIII. Alleged Health Hazards from Metal Inhalation

The EIS presents calculations to determine the ambient air levels of certain metals downwind of a sludge sprinkler. The EIS concludes from these calculations that there is a significant health hazard from these calculated ambient air metal levels.

However, the calculations in the EIS are erroneous and are too high by a factor of at least 100. The EIS authors simply forgot to include a factor which was part of their own calculations. Therefore, the conclusions about ambient air metal levels are erroneous and should be deleted from the EIS.

In closing, I would again ask that your agency earnestly consider this summary and the attached detailed document before issuing the final draft of the EIS. The District also strongly urges the USEPA to rewrite the EIS in lieu of merely attaching the public and written comments to the first draft and making this package the final EIS. This Draft EIS requires a complete rewrite to make it factually correct and commensurate with existing data and scientific information about the Fulton County site.

Mr. Gary W. Schenzel
USEPA
Chicago, Illinois 60604

August 13, 1976

Page Seven

I will make available to the USEPA all of the District staff who have participated in the writing of the District comments.

Very truly yours,

Bart T. Lynam
General Superintendent

FCW:FED:GTK:DJB:acs

cc: Board of Commissioners
Mrs. Louise Rome
General Superintendent
Mr. Rimkus
Mr. Neil
Dr. Lue-Hing
Mr. Lavin
Mr. Mortimer

ITEM #11

Canton, Illinois
August [illegible], 1976

Environmental Protection Agency
230 South Dearborn St.
Chicago, Illinois

Dear Sirs:

After reading the draft of the Environmental Impact Statement I wish to make a few comments(1) on page I-15 it says the malodorants in sludge cause it to have a earthy smell--- it doesn't smell like earth to me! We get the odor from the holding basins and when it is applied to nearby fill when the wind is in the right direction to bring it to our place.

(2) on page I-21 it states that the influent wastes contain a wide range of pathogens including some viruses that are not totally destroyed by treatment and holding in the storage basins-- then why is Fulton County subject to this? Are we guinea pigs for Chicago waste? Why must we have to wait for an epidemic before something is done? By then it may be too late.

(3) The E.P.A. sets standards for the M.S.D. but they (M.S.D.) violates these (p.I-25,I-26). On p.II-7 it states if sludge is applied in large amounts it can retard seed germination and plant growth and adversely affect soil structure. We saw this happen on a field south of St. David. M.S.D. now says they are not in the agriculture business-- this we knew all along, they only want to dispose of their sludge. Neither do they(M.S.D.) care about land reclaimation. They use land that has never been stripped and some that has already been reclaimed and was raising good crops.

(4) p. II-13 states there could be seepage of soluble constituents into groundwater. This could affect more than Fulton County because water travels for long distances. application of sludge to crops for animal and human consumption could result in illness to users--M.S.D. says there is not enough data to prove this. Again must we wait until people die before something is done?

(5) The big Bluestem program is a farce-- we don't need wild animals in this part of the country. The old timers tried to rid the country of these animals-- Buffalo could never roam in farming country and most of the smaller animals are only killers of the farmers livestock-- already we are overrun with Coyotes.

Most of this draft is too difficult for the ordinary layman to understand. Much of it is reduntant. We have been told that the people living near the holding basins are nothing but illiterate farmers. This does not make good public relations does it?

(6) p. IX-40 states a hazard to humans may exist with consumption of fish or wildlife from land spread with sludge, not enough data to tell-- we must wait and see how many people die before anything is done to correct it! We are concerned about the effect this may have on our children, grandchildren. M.S.D. officials call us hysterical because we question their inconsideration to the people of FultonCounty.

M.S.D. makes their project sound good on paper but in actual practice it stinks! It may provide jobs for a few but Fulton County had jobs for their people before M.S.D. and I'm sure there will be work for all who want to work after M.S.D. is gone.

Sincerely yours,

Lydia E. [signature] (Mrs. Franklin)

Rural Route I
Canton, Illinois 61520

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/613

13 1976

Dear Mr. Alexander:

Thank you for the letter of June 25, 1976, requesting our views and comments on the draft environmental statement for Sludge Disposal and Land Reclamation, Fulton County, Illinois. In reviewing the document, we have noticed several areas of discussion which we feel merit re-examination.

We recognize that the area being used for sludge disposal is strip-mined land which has been reshaped for project purposes and that the likelihood of historic or archeological resources being present within the project area is quite remote. Nevertheless, an inadequate discussion on page IV-51 indicates that numerous such resources are to be found within Fulton County. Evidence of contact with the State Historic Preservation Officer (Mr. Anthony T. Dean, Director, Department of Conservation, 602 State Office Building, Springfield, Illinois 62706) and a disclaimer to the effect that no cultural resources would be affected by the proposed project, if such is the case, should be included in the final environmental statement.

The draft statement does not describe sufficiently existing fish and wildlife resources and project effects on these resources. The statement should be revised to describe habitat types and acreages of fish and wildlife habitat that will be destroyed by the project. Although a substantial portion of the project has been completed, we understand valuable wetland habitat may be destroyed by additional sludge deposition. Wetland destruction is contrary to EPA policy, and we would be opposed to any continuation of this activity.

Three seams of coal, Fulton County's most valuable mineral resource, are present in the project area of 15,000 acres. Apparently at least one coalbed, the No. 5, which is the thickest and closest to the surface of these three seams, has been entirely removed by either surface or underground mining. However, the draft statement does not adequately discuss this, particularly with regard to lands west of Fiatt and lands west of Canton. Project lands should be located by section, township, and range; not enough detail is shown on maps provided with the statement. In addition, the current status of coalbed No. 4 and No. 5 should be clearly stated.

Table IV-9 (page IV-28) incorrectly labels a column of data extracted from Durfor and Becker (1964) as "U.S. average." Apparently the data represent a range of values found in untreated water from ground-water sources in the supplies of the 100 largest cities. The numbers for Al, Cr, Cu, Ni and Zn in that column should be divided by 1,000 to fit the units given. Errors in the citation (page IV-62) should be corrected as follows; Durfor, C. N. and Becker, Edith, 1964, Public Water Supplies of the 100 Largest Cities in the United States, 1962, U.S. Geological Survey, Water Supply Paper 1812.

The monitoring stations for surface-water quality shown on Figure VII-19 (page VII-47) are not adequately identified in relation to either the stream net or the sludge application sites. This makes it very difficult to evaluate either the data given or the discussion in the section on potential surface-water contamination (page VII-46 - 58).

The draft statement provides valuable information in its evaluation of the potential for impacts on ground water at this stage. However, we believe that in addition the final statement should include data on horizontal and specific yield or storage coefficient(s) of the aquifer that must have been obtained in the field testing, lateral velocity magnitudes for the ground water involved, and typical hydraulic gradient(s) or water-level contours. Velocity of flow concepts seem very pertinent to consideration of the data. It is not clear whether any or all of the project is located directly upon strip-mined areas, although some of the text suggests this. It would be helpful in impact evaluation to know how much of the project lies on a section such as that of Figure IV-6 and how much lies on shale or coal spoils with no section similar to that of the figure.

We also recommend that a map be included in the statement that depicts all of the recreation areas, and application sites in Fulton County and that the impacts to recreation be enumerated.

We hope these comments and suggestions will be of assistance to you.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. George R. Alexander, Jr.
Regional Administrator, Region V
Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

ST. DAVID, ILL.
9 AUG 76

DEAR SIR:-

WITH REFERENCE TO YOUR ENV. IMPACT MEETING HELD IN CANTON, ILL. 26 JUL 76:-

YOUR CONDUCT OF THE MEETING WAS GOOD WE HAD SEVERAL EXCELLENT SPEAKERS THAT COVERED THE TOPIC WELL.

DEPOSITIONS MADE BY PEOPLE WHO HAVE LIVED WITH THIS PROJECT SINCE 1971 TELL US THAT THE EPA AND OUR LOCAL HEALTH BOARD HAVE BEEN NEGLIGENT IN PROTECTING THE HEALTH AND WELL-BEING OF CITIZENS OF FULTON CO.

RULES GOVERNING GOOD HEALTH ARE BEING COMPLETELY IGNORED. AN ANALYSIS OF SLUDGE AT ONE OF THE CHICAGO PLANTS IS ALL THAT IS NEEDED TO TELL WHAT YOU'RE DUMPING INTO THE WATER, SOIL AND AIR. HOW WILL YOU RETRIEVE THE HIGH LEVELS OF CADIUM, LEAD, ZINC, ETC., FROM HUNDREDS OF IND. OUTLETS? THE DAMAGE WILL BE IRREVERSIBLE - WATER WILL BE POISONED. FOOD NOT SAFE TO EAT - AIR NOT SAFE TO BREATHE. THE PROGRAM IS SELF-DEFEATING & WILL BE ABANDONED IN TIME - BUT, THE DAMAGE WILL BE DONE.

(2)

ON PAGE I-21 YOU STATE "THE MOST USEFUL INFORMATION CONCERNING THE FULTON COUNTY PROJECT IS THE ABSENCE OF REPORTED ILL EFFECTS." HOW DID YOU ARRIVE AT THIS CONCLUSION? DID YOU CANVASS DOCTORS IN CANTON & PEORIA AREAS? OR DID YOU ACCEPT MSD'S FINDINGS AS YOU DID FOR MOST OF THE STATISTICS, CHARTS, GRAPHS, ETC. IN YOUR 212 PAGE CATALOGUE?

A 13 YR. OLD DIED HERE LAST YEAR AS A RESULT OF SLEEPING SICKNESS. DOES MSD HAVE A MOSQUITO CONTROL PROGRAM? NO! AFTER 5 YRS OF CONDUCTING AN OPN. THAT USES TREMENDOUS AMOUNTS OF WATER THAT IS ALLOWED TO REMAIN IN STAGNANT PUDDLES EVERYWHERE - IDEAL CONDITIONS FOR BREEDING MOSQUITOES & FLIES.

MSD HAS PUBLICLY MAINTAINED THAT A HARD CORE, ONLY 20 PEOPLE OR SO, OPPOSE THE PROGRAM. WE HAVE A PETITION WITH OVER 7600 SIGNATURES OF REGISTERED VOTERS OF FULTON, CO. OUR INTENT WAS TO ENTER THE ISSUE ON THE BALLOT ONLY IN AN ADVISORY CAPACITY. WE WERE DENIED THE RIGHT BY MSD LAWYERS.

MSD'S APPLICATION FOR FED. GRANT IMMEDIATELY FOLLOWING PUBLIC DISCLOSURE OF MILLIONS IN GRAFT & INDICTMENTS HANDED DOWN IN CONNECTION WITH THIS GRAFT WAS VERY POORLY TIMED & VERY BRAZEN. IT TELLS ME HOW SURE THEY ARE OF THEIR POWER.

-3-

THAT EARTHY SMELL YOU MAKE REFERENCE TO IS NOT THE PROPER DESCRIPTIVE.

IN VIEW OF THE FORE-GOING, I REQUEST THAT THE APPLICATION FOR FED. GRANT BY MSD BE DENIED.

Peter Ferro Sr.
PETER FERRO SR.

PETER FERRO SR.
BOX 281.
ST. DAVID, ILL.
61563

SAINT [illegible] AUG 10 PM 1978 61563

JULY 4, 1776

UNITED STATES E.P.A.
REGION V
230 SO. DEARBORN ST.
CHICAGO, ILL.
60604

ATTN:
PLANNING BRANCH - EIS PREP. SEC.

Aug 6th

U.S. Environmental Protection Agency

Dear Sirs:

Having attended a meeting of the EPA in Canton a week or so ago, I would like to add a comment to your effort.

Having [illegible] at [illegible] the past eleven years, I do not notice any difference in the odor at [illegible] other than the [illegible]. Have noticed [illegible] since 1976. [illegible] continued [illegible] and can [illegible] can be controlled.

Sincerely
[illegible signature]
RR2
Cuba, Ill 61427

[illegible]

[illegible]

[illegible] FUNDING [illegible] DISTRICT [illegible] FULTON COUNTY, [illegible] ON THE FO[illegible]:

1. WE DO [illegible] SIGNI[illegible] SUITAB[illegible] METHOD FOR [illegible].

2. WE DO NOT [illegible] THAT THE DISTRICT HAS DEVISED A WAY TO CONTROL ODORS AND [illegible] HAZARDS.

3. WE DO NOT FEEL THAT SINCE THE DISTRICT IS CURRENTLY UNDER SUIT FOR VIOLATIONS IN RELATION TO THE PROJECT THAT FEDERAL FUNDS ARE WARRANTED.

Name	Address

(310 SIGNATURES)

CITIZEN'S STATEMENT

FOR USEPA DRAFT ENVIRONMENTAL IMPACT STUDY

RE: FULTON COUNTY PRAIRIE PLAN PROJECT
OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DATE: AUGUST 16, 1976

My name if Leon Zedrick, and I reside at *Cherokee Drive*, Wee Ma Tuk Hills, Fulton County, Illinois, and have lived there for *eight years*.

I am employed by Fulton County as the Director of the Fulton County Conservation and Camp area, consisting of approximately *460* acres of strip-mined land which has been purchased by the Metropolitan Sanitary District of Greater Chicago and turned over to Fulton County for a public recreational area. I have been the resident superintendent and manager of the site since it was opened to the public in *1971*, and have been on the site virtually every day during the summer camping season.

The recreational area is ideal for camping and for fishing. It has a large number of ponds and lakes, formed by the depressions in the strip-mined land. These bodies of water are stocked with fish and the entire area is open to the public for fishing and transient camping, for a fee of $2 per day. Since the project started, there have been approximately 150,000 people use the facilities. The topography is rolling, wooded and ideal for camping.

The entire area is adjacent to fields upon which the MSD applies sludge, formerly by a spray irrigation system, now by incorporation. No part of the camp grounds and recreational area is more than 300-400 feet from such an application field, and many parts of the site are as close as 150 feet to application fields, which are in plain view from most parts of the recreational area.

I testified as to the alleged presence of offensive sludge odors emanating from the application fields and from the holding basins utilized by MSD in its sludge fertilization project. This testimony was given before a hearing officer of the Illinois Pollution Control Board in December of 1975 in Fulton County, and a copy of my sworn testimony is attached to this statement. I was subpoenaed as a witness to testify at the hearing by MSD.

As of this date, August 16, 1976, I can say that I have never been personally bothered by any odor from the sludge, and I have never had anyone using the recreational site complain to me about any such odors. The use of the area by campers and fishers has increased steadily, since it was opened, as my attached testimony indicates.

I believe that the complaints of a few families who live in the proximate are of the MSD Prairie Plan site and have led the public opposition to the project, are unfair and grossly exaggerated. Most of the people who are the chronic complainers are also plaintiffs in a lawsuit seeking $1,000,000 damages from the district.

As for my own observations, I can say that this summer of 1976 has been the busiest season yet for the recreational area which I manage. We now have a maximum number of season-long campers, who rent sites at the recreational area for the whole summer, and live there day in and day out. There are 58 such sites available, and every one of them is rented, at an annual fee of $120 per year. That is our high-water mark for useage. No complaints, as I say, from any of the permanent campers have ever been made to me concerning odors from the adjoining MSD application fields.

In addition to the permanent campers, this summer has been the most active summer for transient users of the recreational site, and to this date we have had, by actual count, [illegible] visitors and campers who have used the facility. I have never heard a complaint from any of them concerning odors or any form of pollution. The fish are plentiful in our lakes, wildlife is everywhere, the people of Fulton County use the facility to its maximum capacity and I personally believe it has been a great boon to our county and to our citizens.

[signature]
Leon Zedrick

I LeRoy E Huston have spent the past four summers in residence from February through November and am retired. I live 500 yds from the spreading fields of the MSD and travel among all the spreading fields weekly. I fish and live in the MSD Conservation area everyday. My wife and I have smelled the smell one time when I was within fifteen feet of the field being sprayed I could smell the odor slightly. Our residence is situationed in the middle of the spreading fields. The slag piles found in this area some years ago and oil wells & others caused problems but the MSD project has caused us no discomfort whatsoever. The MSD Conservation area is a fine recreation area for family outing. I've heard one complaint in four years. LeRoy E Huston
Dated August 16, 1976 LEROY E. Huston

I Irene Rice, hereby state that I live within the MSD Conservation project and our permanent home camping site is surrounded by MSD sludge spreading fields. The closest one is twenty yards from our mobile home and others are within fifty to one hundred yards. The application of sludge near our home has not bothered us. We have not smelled an offensive odor, and our family has not been affected whatsoever. We spend weekends and five weeks of vacation from Easter weekend until the last of October. We have had this schedule since 1973. We fish and enjoy the natural quiet surroundings of the MSD project.

Dated August 16, 76

Iris Rice

CITIZEN'S STATEMENT

FOR USEPA DRAFT ENVIRONMENTAL IMPACT STUDY

RE: FULTON COUNTY PRAIRIE PLAN PROJECT
OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DATE: AUGUST 16, 1976

My name is [illegible] Swan. I live with my husband and children in a farm house about 300 or 400 yards from the home of Mr. and Mrs. Lyle Boughan. We rented the house we now live in earlier in the summer of 1976, and moved into it from our previous residence in Canton, Illinois, about [illegible].

Our house is the next closest to the Boughan house to the MSD holding basins, and is on property next to the Prairie Plan project. We are located about one-[redacted] mile [redacted] EAST of the holding basins.

We moved to the country in order to provide space for our children, and a more rural and healthful environment than we had in the City of Canton -- more yard, a garden, etc.

I have been interviewed by a representative of The Metropolitan

Sanitary District of Greater Chicago, and asked whether or not any member of my family or myself has been bothered by any sludge odors during the year 1976. I have stated that we have never experienced any bothersome sludge odors, even though we have no air-conditioning in our house and have slept with our windows open to the air during all of the weeks and months that we have lived here.

I am at home almost every day and every evening, not being employed, and being a housewife and mother. My children are also at home. They range in age from 14 to 18.

I am repeating these verbal statements in the form of this written statement, for inclusion in the USEPA Environmental Impact Study, at the request of MSD.

Thelma Swan

THELMA Swan

CITIZEN'S STATEMENT

FOR USEPA DRAFT ENVIRONMENTAL IMPACT STUDY

RE: FULTON COUNTY PRAIRIE PLAN PROJECT
OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DATE: AUGUST 16, 1976

My name is Junita Crosetto, and I own and operate the Village Cafe in St. David, Illinois. My restaurant is in the Village of St. David, just north of Route 100, which runs through the property owned by the Metropolitan Sanitary District in Fulton County and used for their sludge fertilization project. My restaurant is within a mile of the operation's office of MSD, which is in a former farm house on the south side of Route 100. Many of the MSD employees and many visitors to the Prairie Plan office come to my restaurant for lunch, as well as many towns people and neighbors in the immediate community.

I have been operating the restaurant since before MSD began its project and purchased its property, and the presence of MSD in the neighborhood has certainly increased my business and increased the patronage at my restaurant. I recently expanded my facility, by adding a room to my cafe which seats an additional __________ people, giving me a total seating capacity of approximately __________ people.

I spend every day at my place of business, and I am on a friendly basis with all of my customers. I visit with them about their jobs, and I hear all of their complaints and all of their daily experiences.

I can honestly say that I have never been bothered by any odor from the MSD operation, and it has certainly not affected my food business adversely. My customers do not complain about odors and they have healthy appetites. Many of the employees who work in the application fields come to my restaurant for lunch, and they certainly have no visible ill-effects from their work in the sludge application fields. I believe that the protestors against MSD, who constitute only a few families and a small number of critics, probably about 20, do not represent the majority of the homeowners or citizens in my community; and I believe that the few critics of the MSD project have grossly exaggerated their claims, and have enjoyed the publicity which they have generated. Most of the people whom I come into contact with on a daily basis simply pay no attention to the MSD project, and go about their business routinely and without any complaints about MSD.

I have been asked to make this statement on behalf of MSD, for the record in connection with an USEPA Environmental Impact Study.

Junita Crosetto

CITIZEN'S STATEMENT

FOR USEPA DRAFT ENVIRONMENTAL IMPACT STUDY

RE: FULTON COUNTY PRAIRIE PLAN PROJECT OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DATE: AUGUST 16, 1976

My name is Lyle Boughan, and I reside on the border of the Metropolitan Sanitary District's Prairie Plan project in Fulton County. I live in a farmhouse on a township road, west about one-[redacted] mile EAST OF [redacted] the holding lagoons, and about [illegible] one-fourth mile south of the Shields Chapel Church. I have resided at this location with my wife for 3[illegible] years. We own our home and weenjoy the relative seclusion and open-space of the rural area in which we live.

I believe that I am the closest resident to the MSD holding basins, and I am in the direct line of the prevailing westerly winds from those basins. Among my neighbors, within a distance of a mile or two south and north of me, are some of the most consistent and chronic complainers about the MSD operation. Some of my neighbors including Mr. Tom Downs and members of the Vaughn family, have asked me to join the Citizens for Better Health and Environment, which has become the central organization opposing the MSD operation. I have declined to join the organization, believing that their claims are greatly exaggerated and that their complaints are not well founded.

I am employed as a superintendent for a mining company, which operates a strip-mine near [illegible], in Fulton County, and I have been employed by the company operating that mine for [illegible] years. My wife [illegible] [redacted] a school teacher in the [illegible] school in Canton, Illinois, in Fulton County [illegible].

I testified at a hearing before a hearing officer of the Illinois Pollution Control Board in connection with the MSD project last December, 1975, having been subpoenaed by MSD. A copy of my sworn testimony is attached hereto.

I have never been bothered by any odors emanating from the holding basins or the application fields, which are in plain view from my house. I believe that Prairie Plan project is a fine example of land reclamation and restoration. I have no criticism of the operation or of the project, and I believe it has great merit and is greatly in the public interest.

I am making this statement, upon request by MSD, for

submission as part of the record in an USEPA Environmental Impact Study of the Prairie Plan project.

Lyle Boughan

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ITEM #17

POTENTIAL EFFECT OF SLUDGE ON HEALTH AND ENVIRONMENT

BY: Rachel Schmidt, R.N.

Managing the environment in Fulton County is a complex and challenging situation. Before the Metropolitan Sanitary District converged upon the county, we felt that we had an environment relatively free of pollution. Note the term relatively free. The county is not without guilt.

The M. S. D. is a complex project. It is an "experiment". Nowhere in the world has this type of project, this extensive been tried. Don't be fooled by M. S. D. propaganda about similar projects. This is different in that this project involves not only human wastes, but also heavy industrial wastes. It is important at this time to define, analyze, and attempt to describe potential problems of this sort. It will require not only expert resources but you, the people of Fulton County. Challenging the problems emotionally is not the acceptable form of approach. Scientific methods must be instrumented. It is most important that we seek out qualified and trustworthy resources. We cannot trust M. S. D. to look after us. Their primary goal is to get rid of a lot of sludge. Their credibility, or lack thereof, has been substantiated. They promised to send us only fully digested sludge, but then they proceeded to bring down improperly digested sludge. It caused a stinky problem, and it showed that they were not thinking about the environment of Fulton County, nor its people.

10-234 C At this point let us define sludge; 1) Sewage sludge is the accumulated settled solids deposited containing more or less water to form a semisolid mass. Properly digested sludge is not objectable.

-1010 A In sewage disposal microorganisms play an important part in treatment of sewage. A large number of bacteria are present in sewage, some are intestinal in origin - i.e. E.Coli. Some are from soil, air, and in some cases, industrial wastes. The main objective of any method of sewage treatment is to remove or decompose the organic material to a final product. That is, to a chemically stable product which is not subject to further decomposition. 2) On a recent visit to the Sanitary Districts project, considerable bubbling was noted in holding basin number two, which precludes that a chemical process was still taking place. A report from Lyle A. Ray, Illinois Direct Sub-Unit S.S. D.W.P.C. noted on March 30, 1973 the following things about holding basin #2. The basin was being filled with sludge. A strong sewage-like odor was noted along the shore of this basin. An aerobic bubbling was more noticeable in Basin #2 than #1. The sludge was black and had a soapy appearance with extensive accumulations of hair and debris. The sample collected is worthy of mention. Analysis is as follows;

Coliform/100 Milliliters	-	30,000
Fecal Coliform/100 ml	-	3,600
Fecal Strep/100 ml	-	5,100
Volatile Acids mg/l	-	980
*Volatile Solids mg/l		
Ammonia mg/l	-	1,100

The conclusion of Mr. Ray is that the samples collected and physical conditions observed at the holding basin indicated the sludge was not well digested.[5]

The following concentrations and percentages are extracted from WPCF Manual of Practice No. 11, Operation of Wastewater Treatment Plants and represent concentrations that should be expected from well digested sludge.

WPCF Manual #11		Sludge Basin #1	Sludge Basin #2
Volatile Acids	300-500 mg/l	340 mg/l	980 mg/l
% Volatile Solids	40-45%	63.3%	75.3%

Since this is an experimental project we are confronted with many unknown factors and many unanswerable questions. This is a project that must be dealt with to the finest degree. A project of this sort involves pollutants. They are classified as physical, chemical or biological. Our most important concerns are the biological and chemical pollutants.

Let us first discuss biological pollutants. There are living organisms found in sewage. Unless the sewage is fully digested these organisms continue to thrive. Salmonella is an example of a hardy bacteria that can pollute ground water. Others are coliform, streptococcus, shigella, ameobas, cysts, and parasites.

18-183 At this point, one should also be concerned about viruses. "A so called negative coliform test however does not preclude contamination with viruses. Control tests for virological contaminants are needed.[5]" This is a very difficult area, as viruses are most difficult to culture and identify. Yet, the contribution of virus diseases to human misfortune is a large one. This subject is too numerous to discuss at this time, but it certainly lends itself to a very important topic. Who is to say that viruses are not a definite concern in the sludge disposal. I suggest that we should be just as concerned about the unknowns as the known factors.

23-49 "Viruses are self-reproducing microscopic agents smaller than bacteria, and multiply only within living susceptible cells and are responsible for a wide range of infectious diseases. There is a controversy as to whether viruses represent a real biological group or a mere heterogenesus of intracellular parasitism.[6]" They are so small that they can be viewed only with an electron microscope.

23-51 "The human intestine is now known to harbour on occasion viruses almost as diverse as their bacterial inhabitants.[7]" It is necessary to further defend the environment of Fulton County and the private right of the citizens to a decent environment. We are presented with an agricultural and reclamation endeavor, but the project qualifies better as pollution "dumping ground" in disguise.

The chemical pollutants of the industrial wastes should alarm us. These are very numerous and concentrated, and can pose a threat to the environment by polluting the air and the ground water through runoff. Those of concern include heavy metals which M. S. D. is bringing down along with the human waste. Some of the main components of sludge are: lead, cadmium, mercury, nickel, zinc, nitrates, arsenic, barium, chromium, cyanide, phenols and possibly radioactive substances.

13-183 Other potentially hazardous substances are hydrocarbons which can be released in the environment in the form of vapour. Hydrocarbons are associated with carcinogenic (cancer) diseases in man. The benzene ring is an example.[8]

13-186 Nitrogen compounds are most abundantly generated and released in form of nitrogen oxide and ammonia. In excessive amounts these can prove harmful.[8]

13-184 The major interest in nitrogen oxides as air contaminants is related to their participation in atmospheric photochemical reactions i.e. production of ozone. The formation of secondary contaminants depend on several factors.

18-185 "The reaction rates, routes, and intermediate steps involved in generating new pollutants are influenced by many factors such as concentrations of reactants, extent of photoactivation, meteorological forces, local topography, temperatures, and relative amounts of moisture. Of important consequence is the formation of sulfates, from sulphur dioxide and nitric oxide. Most troublesome to control include ozone, formaldehyde, organic and hydroperoxides.[9]"

P.10 1975 YPSF The pollution is also a threat to wildlife. Chlorinated hydrocarbons wash into water where they are ingested by microorganisms then eaten by fish and other animals. These are later eaten by birds and waterfowl. At each step in the food chain, the concentration of the hydrocarbons is greater. The result of such concentration is that affected birds produce eggs with shells so deficient in calcium that they are crushed in incubation.[9] Let us now focus on three very heavy metals: mercury, lead, and cadmium.

P.362 YPSF **These have never been mentioned nor discussed by M. S. D. Why?** They are notorious and very hazardous. There is much to be said about these. The discussion must be limited, however. First we will look at Mercury. It is seen as a special threat to man because inorganic mercury can be converted to methyl mercury an organic compound that has a long biological half-life (70 days in man) compared to the inorganic forms of mercury, which are usually excreted from the body in a few days. Methyl mercury's bad reputation is fortified by the fact that it easily passes through biological membranes including the barrier that separates the brain from the rest of the body. The compound is particularly destructive to nerve cells and early symptoms include headache and fatigue. This is followed by sensitivity loss in toes and fingers, visual disorders, poor muscular coordination, speech, and hearing difficulties, mental retardation and death.[10]

P.363 YBSF — The greatest single use of Mercury is as a component in the electrodes that prepare high-purity hydroxide and chlorine gas from brine solutions to meet the needs of petroleum, glass, paper, and detergent industries. There are multiple other areas where it is used. This is one reason it is increasing in the environment.[10)]

P.363-364 YBSF — The current concern over methyl mercury pollution can be traced to 1953 in Japan and the "Minamata Disease". In 1965, the disease broke out in Niigata Japan and even babies seemed to be affected by the disease.

P.364 YBSF — Methyl mercury also crept up in Sweden when conservationists observed population drops among many seed eating birds, including phesants and partridge and among their predators. There is also a case in Alamogordo, New Mexico where several members of a family ate the meat of a hog that had eaten millet seeds

N.E.J.M. 7-1-1971 — that contained methyl mercury.[10)] The consequences were sad. Other epidemics occurred in Iraq, Pakistan and Guatemala.[11)]

P.365 YBSF — In March 1970, Norvald Fimreite, a chemist at the University of Western Ontario, found that commercial shipments of fish from Lake St. Clair (near Detroit) contained mercury close to the levels found in the fish involved in the Minamata and Niigata episodes. Other Chemists reported similarly high levels (about 7ppm) in fish from many other lakes and rivers along the U.S./Canadian border, including the Great Lakes, and subsequently from the waters of 33 of the 50 U.S. states.[12)]

P.365 YBSF — The potential for widespread methyl mercury contamination is enhanced by many kinds of industrial pollution. Carbon dioxide, organic wastes, nitrates and phosphates provide food for the organisms that permit transformation of inorganic mercury runoff from industries into methyl mercury.[12)]

P.364 YBSF — The process is the result of the action of microorganisms in bodies of water. Methylation can continue for generations once the process has begun.[12)]

P.367 YBSF — Safety thresholds for mercury are vague because it is not known how much methyl mercury in the blood is required before poisoning occurs. Neurological damage may occur at 0.4-1.0 parts per million of mercury.[12)]

N.E.J.M. 11-11-71 P.1143 — Although methylation of the mercuric ion by the human body has not yet been demonstrated, it is not unreasonable to expect that such a reaction could occur. The methylation of mercury in living systems was discovered in bacteria by R. L. Smith. He pointed out that the gut flora may be a more important influence on the biologic properties of the enormous substance than ever recognized. This suggests that the gut flora could serve as a source of methylated mercury in man. A recent review by T. C. Stadtman, Science 1971, notes the presence of enzyme systems appropriate for the methylation of mercuric ion in the livers of mammals other than man. The human body itself might have the capacity to methylate mercuric ion.[13)] The treatment for methyl mercury poisoning is not well defined.

Let us look at another heavy metal, Lead. Industry wastes contain high levels of lead. It is responsible for the increased presence in the atmosphere.

P.369 YBSF — Lead poisoning is one of the most unpleasant ailments afflicting mankind. Its symptoms are commonplace and often misdiagnosed as lesser problems, such as headaches, diarrhea, or just plain irritability. As the lead reaches its, as yet, poorly defined toxic level in the body, the symptoms of poisoning become more characterestic and lead to wild delirium, coma, convulsions, blindness, mental retardation, brain damage, and death. Lead may be lost into the air,

P.370 — water and soil.[12)] It can be carried by particles of dust. Very little is known about the effects of low level exposure to lead.[12)]

P.371 YBSF — Cadmium is considered the most lethal of the metals. Its ill effects have not been studied as completely as those of lead and mercury. Cadmium's deadliness comes from its ability to build up in the body, especially in the kidneys and its link to high blood pressure and heart disease. In animals, small dosages have produced brain damage, birth defects, damage to reproductive organs, blood abnormalities and many other physiological disturbances. In man, inhalation of cadmium dust is known to have caused lung damage resembling emphysema. In Japan 200 cases of severe degenerative bone disease occurred. This was due directly to cadmium.[12)]

P.372 YBSF — Toxicologists are concerned about cadmium as a hazard to man's health. Because there is so little irrefutable evidence about the long range effects of less than obviously exposure to cadmium, health officals have been slow to set up standard levels for it in food, air and water. A joint FAO/WHO commission has suggested 1ppm, even though scientist, Robert Nilsson of the Swedish Natural Science Research Counsel, insists that animal studies and the Japanese cadmium poisoning incidents make that level much too high. The U.S. has established the maximum permissable level amount of cadmium in drinking water as 0.01 ppm. Measurements of the metal's presence in rivers and reservoirs throughout the country indicate that 33 out of 720 water samples tested were higher in cadmium than the prescribed level.[12)]

P.373 YBSF — These other metallic hazards that have triggered investigations are nickel, zinc, and arsenic. Nickel has been proven able to produce cancer. The presence of any of the previously mentioned metals will certainly be detrimental to the health of any individual.[12)]

P.228-229 YBSF — Let us focus on another component of sludge - Asbestos. It is considered occupational disease of the lungs. Asbestos is a hydrated magnesium silicate. It has a very high affinity for water in both liquid and vapour form.[14)] It can certainly be carried through air.

P.43 49a — Respiratory diseased can occur after breathing air polluted with asbestos. It appears in finely divided state as minute particles ranging in the size of 1, and 5 microns (unit of measurement) in diameter. It is thought that even smaller sized particles are potentially dangerous. An increase in cancer has been found in persons who have been in contact or breathed these particles.[15)]

18-186 — It involves the pleura and pericardium (the coverings of the lungs and heart) and causes heart failure. Prevention is important, because there are no successful cure once the fibroses has actually developed. Cases have been cited in Quebec, Canada.[16)]

P.910 N.E.J.M. 1-26-1973 Recent studies have shown that 1/4 to 1/2 of the lungs of Urban America[n]s contain detectable asbestos bodies. The EPA has not set guidelines for asbestos. The Massachusett's Department of Public Health established its own emission standards. It is one of the first states in the nation to take such action. The regulation now bans the application by spraying of asbestos fibers or of mat[erial] containing asbestos fibers. The Department is authorized to ban the applica[tion of] these materials by any method it believes may cause or contribute to pollut[ion of] ambient air.17)

Another topic of interest is organic gardening. The M. S. D. brought [two] allergy specialists to speak at their meeting. They talked at great length [on] the marvelous organic food. One talked about chickens being washed in a dete[rgent] which has nothing what so ever to do with organic gardening.

N.E.J.M. Vol.285 8-12-71 The New England Journal of Medicine has featured articles citing organ[ic food] as a fraud. We see a lot of advertising lately of "Organic Food" which purpo[rts to] means grown without added pesticides or chemical contaminants. We know that [pesti]cides and chemical soil additions have had worldwide distribution and that s[uch] substances remain in the soil for many years at least. At this point in time [one] can question whether such pure growing soil exists. We may find that people [are] paying a lot more money for an inferior food because we have no standards for t[he] term "Organically Grown". "Organically Grown" food looks like the biggest co[nsumer] fraud yet perpetrated on the American public. A definition for organic is (a) o[f] or relating to, or derived from living organisms (b) of, relating to, or contai[n]ing carbon compounds. Therefore, all food is organic and indeed organically grown.18) To further substaniate the discrepancies of organic gardening tak[e] a look at this statement.

N.E.J.M. Vol.284 6-3-1971 "The organic method of growing fruits and vegetables in the United Sta[tes] does not involve the use of human excrement as a fertilizer. Sludge treated [soil] should not be used to grow vegetables or anything that will be eaten raw. [A] parasite called ascaris lumbricoides is present in sewage. The ascaris is u[sually] destroyed. However, a large number of eggs may pass out through the sewage effluent... When this effluent is used to water salad plants that are eaten uncooked by man, the surviving eggs may get on to these plants and then infe[ct the] person who eats it. Therefore, ascariosis is more likely to be a general en[viron]mental problem, caused by failure of sewage treatment and the subsequent use [of] effulent for irrigation.19)"

YESF 1972 P.373-374 In Britain, it was decided that the most appropriate way to dispose of [sludge] was to use the land. However, the attempted disposal on land of vast quantit[ie]s sewage water, which has relatively few dry months per year was a dismal failure. It was also a failure in many other countries in which equally inappropriate climatogical conditions prevailed and where sufficient land was unavailable. In addition, great difficulties were encountered with soils too fine to prevent continuous absorption of liquids and solids without clogging.20) Certainly the conditions especially during the winter and spring in Canton are not conducive t[o] huge quantities of sludge disposal on the land. And it is not known whether or n[ot] liquid fertilizer containing sludge is harmful to the soil. There is so littl[e] research that has been done in this area. Furthermore, the people of Fulton Coun[ty] can never be sure and should view with skeptisim any sludge that enters the coun[ty].

Personal Feelings Another area of concern and perhaps an area where no one has the answer [is] the spraying of the sludge itself. Minute particles from the spraying sludge [are] carried by the wind in the form of mist and can adhere to dust particles. [We] must concern ourselves with people who live in such close proxicimity to the spraying of sludge. It is an infringement on the personal rights of these p[eople]. To throw garbage on them is a violation, but to spray sludge in their face i[s] called an agricultural endeavor. What adverse effects can you expect? Certai[nly] the vapours are highly concentrated and contaminated. How toxic these are de[pends] on the physical state at the time of spraying.

Other very important areas of concern are the Game and Wildlife Reserve [and] the Fishing Lakes. These areas were created long before M.S.D. was brought in[to] the county. I am totally unimpressed that a sludge disposal area should be created in such close proxicimity to such a reserve. It goes without saying that good judgement was not used. If the crops grown are indeed contaminated then [bird]s, waterfowl and game will be affected. If there is runoff, then the lake[s] are very capable of receiving the drainage. These can easily become polluted. Waterfowl also migrate and there are other areas where hunting is allowed. If ducks and geese concentrate the heavy metals, then people will be eating lead cadmium, and mercury. The game can be just as affected with parasites, cysts, viruses, and bacteria as humans. The other big concern is groundwater contamin[ation]. This is possible more so in that the soil and drainage systems have been distu[rbed]. They cannot possibly be put together in the same fashion as nature did million[s of] years ago. And to put concentrated sludge on it is another thin. It has only o[ne] way to go and that is down.

I would hope that all the previously mentioned material helps to bring in[to] focus a broader perspective of the situation that confronts us. The facts and quotes presented are researched. Personal thoughts are included.

One last person thought. Environmental planning must be an integral part [of] the community. It must be managed and directed to be successful. M. S. D. operations have a degrading effect on the community. It is important to corre[ct] the problem before the critical need to face the damage arises.

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Report by - Rachel Schmidt

ITEM #10

STATEMENT

BY

JOANNE H. ALTER

COMMISSIONER

OF

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR THE PRAIRIE PLAN PROJECT

FULTON COUNTY, ILLINOIS

Presented at

PUBLIC HEARING HELD BY

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Monday, July 26, 1976

1:00 P.M. and
7:00 P.M. CST

Wallace Park Field House
Canton, Illinois

The Metropolitan Sanitary District of Greater Chicago is pleased to have this opportunity to make a statement on its Prairie Plan Project in Fulton County and the recently issued draft Environmental Impact Statement (EIS). These remarks are intended to supplement our more detailed written response which is now being prepared. The United States Environmental Protection Agency is to be commended for moving forward and completing the draft statement on this comprehensive and complex project.

The Prairie Plan is a fundamental redirection from waste and depletion to recycle and reuse. The project demonstrates on a major scale that through careful planning, monitoring, engineering, and operation, municipal wastes can be beneficially utilized to reclaim strip-mined land and fertilize place land.

The successful implementation of the Prairie Plan has been made possible through the cooperation of the local, state and federal governments and various agencies which have been involved in this program. We would like to take this opportunity to recognize the following organizations and thank them for their important contributions and continuing support and effort:

The Fulton County Board
The Fulton County Planning Commission
The Fulton County Health Department
U. S. Environmental Protection Agency
Illinois Environmental Protection Agency
U. S. Department of Agriculture and Soil Conservation Service
State of Illinois, Department of Conservation
State of Illinois, Department of Transportation
State of Illinois, Department of Business and Economic Development
U. S. Geologic Survey
University of Illinois
Spoon River College
Cities of: Canton
Cuba
Lewistown
St. David
Bryant
Scientists and Researchers

The Metropolitan Sanitary District has, from the beginning of this project, invited governmental, organizational and citizen input in the program and its specific site developments. The Steering Committee, formed at the inception of the project, has continued to provide valuable input from citizens and from all levels of government.

In its 80-year history, the District has always strived to provide maximum service and, at the same time, protect the environment. In 1967, the Board of the Metropolitan Sanitary District, after reviewing a large number of wastewater treatment and disposal or recycle alternatives, adopted the policy of recycling wastewater treatment by-products on land. This commitment was the impetus to establish the Prairie Plan now operating in Fulton County, Illinois.

A great deal of research work on the utilization of wastewater solids as a fertilizer and soil conditioner preceded the actual implementation of the Prairie Plan in 1971. Thus the project should not be considered as an experiment; on the contrary, it is a large scale implementation of the long and widely practiced utilization of wastewater solids in an agricultural setting.

From its inception, the Prairie Plan has been funded solely by the District. The cost of this vast project has been great, however, and financial assistance from the Federal government would be most welcome. Since the Prairie Plan has nationwide significance with respect to two major problems--disposal of municipal wastes and reclamation of strip-mined land--Federal funding would be quite appropriate.

A recently adopted Federal law, Public Law 92-500, expressly encourages the recycling of municipal wastewater solids, and has established programs for providing Federal funds to assist in the attainment of that goal. The draft Environmental Impact Statement which is being addressed here today has been prepared to assist the USEPA in evaluating the District's grant application.

The EIS for the Prairie Plan is really quite unique in that the project has already been in operation for several years. Thus, the project's impact on the environment is not merely speculative; there is a wealth of monitoring data, operational data and supportive research available. For this reason, we feel that some of the statements made in the EIS regarding the impact of the project on surface water, the health effects of the project and the matters of odors and noise are incorrect. A detailed discussion of the items which are felt to be in error will be included in our written presentation.

In addition, the Draft EIS fails to delineate the comprehensive objectives of the Prairie Plan, which are:

1. RECYCLE wastewater treatment by-products through rebuilding nutrient depleted soil.
2. CONSERVE natural resources by alternate soil enrichment through a liquid organic fertilizer and the conversion of urban waste product to a resource.
3. CONSERVE energy by the reduction of fossil fuel energy in the wastewater treatment process.
4. IMPROVE environmental quality in the Metropolitan Chicago Area and in rural Fulton County.
5. PROTECT the environment through a safe, intensively monitored and regulated recycle program.
6. EXPAND Fulton County economic base through increased employment opportunities, ancillary facilities, real estate taxes and personal property taxes.
7. PROVIDE a broad spectrum of multiple-use benefits and complementary land uses including agriculture, conservation, recreation, wildlife management, natural science education, urban and industrial developments.
8. DEMONSTRATE a full-scale viable working model for the Nation in the utilization of advanced wastewater treatment technology, background research, data and experience through a recycle and reuse philosophy.

The Prairie Plan is one alternative that does not use extravagant amounts of energy and demand increasing amounts of valuable urban land. It has amply demonstrated that land ruined to extract energy resources can again be made productive, and continually replenished without having to resort to costly and scarce petrochemical fertilizers.

Immediate energy savings include major reduction in fuel used during the treatment process, and long term energy savings by reducing further depletion of petrol chemical resources used in commercial fertilizer. Energy savings will release millions of barrels of oil yearly for alternate uses as well as increase energy self-sufficiency for this Nation.

The Metropolitan Sanitary District is proud of the Prairie Plan in Fulton County; we feel that the environmental monitoring and careful operation of the program insures the protection of the environment. A full range of professional and technical skills including planning, engineering, research, management and operations has gone into the project. These efforts have been recognized nationally by the American Society of Civil Engineers (ASCE) as the Outstanding Civil Engineering Achievement Award of 1974; by the National Society of Professional Engineers (NSPE) as One of the Ten Outstanding Engineering Achievements in the United States, 1972; and the Izaak Walton League.

In operating the Fulton County Project, no detrimental health effects have been evidenced or substantiated nor have water quality problems arisen. The programs, technology and experience relating to this Prairie Plan Project in Fulton County will lead the way for other sanitary districts throughout the Nation, and provide valuable methodology for an alternative to utilize a once discarded resource material.

The Metropolitan Sanitary District believes that the USEPA should adopt a national policy of recycle as demonstrated in the Fulton County Project. In adopting this policy and providing the necessary and essential funds, the USEPA would be implementing their stated preference for land application as a means of wastewater solids disposal. Such funding by the USEPA would support the findings of the Ad Hoc Panel on Sludge Disposal/Utilization which concluded that with good engineering practice, proper experimental design and a better understanding of the means to protect human health and ecosystems, sludge utilization options can be made environmentally safe and acceptable. The District feels that the Prairie Plan represents an answer.

SECOND REVISION 8/17/76

ITEM #18
(Cont'd)

STATEMENT

BY

JOANNE H. ALTER

COMMISSIONER

OF

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

ON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR THE PRAIRIE PLAN PROJECT

FULTON COUNTY, ILLINOIS

Presented at

PUBLIC HEARING HELD BY

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Tuesday, August 17, 1976

7:00 P.M.

Dirksen Federal Center
230 South Dearborn
Chicago, Illinois

The MSD, after initiating its Solids-on-Land Program with the Board of Commissioners decision in 1967, has accomplished in the Prairie Plan the first large-scale reclamation program based on the recycle of wastewater treatment by-products. The policy established by the Board and the nearly 10 years of subsequent research , development and implementation have demonstrated that recycle is not only the safest, but an economical and conservative methodology for managing sewage sludge. The Prairie Plan is an integral part of the MSDGC facility plan. Though the EIS has concentrated on the Fulton County Prairie Plan; it is seriously remiss in not mentioning the 7 million people served in Chicago by the Prairie Plan and the integral part of the MSD facilities in the metropolitan area. The Prairie Plan, operating in Fulton County, has benefited millions of urban residents with cleaner air, cleaner water, a productive re-use of processed solids, no new land or capital costs for storage, and a much reduced energy cost and consumption for treatment operations.

The USEPA's EIS on the Prairie Plan is unique in several ways. The impact statement has been written after the project has been in operation for five years and ten years of research has been completed. The studies that indicated the cost effectiveness, energy saving, and environmental safety are now history rather than projections of alternative courses. When the program was in the research, planning and design stages, there was little literature on which to base development.

There were no governmental guidelines or standards. The MSD, in initiating this program, established as the highest priority that the program would be environmentally safe. Built-in monitoring, information feedback, checks and fail-safe options were integrated in the development to prevent damage due to unforeseeable errors, accidents or extreme weather occurrences. The system was designed to be operational under all conditions and to be a permanent facility. The MSD with partial federal funding initiated, with the University of Illinois, studies and research on liquid fertilizer application, plant response, soil development, and environmental protection and quality. After several years of that still on-going program, the MSD established a number of "micro recycle demonstration sites" in the Chicago and Cook County area and several beyond the Metropolitan region These provided valuable work data and methodology that was incorporated into the about-to-be initiated Fulton County Project. The MSD, in its own behalf, searched literature and available documented sources, initiated research, and established with its interdisciplinary professional staff and consultants, the program, the planning and the operations methodology that became the Prairie Plan in Fulton County.

The Prairie Plan has been successful. This success is demonstrated by the encouraging documentation of soil development and plant responses in Fulton County. The Prairie Plan has not degraded the environment; it has acutally improved water quality leaving the site, implemented conservation practices and is reclaiming spoil lands into farm fields able to support agricultural crops. The program continues to be monitored by the MSD as well as county, state and independent organizations. The MSD is most appreciative of the cooperative and competent contributions from many federal and state agencies; among them, the U. S. Department of Agriculture, the Soil Conservation Service, the Cooperative Agricultural Extension Service, and the University of Illinois.

Though there have been, on rare occasions, some human and operational errors, as well as some major acts of vandalism, the plan's fail-safe systems have operated as intended. At each occurrence, and for each site, repair or modification was immediate and no permanent damage was done to the site or to the larger environment.

A major point of benefit in the years of research and development prior to and continuing through the project implementation has been the modification and operational changes indicated by the research and implemented in full scale operation on the site.

At the inception of planning for the Fulton County Project, the MSD, in conjunction with the Fulton County Board, requested cooperation from federal, state and local agencies and governments, established the Fulton County Steering Committee.

The Committee provides a forum for information interchange between citizens, government agencies, educational institutions and the MSD. It provides valuable input and public response which has modified and in some cases redirected specific aspects of the recycle-reclamation program. An example of this mutual benefit has been the 400-acre Fulton County conservation area leased to the County for a dollar a year to provide recreation and conservation lands available to local people and citizens of the State. The establishment of this Steering Committee has demonstrated many times over the value of intergovernment and interagency cooperation, with citizen input. The idea of establishing this broad base coordinating committee predates and, in fact, encouraged federal program requirements.

The Metropolitan Sanitary District is, and has always been, concerned not only with the safe operations of the project, but also with the beneficial results that land recycle of solids could have on local and national resource recovery programs.

Though the project has not been without criticism, even the most intransigent critic recognizes the benefits of solids on land and of recycling this resource. A major concern presented has been; even though the project operates safely, are there possible dangers of long-term or even perpetual use of the site? The MSD and the University of Illinois research is 6 years ahead of actual operations on the site. Any possible potential damage to the land, plant materials, water or the environment will be forecast years earlier through these continuing studies. There would be time and the professional expertise to modify, change or redirect the program long before a point of critical damage could occur. The MSD has spent millions of dollars of its own resources, as well as cooperated in federal funding for long-term and comprehensive research and monitoring. It believes that the project not only has and does demonstrate safe and productive re-use, but that primary research toward a national policy for resource recovery in this field has been planned, demonstrated and documented. The MSD is confident that a significant amount of its on-going monitoring can be redirected without endangering the validity of the data base. The MSD proposes to redirect a portion of its research activities toward specific areas of development unique to this site, such as the Big Bluestem Prairie. The MSD accepts the responsibility of having pioneered and demonstrated the validity of the economic and environmental benefits in the Prairie Plan. It will continue to make the research, the information and the methodology available to the federal and state governments in the development of other recycle policies and programs. The MSD will cooperate in larger and more nationally applicable research and operations studies. It is willing to provide the professional expertise, the land and equipment resources; but would require funding for these wide range programs and long-term activities. Though the vast majority of work accomplished in this recycling program has

been entirely funded by the MSD, it is now seeking and urgently requesting reimbursement funding and long-term research and operations costs for the nationally significant work initiated in Fulton County.

The U. S. Environmental Protection Agency is to be commended for moving forward and completing the EIS for this comprehensive and complex project. The MSD expected, and is appreciative, that the document affirms the recycle program and concurs in recommending that a national policy of resource recovery and recycle be established and implemented. The MSD is taking this opportunity to request amendment and modification of the draft statement. In the preparation of the Draft EIS for the Prairie Plan, some areas of benefit and value have been overlooked; some base and research information misinterpreted, and some errors inadvertently committed. The MSD has submitted recommended changes, deletions and modifications to be incorporated in the final environmental impact statement.

However, the EIS contains errors, false conclusions and needless recommendations which will be misleading and damaging not only to this project but the nation's policy for recycle and land treatment. Summarized below are eight major areas of concern to the District which are contained in the EIS.

I. <u>Environmental Monitoring</u>

The EIS states that the existing District environmental monitoring and research programs are inadequate to assess environmental impacts. The EIS authors go further to suggest additional monitoring and research and that such an expanded program be reviewed by an independent agency (unnamed).

The District has the most extensive monitoring program ever attempted for a sludge application site. The EIS does not recognize nor discuss many important aspects of this program despite the fact that every opportunity was given the authors to investigate the program. The existing program is discussed in detail in the attached statement and is designed to monitor the effects on soil, plants, surface and groundwater, air and indigenous animals.

We reject the concept that the project requires an independent agency for review of all data. Presently, the project is monitored by the Illinois Environmental Protection Agency (IEPA), Fulton County Health Department (FCHD), United States Geological Survey, and the University of Illinois (U. of I.). Peoridic reviews of the environmental monitoring data have been made by the Food and Drug Administration and the United States Department of Agriculture. Also, the District and the University of Illinois have been active in disseminating such information in the technical literature.

We believe that the existing environmental monitoring program can determine any potential harm to the environment.

II. Alleged Odors

The EIS states that there is insufficient dilution of alleged odors at the Fulton County site. This is concluded

by means of calculations made regarding atmospheric dilution of alleged odor emissions at the site. In addition, odor complaints phoned in to the FCHD are used to state that the probability of an odor complaint being tied to the District project is greater than 70%.

The calculations used to arrive at the atmospheric dilution at the site were found by the District to be erroenous. Dilution four miles from the District sludge holding basins was calculated in the EIS to be a 2 - 4 fold reduction. In fact, the dilution at 4 miles from the holding basins is a 7 - 75 fold reduction.

Analysis of complaints to the FCHD neglected to include the fact that only about 2% of the complaints are confirmed by the FCHD. The statements about probable sources were based on wind directions compiled by the FCHD at verified odor sites. Unfortunately, wind direction measurements have a variance of 22.5 to 45° from the reported direction. If this fact were included, one could easily indicate a nearby agricultural feed lot.

The District objects to the entire section on alleged odors as written in the EIS and asks that this be rewritten in the final statement.

III. Metals in the Food Chain

The EIS suggests that there is a health hazard due to metal accumulations in the crops grown on sludge amended soil. However, little experimental evidence is presented to support this suggestion.

The U. of I., the District and the USEPA have participated in a joint research venture to study, among many things, the metal uptake of crops grown on sludge amended soil. The data from this program conducted since 1967, has been made available to the EIS authors, the USEPA, and has been published in the technical literature. This data has shown, contrary to what is stated in the EIS, that metal accumulations are not the limiting factor in sludge application. In fact, metal levels in crops have been found not to be related to accumulative sludge application.

The recently released USEPA technical bulletin on Municipal Sludge Utilization published on June 3, 1976, contains no limitations on sludge metal levels nor does it limit applications based on such metal levels.

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IV. Sludge Quality

The EIS compares certain sludge quality parameters with then existing FCHD regulations. It is concluded from such a comparison that the District sludge shipped to Fulton County is inadequately stabilized.

However, the comparison with FCHD regulations is inconsistent with District sludge quality data. The only values not consistent with the FCHD regulations were sludge alkalinity. Recently, the FCHD has amended its sludge regulations and

lowered its alkalinity criteria. No further values are anticipated which would not be consistent with these new regulations.

The use of the FCHD regulations for sludge quality to condemn District sludge quality is inconsistent with the fact that the FCHD has never cited the District for sludge quality violations.

The EIS after reviewing the FCHD regulations and District sludge quality concludes that additional lagooning at the West-Southwest Treatment Works is needed prior to shipment to Fulton County. In fact, the District has been lagooning sludge prior to shipment to Fulton County. However, due to the northern Illinois climate, it is not possible to provide lagoon sludge to Fulton County during the winter season.

We object to the above recommendation in the EIS as not based upon valid data and ask that it not be included in the final statement.

V. Field Runoff Basin Capacity

The EIS states that the District field runoff basins are undersized and cannot retain the 100-year storm. In addition, siltation is stated as sufficient to even further reduce this capacity.

The calculations used to determine capacity assumed that the soil had no absorption capacity during storm events. This is an unrealistic assumption. According to accepted engineering principles, the field runoff basins were designed to accept the 100-year storm. Additional capacity was provided for possible siltation. This capacity exceeds recently published requirements for agricultural feedlots.

All of the above calculations and field runoff basin capacities were submitted to the IEPA and permits were issued by this agency without any question on this phase of the project.

The District does not agree with the conclusion that the field runoff basins are inadequately sized and asks that this be corrected in the final statement.

VI. Surface Water Quality

The EIS states that the surface water on the District's Fulton County site has levels of contaminants above state standards and that this is a result of discharges from sludge amended soils.

It is true that surface water quality at Fulton County for some constituents exceeds State of Illinois standards. However, there is no evidence in the EIS linking such water quality with District operations. The surface water at Fulton County is influenced mainly by the previous stripmining operations at the site. Also, there are discharges from sewage treatment plants, sanitary landfills, septic tanks, feedlots and agricultural non-point sources which influence surface water quality.

The most compelling evidence which shows no degradation of surface water quality at the site is the quality of Big Creek which flows through the District property. As noted in the EIS, water quality in Big Creek leaving the District's site is consistently of better quality than water entering the site. The obvious conclusion is that District operations do not contribute to surface water degradation as suggested in the EIS.

In addition, the EIS goes on to assess the water quality of discharges from District runoff basins. They compare such water quality with what is purported to be the IEPA standards for these basins. After this evaluation, it is concluded in the EIS that excessive violations have occurred and that this represents the major reason for surface water quality degradation at the site.

However, we believe the EIS authors did not utilize the proper standards which are enforced by the IEPA in permit conditions for the Fulton County site. Use of the proper standards would have revealed that on rare occasions are the IEPA standards exceeded.

The District does not accept the statements in the EIS on surface water quality and asks that they be rewritten in the final statement.

VII. Alleged Pathogens from Sludge Spraying

The EIS suggests that there is a significant health hazard due to pathogens being present in aerosols created by sludge spraying. [redacted] evidence is given to support this suggestion.

The District has compiled for the records, a literature survey which deals with this topic. This is contained in the detailed document submitted. The survey concludes that there is no health hazard from sludge spraying.

The District now has a contract with the USEPA which is investigating the aerosolization of bacteria and viruses from sludge spraying. This contract is being conducted in cooperation with Illinois Institute of Technology Research Institute.

The conclusions in the EIS are unjustified and certainly premature until the study is completed. We ask that the statements in the EIS be amended and corrected in the final document.

VIII. Alleged Health Hazards from Metal Inhalation

The EIS presents calculations to determine the ambient air levels of certain metals downwind of a sludge sprayer. The EIS concludes from these calculations that there is a significant health hazard from these calculated ambient air metal levels.

However, the calculations in the EIS are erroenous and are too high by a factor of at least 100. The EIS authors simply forgot to include a factor which was part of their own calculations. Therefore, the conclusions about ambient air metal levels are erroenous and should be corrected in the final EIS.

In closing, I would again ask that your agency earnestly consider this summary and the attached detailed document before issuing the final Environmental Impact Statement. The District also strongly urges the USEPA to rewrite the EIS in lieu of merely attaching the public and written comments to the first draft of the EIS and making this package the final Environmental Impact Statement. This EIS requires a complete rewrite to make it factually correct and commensurate with existing data and scientific information about the Fulton County site.

I will make available to the USEPA all of the District staff who have participated in the writing of the District comments.

The Metropolitan Sanitary District would like to thank the USEPA for issuing the EIS and to express its appreciation. We join with the USEPA and Mr. Russell Train, its administrator, in supporting a national policy of environmental safety, resource recovery and energy conservation.

League of Women Voters OF COOK COUNTY

67 EAST MADISON STREET / CHICAGO, ILLINOIS [illegible] / CEntral [illegible]

STATEMENT ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT:

SLUDGE DISPOSAL AND LAND RECLAMATION IN FULTON COUNTY, ILLINOIS

August 17, 1976
Mrs. Emily Smith, Natural Resources Chairman

The League of Women Voters of Cook County is pleased to offer the following comments on the Draft Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County. The development of environmentally sound land reclamation has been expressed in our continuing support of federal and state strip mine legislation. Maintenance of air and water quality standards is found in our long-standing support of both regulatory and enforcement measures inherent in the Clean Air Act (P.L. 91-604) and the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500). We are also concerned with the issues of waste disposal, resource recovery and energy c nservation.

In November 1973, The League of Women Voters commented favorably and with specific research recommendations on the draft Environmental Assessment of the Fulton County Reclamation, or Prairie Plan. For the record of this hearing, we have not changed our position and would like to restate a portion of it as follows:

> "...We view the District's project as a research experiment and demonstration project which has tremendous implications for the nation as a whole and have included an optimistic description of the Prairie Plan in our national publication, Environmental Update on Solid Waste Management, September 1973, League of Women Voters Educati n Fund, Publication No.454...With specific reference to sewage sludge in testimony before the House Public Works Committee on proposed amendments to the Federal Water Pollution Control Act in December 1971, the League of Women Voters of the United States said, 'The League strongly supports projects designed to demonstrate the effectiveness of using sewage sludge to reclaim mined land and prevent acid mine drainage. Leagues in coastal areas and around the Great Lakes have long been seriously concerned about dumping sludge into oceans and lakes and have sought a non-polluting means of disposal. We hope that utilizing sludge to combat another type of environmental damage, returning otherwise useless land to productivity instead of adding to air and water pollution, will prove practical.'"

Since the inception of the Fulton County Project, the national problem of sludge disposal has changed considerably. Sludge production from improved and expanded treatment plants has already increased and the National Commission on Water Quality estimates it will triple or quadruple by 1990. (See Staff Draft Report, National Commission on Water Quality, Page 1-12). The recently announced ban on ocean disposal off the New York Bight after 1980 means that most sludge must be disposed of on

land or incinerated. The natural gas shortage and proposed price increases for all fuels could result in a ban on existing heat-drying operations and incineration. The taxpayers of the District will have spent $3 million on natural gas for heat drying operations this year and face a major increase in that cost for 1977. The use of natural gas for this purpose is highly questionable. Each of these problems is a serious environmental threat but collectively they are a major challenge to the United States Environmental Protection Agency.

Nearly four years after passage of P.L. 92-500, the Section 201(d) requirements for "recycling of potential sewage pollutants through the production of agriculture, silviculture, or aquaculture products" and "the ultimate disposal of sludge in a manner that will not result in environmental hazards" remain essentially unaddressed. The Agency's June 3 Technical Bulletin on Municipal Sludge Management places responsibility for determining the heavy metals levels of sludge used in agriculture on the Food and Drug Administration and the Department of Agriculture. We are without definitive directions from the U.S. EPA which is the agency responsible for enforcing P.L. 92-500.

The League position supports utilization of sludge for reclamation of strip mined lands. In spite of the negative questions raised in the Impact Statement, it clearly states: "Sewage sludge is particularly well adapted for use on strip mined lands where the topsoil has not been replaced" (page II-5) and projects encouraging results for reclamation. Since there are approximately 100,000 acres of unreclaimed pre-law land in Illinois, the potential for sludge utilization is great but must wait for a policy decision by the U.S. EPA. We would also like to point out that strip mining is increasing in Illinois with special requirements under the Illinois Surface Mined Land Conservation Act for the return of row-crop lands to their original use. No action can be taken to utilize sludge on any of this land without a policy decision from U.S. EPA. We are also aware of the use of municipal sludge on agricultural land by a large number of other sewage treatment systems in the state. (See report of the Illinois Advisory Committee on Sludge and Wastewater Utilisation on Agriculture Land, February 1975.) The District's Fulton County Project utilizes sludge on both strip mined and place land, offering a unique laboratory for monitoring a total land utilization program in one location.

The Fulton County Project has been funded by residents of the District and we strongly urge close cooperation between the District and the U.S. Environmental Protection Agency so that this largest project of its kind can be scientifically evaluated with a broad, national distribution of research results. The project's implications for the entire nation are too broad to place the financial burden on a local jurisdiction.

The League agrees with the District, the state and federal agencies that this project requires careful monitoring to determine both positive and negative consequences. We agree that only properly digested sludge should be shipped to Fulton County so that health hazards from this source are eliminated. The best engineering and monitoring must be used to protect ground and surface waters from contamination. The water quality standards of the Pollution Control Board must be met at all times. Heavy metals and toxic substances in the sludge, soil and crop must be scientifically evaluated. We recognize that the potential build up of heavy metals, particularly cadmium, could limit future agricultural use of the land.

The League supports those provisions of P.L. 92-500 which require effluent limitations, or pre-treatment, for industries discharging to municipal systems and asks U.S. EPA to oppose any effort to weaken these provisions in pending amendments to the law, since they will help reduce the load of heavy metals and toxic substances in municipal sludge. We recognize that a large share of these substances comes from domestic sewage as well and would suggest an educational program to guide consumers in the selection of home products which do not contain these contaminants. We support your recommendations to minimize direct health hazards and believe the District's future actions will incorporate all of them. We believe the improved evaluation of indirect health hazards requires your cooperation in research and funding. The bibliography is replete with District research reports as well as University of Illinois research reports.

- In general, we support the Prairie Plan and urge less rhetoric and more research to establish a national policy on sludge utilization since the quantity can only increase and has known beneficial resources which we would like to see effectively and safely utilized.

On Page V in the list of Federal State & local Agencies & individuals Notifed of this Action, an Organization made up of a very large group of citizens who are probably the most interested concerned & affected by this project were omitted. They are the FULTON COUNTY CITIZENS FOR BETTER HEALTH & ENVIRONMENT who are the residents, taxpayers & voters of Fulton County.

On Page L-1, I call your attention to an apparent mistake-there are 512,000 acres in Fulton Co. and therefore 45,000 acres of strippedland would not be 60% but 8%.

I question the sentence "The Sanitary District does not anticipate any future significant land purchases upon fulfilling the development plans for the present land holdings." The Dec. 1975-ARMY CORPS OF ENGINEERS-- URBAN WATER DATA E STUDY -- THE CHICAGOLAND UNDERFLOW PLAN include the Fulton County project as one of the four sources of disposal needed to implement the underflow (or tunnel Plan) for which MSD is also asking the Federal Government to finance with a price tag of Billions of dollars. Reference to additional land needs in Fulton County is made several times. I quote you one of them (Appendixes-page E-22 line 60), "-it is proposedto expand the Fulton County Program. Presently, over 15,700 acres are owned by MSDGC." "If the Fulton County site is to be expanded to meet the total system disposal need for the year 2000, some 22,400 acres would be required for direct application. Based on the present ratio of land use, i.e., productive versus gross acreage, this level of application would require a total commitment of 69,400 acres."

In the evaluation of the Prairie Plan, the past, present, and future of MSDGC must be considered. This project directly affects many lives of the citizens and residents of this county, whose property, businesses, homes, lives, and existance in Fulton County would depend on the conclusions reached by this E I S. Of utmost importance to us are the pending dangers of an experiment of this size.

The report states--the surface water on and near the MSDGC Priarie Plan has been contminated by runoff from the sludge fields. "Strip mining has left steeply sloping spoil mound which may increase the capacity of storm runoff to carry suspended solids into receiving waters. Runoff over stripmined areas and sludge application fields is most likely responsible for poor stream qualtiy. The established monitoring program is incapable of revealing this respective sources. The inadequate design and management of many runoff retention basins is indicated to be one of the major causer of surface water contamination.

The retention basins were meant to be constructed to hold runoff from a 100 year storm. Numerous basins could not hold 100-year storm run-off and that some could not even hold a 25-year storm runoff. "Runoff basins that are deficiient in capacity are particulary ineffective in removing suspended solids, resulting in siltation and excess dissolved oxygen depletion in the receiving waterways and reservoirs were substandard water has been documented.

"Surface water is an extremely important resource in Fulton County because groundwater concentrations of dissolved minerals make the groundwater an unsuitable source for public water supply. CONTAMINATION RESULTING from Sludge has not yet been found in groundwater, BUT WITH FURTHER APPLICATION THE POTENTIAL IS THERE.

Since many of the Heavy metal contaminate are found in both strip mine spoil and sewage sludge, ground water resources will be increasingly vulnerable to poullution by run off and leaching as sludge loading rates are increased. The dangers of water pollution itself should be cause enough to demand that this project size be greatly reduced. But there is more.

The EIS agrees with the citizens of this area that there is an ODOR problem. It is discribed several times with the word "Earthy" An Entire chapter should be included in the final statement on this problem. Input and interviews from the local residents should be included. I'm sure you will get descriptions and words that describe the problem much more accurately, and a better understanding of the suffering caused by the odor problem.

The EIS draft says "The odor impact area is contained within a circle with a radius of four to five miles, including the communitites of St. David, Bryant, Cuba and the outskirts of southwest Canton, Dunfermline, Fiatt and wee Ma Tuk Hills, should be included in this. The report admits the odor problem could be hazardous to humans and suggest chemicals be used to suppress evaporation or mask malodorants be used, athough these have been tried and have not proved to be effective or feasible in any way. We citizens feel adding more chemicals to the problem could possibly add to the dangers, and we feel the only reasonable solution to the problem is reduce and elimate the source.

Most of the odor is attributed to the lagoons, where MSD stores 8 million cubic yards of wet sludge. Aerosolization from sludge spraying is a major souce of odor and also offer the greatest potentioal for direct transfer of hazardous components to humans or animals. "Inhalation of sludge aerosols possibly containing pathogens or toxic substances presents an opportunity for protracted and repetitive exposure. "Assessing the risks associated with the inhalation of airborne particles is extremely difficult, because the absence of data concerning the nature and concentration of pathogens in the sludge, the virulence of these pathogens after downwind transport and the number of inhaled organisms required for human and animal infection." Treatment plants also contain a wide range of pathogens including some virsus that are not totattly destroyed by treatment and holding in storage basins according to the report.

The immediate area has already had one unexplained death, which doctors say might have been caused by inhaltion of some unknown virsus. Must there be more before we are protected from this experiment.

D-51

Perhaps a Chapter should be added to this project on the Economic impact the Fulton County project has had on individual and businesses both large and small through the resources genrrated by numerous contracts, kickbacks alleged bribes and private contributions. Included in this should be copies of the recent indictments handed down by the U S atterneys office. Perhaps in this, the real reason (other than the disposal of sludge) will be found and why this project is being allowed to contintue in spite of the failure of the Promise of the Prairie Plan.

Since stripmine land in Fulton has historically supported pasture type cattle operation in the past, without the Hazards and Dangers of Sludge, and since this project cannot be used indiretly and safely for the row-crop reclamation that was promised. Since Fulton Co. certainly does not need more large scale recreational type projects we cannot afford. And taking into consideration all the suffering, both physical and mental anf financial and experiment this size is causing and may cause in the future, We plead with the Federal government to put a stop to this farce before our Homes, health, and Lands are ruined. The Price we residents must pay for this experiment is too great.

Nellie Kipper, Pres
Fulton Co Citizens
for Better Health & Environment

To be a little more personal, why do my parents who are in their eighties and have lived and worked on their farm over 55 years have to feel the disco forting effects of this sewage disposal project. It hurts me deeply to greet them in the morning and have them tell me they couldn't sleep the night before because the ammonia from the sludge was so strong it burned their noses and throats.

M S D has taken advantage of our County Officals, trampled over our rules and regulations, are now trying the same thing with the State E. P. A. and all the while they are asking the Federal Government to pay the bill on this experiment.

If M S D gets these Federal Grants it will be a damn shame to think that our tax dollars are being used to support a project which aggravates us both physically and mentally, abuses our right to enjoy our homes and decreases the value of our property.

Comments for E I S hearing --- Chicago Aug. 17, 1976, Melba Ripper for FULTON COUNTY CITIZENS FOR BETTER HEALTH & ENVIRONMENT

At the July 26, 1976 EIS Hearing held in Canton, Illinois a discussion was held about a petition signed in Fulton County about sludge projects. We would like to submit the following information about the PETITION FOR REFERENDUM.

In March of 1974 a petition was filed with the County Clerk in the County of Fulton a petition which reads as follows........(See A.1)................ This petition was signed by 7611 registered voters which is over one-fourth the registerd voters as required by law for a public policy question. This referendum was placed on the ballot for the Nov. 74 election. In August of 1974 there began a series of legal actions against this petition, beginning with the Complaint for Declartory Judgement by the Metropolitan Sanitary District of Greater Chicago. The case No.74-MR-14 filed in the County of Fulton asked this be brought before the court & removed from the ballot.. All legal actions the petition are on file in the Fulton County Courthouse. The legal actions ended with M S D achieving their goal. The Referendum was removed from the ballot the night before the election.

We call your attention to the Wednesday, Aug. 11, 1976 edition of the Canton Daily Ledger, the editoral page and the editoral written by the papers General Manager Mr. Thomas Wood. In it he summerizes the E I S and expresses his concerns for the citizens of Fulton County and hopes the Federal Government will force the necessary changes in the project to reduce potential hazards.

~~I quote~~ Mr. Woods "THEN PERHAPS the MSD could devote a little more time to doing what it said it would do when it came into Fulton County and fell far short of: leveling and reclaiming strip mined land by application of sludge."unquote. WE ask that this editoral be made part of the final E I S Statement.

The EIS Draft States " The Sanitary District does not anticipate any future significant land purchases upon fulfilling the development plans for the present land holdings." I question this statement. The dec. 1975-ARMY CORPS OF ENGINEERS**URBAN WATER DAMAGE STUDY --THE CHICAGOLAND UNDERFLOW PLAN include the Fulton County project as one of the four sources of disposal needed to implement the underflow (or tunnel Plan) for which MSD is also asking the Federal Government to finacne with a price tag of Billions of Dollars. Reference to additional land needs in Fulton County is made several times. I quote you one of them (appendixes page E-22 line 60), "-it is proposed to expand the Fulton County Program. Presently over 15,700 acres are owned by MSDGC." "If the Fulton County site is to be expanded to meet the total system disposal need for the year 2000, some 22,400 acres would be required for direct application. Based on the present ratio of land use i.e., productive versus gross acreage, this level of application would require a total commitment of 69,400 acres."

In the evaluation of the Prairie Plan, the past, present, and future of MSDGC must be considered. This project directly affects many lives of the citizens and residents of this county, whose property, businesses, homes, lives, and existance in Fulton County could depend on the conclusions reached by this E I S. of Utmost importance to us are the pending dangers of an experiment of this size.

The report states--the surface water on and near the MSDGC Prairie Plan has been contaminated by runoff from the sludge fields. "Strip mining has left steeply sloping spoil mounds which may increase the capacity of storm runoff to carry suspended solids into receiving waters. Runoff over stripmined areas and sludge application fields is most likely responsible for poor stream quality. The established monitoring program is incapable of revealing this respective sources. The inadequate design and managment of many runoff retention basins is indicated to be one of the major causes of surface water contamination.

The retention basins were meant to be constructed to hold runoff from a 100 year storm. Numerous basins could not hold 100-year storm run-off and that some could not even hold a 25-year storm runoff. As recent as July 28, 1976, the Canton Daily Ledger reported a break in a siltation basin on Field 47. The break had been caused by heavy rain. It has been investigated by Fulton County Health Dept. and the Ill. Environmental Protection Agency.

"Surface water is an extremely important resource in Fulton County because groundwater concentrations of dissolved minerals make the groundwater an unsuitable source for public water supply. CONTAMINATION RESULTING from Sludge has not yet been found in groundwater, BUT WITH FURTHER APPLICATION THE POTENTIAL IS THERE. Since many of the Heavy metal contaminations are found in both strip mine spoil and sewage sludge, ground water resources will be increasingly vulnerable to polutionby run off and leaching as sludge loading rates are increased. The dangers of water pollution itself should be enough to demand that this project size be greatly reduced. But there is more.

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WILBUR WRIGHT COLLEGE

A CAMPUS OF
CHICAGO CITY COLLEGE

3400 NORTH AUSTIN AVENUE CHICAGO, ILLINOIS 60634

SPRING 7-7900

17 August 1976

U. S. Environmental Protection Agency
Region V
230 South Dearborn/ Street
Chicago, Illinois 60604

Dear Sirs,

Did you have orange jüice for breakfast?
Did you enjoy its flavor?
Chances are your orange juice came from Florida oranges.
The flavor of the juice was from the mineral content in the söil. These minerals helped make the enzymes that gave full growth and performance to the orange tree, and the flavor to its fruit.
This mineral content of the soil is brought to you thru the courtesy of The Metropolitan Sanitary District of Greater Chicago.
Did you have a steak lately?
Was it corn fed?
Did you have margarine on your toast this morning?
Were the french fries you had with your hamburger fried in corn oil?
The Metropolitan Sanitary District of Greater Chicago has probably touched the nutritional life of at least half of the U. S. population.

Surprised that a sanitary district is directly related to your nutritional health, the nutritional health of the nation?

Back in the pre-industrial days of our nation, it was natural for agriculture to put back on the land what it took from the land. After all, this is the way it works in nature from the beginning of time. This is the way farmers maintained their soil fertility and could produce better crops each year.

Today the farmer still sells his products to the people who now live in highly concentrated cities. Thru the inventiveness of industry, with the aid of scientific knowledge and a lot of cooperation with nature, mankind has been able to develope a water seperation process that is faster, safer, and more efficient than ever known to this world before. Mineral wealth is recovered and can now be returned to the soil from where it originated.
The cycle is complete.
Minerals are never lost or destroyed.
They only change forms as they pass thru the cycle of nature.

These are the facts of nature I help my college students to understand.
Everything MUST go somewhere.
Nothing is disposable.
Find out where the object fits in the natural cycle, and you will know where to secure its supply and where it goes when you are finished with it.

I've taken my students to the Sanitary District's operation in Stickney for the last 5 years and to Fulton County for the last 4 years. They return with greater knowledge of the wisdom and understanding of the great foresight and inventiveness of man. They understand where the work of the Sanitary District fits in the total picture of nature. They have hope, great hope, that there will be something of value left in the environment for their cheldren to see, to eat from, to run thru, to fish from, to visit again and again.

To ask what the impact of "sludge" is on strip-mined rocky land surfaces, is like asking the question of what impact cow manure will have on overgrazed water-gullied land.
However, both of these studies have been approached.
Both studies continue to be investigated.

As long as we have a continuing increase in the human world population, these studies, and others that show us a better way to cooperate with nature, as well as to increase our food yields and nutritional content, must be pursued for our own sake as well as for the generations that are to follow. Any other approach would be to deny hope or continuity for the future generations.

A simple example:
How would I explain to my students that an important project , in operation for 6 years, which included the application of liquid organic fertilizer directly to leveled-and-graded strip-mined spoil produced a fertile site for plant growth and high nutritional yields, was discontinued because:
there was a distinctive odor to the liquid organic fertilizer?
Or, there might be some soil mineral run-off into a local stream in the case of a heavy cloud burst?
Or, the effects of a second application of liquid organic fertilizer are not certain?
Or, that there be any other question to be asked, but the project was not allowed to pursue the question or to seek the answer.

The Sanitary District is an important link the the biggest business of this nation, the agricultural business. How it handles water and what it recovers is one of industry's greatest achievements to man's inventiveness. To call its product anything other than the important organic fertilizer it is, is to misread its contents and all the effort put into its reclamation.
"Sludge" is an outmoded and inaccurate word . It only attempts to describe its appearance.
It does in no way convey to me its contents or its value.

In reading over this E.I.S. Draft, may I offer an editorial suggestion which gives more meaning to the way I view this work.
Instead of "Sludge disposal and Land Reclamation in Fulton County, Illinois", I would suggest that it better sets the mind to the importance of this draft if it were to read: "Liquid Organic Fertilizer Application on Future and Used Agricultural Land in Fulton County, Illinois."

There are two more observations I wish to call to your attention at this time — one is a restriction, one is an omission.

The biggest restriction I can see in this entire draft is that the only location to be considered that derives the benefits of this project is Fulton County, Illinois.
A project of this magnitude and importance will surely have more than a nutritional impact felt thruout the agricultural world.

As to the omission, there is another whole new dimension of this project that has NOT been properly discussed. In this year alone, some near agricultural communities of western Minnesota, southern South Dakota were bewailing this need. Thruout all of history, mankind has tried to control it. The omission in this draft is the value of the WATER that is also being shipped along with the mineral content of the liquid organic fertilizer.
To be able to place water and nutrients in the right place at the right time in the correct proportions surely must be the finest achievement of agricultural man on this planet.
This project can enflame the imagination of the best to help solve the details that can achieve this goal —— for the benefit of all of us,
and for all of our children,
and for all of our children's children,
and for all of our children's children's children ——————

Sincerely,

Norbert J. Schommer
Assoc. Prof. of Biology

B-35

ITEM 022

STATE OF ILLINOIS

DEPARTMENT OF CONSERVATION
605 STATE OFFICE BUILDING
400 SOUTH SPRING ST
SPRINGFIELD 62706

ANTHONY T. DEAN
DIRECTOR

WILLIAM A. WATTS
ASSISTANT DIRECTOR

CHICAGO OFFICE — ROOM 100 160 N. LA SALLE ST. 60601

TO: Terry Hornbacker

FROM: Anthony T. Dean

DATE: August 5, 1976

SUBJECT: REVIEW OF THE DRAFT E.I.S. FOR SLUDGE DISPOSAL AND LAND RECLAMATION BY THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO IN FULTON COUNTY (DEIS #76-06-251)

The draft EIS did a good job of outlining the environmental issues of the Metropolitan Sanitary District of Greater Chicago's land reclamation and sludge program in Fulton County. However, the following environmental issues need more attention or a detailed investigation as to their impact on the fish and wildlife resources of the region:

1. A detailed study is needed to identify the sources of heavy metals and their fate in the various food chains. Fish flesh should also be analyzed for various contaminants. Big Creek should be the target of this study.

2. Land reclamation (drainage, leveling and sludge application) should be evaluated as to its affect on the giant Canada goose population of the project area. Many acres of marsh type habitat have been lost by the land reclamation activities of MSDGC. Habitat diversity lost through reclamation activities was not adequately covered in the draft EIS statement.

3. Effects of sludge application on wild birds and mammalian species needs more investigation since it is stated in the draft EIS that available research data indicates a potential hazard exists.

As of August, 1975, the MSDGC owned 15,528 acres of strip mine lands in central Fulton County. These lands currently contain a magnitude and diversity of surface water resources consisting of lakes, ponds, marshes and streams. The draft EIS does not call attention to the loss of valuable water resources through the land reclamation plans of MSDGC. In our opinion, Terry Hornbacker - 2 -

these losses and their implications should be fully discussed in the final EIS.

We also note the draft EIS indicates there are three endangered plant species which probably exist in the project area. We feel this information should be verified, and, if these plants do occur, the final EIS should discuss alternatives for preservation or mitigation of these species.

ATD:meh

Illinois Environmental Protection Agency
Richard H. Briceland, Director
2200 Churchill Road, Springfield, Illinois 62706
Telephone 217/782-3362

September 28, 1976

Mr. Kent Fuller, Acting Chief
Planning Branch
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Fuller:

Attached are this Agency's detailed comments on the draft Environmental Impact Statement on the MSDGC Fulton County project.

Our criticisms and suggestions regarding the water quality analyses are quite detailed. It is not our intent to criticize for the sake of criticizing. We hope to help in producing a final document which will analyze as fully as possible the impacts this important, controversial project which has been in operation for five years. That the project has been in operation so long makes this EIS unique. The need in this EIS is broader than the usual case of merely analyzing potential impacts of and possible alternatives to a proposed Federal action. This EIS is also an opportunity to analyze impacts which have already happened and, where those impacts are not easily defined, propose better methods to measure the impacts.

In the written comments, we offer this Agency's assistance to the USEPA's consultant in refining the analyses of surface and ground water impacts. To arrange such assistance, contact Daniel J. Goodwin, Manager of the Planning and Standards Section, Division of Water Pollution Control, (phone 782-3362).

Cordially,

M. P. Mauzy
Manager of Environmental Programs

DJC/DRC/mkp

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
OCT 1 1976
PLANNING BRANCH - Region V

Illinois Environmental Protection Agency
Comments on MSDGC Fulton County
Draft Environmental Impact Statement, June 1976

Context of the EIS

There is virtually no discussion of the proposed USEPA action. The Foreward, p. ix, mentions that MSDGC is "a grant applicant for this sludge application/ land reclamation program." No further information is given about the extent of possible USEPA funding for the project. This lack of information seems to preclude satisfaction of the requirements of the USEPA's own EIS regulations of April 14, 1975. These regulations (Federal Register, Vol. 40, No. 72, Section 6.304) require, among other things, these two items:

1. Background and description of the proposed action. (6.304(a)).
2. Alternatives to the proposed action (6.304(b)).

While the draft EIS does contain some details about the background and description of the project and about alternatives to the project, information about the project is not the same as information about the proposed federal action in relation to the project.

This paucity of information about USEPA involvement in the project results in a document without a context, or perspective. We hope the final EIS will rectify this deficiency.

Surface Water Quality Analysis

The analysis of the impact of the project on streams is superficial. The analysis cites some of the voluminous MSD data contained in MSD's monthly "Fulton County Environmental Protection System" reports. The EIS attempts to summarize the most relevant data in the reports for the last four years. Some of these data and some of the conclusions stated are useful, but two important items of available information were ignored. Without including these items, the analysis could and did produce only very tentative conclusions. Example: "Runoff over strip-mined areas and sludge application fields are most likely responsible for poor stream water quality". This sentence is weak and unsupported by data.

The two missing items of information are 1) scheduling of retention basin discharges and 2) IEPA data, both effluent data from the Canton and Cuba sewage treatment plants and stream quality data from IEPA Water Quality Station DJB-01, on Big Creek downstream of the project. An explanation of how the consideration of these additional data can improve the stream quality analysis follows.

1. Scheduling of Retention Basin Discharges

   There are 53 basins. During any month as few as 5 or 6 basins are opened to discharge. The MSD monthly report tells the quality (TSS, BOD, Fecal Col.) and quantity of discharge and the dates each basin was open for discharge. Using the last item of information, period opened for discharge, periods during which receiving streams are subject to influence from runoff from sludge fields can be identified.

   There are also some areas tributary to the sampling stations which contribute runoff to the streams directly. These areas are not application fields and therefore do not need runoff collection. By inspection of precipitation records kept by MSD and comparison with basin discharge periods, periods of runoff from non-sludge areas but no retention basin discharge can be identified. Finally, there are many periods of no direct runoff or retention basin discharge. Samples taken during these periods primarily represent point sources, especially the Canton and Cuba sewage treatment plants. (There may be a slight influence of the retention basins during these periods in the form of benthic deposits.)

2. IEPA Data

   IEPA effluent and water quality data has been ignored in the EIS. IEPA data includes monthly effluent samples for the Canton and Cuba sewage treatment plants and monthly water quality samples for Water Quality Station DJB-01 on Big Creek west of Lewistown. This station complements the MSD stations, all of which are within the project areas or on its perimeter. DJB-01 is several miles downstream from the project and can therefore give a picture of the total impact on Big Creek of the project better than any single MSD sampling station.

The draft EIS emphasizes the scarcity of data; but, in fact, there is considerable data relevant to surface water impact which could be used to arrive at more definitive conclusions than those put forth in this EIS: 11 stream monitoring stations, 10 "reservoir" monitoring stations, daily weather information, effluent data for the two major point sources (Canton and Cuba Sewage Treatment Plants), and finally, two USGS stream gaging stations on Big Creek. A more thorough analysis than that contained in the draft EIS is possible. And considering the importance of this project to MSD, Fulton County, and to people around the world interested in land disposal of wastewater sludges, such an analysis should be made. The Illinois EPA is willing to advise and assist the EIS consultant in the implementation of this suggestion.

Operation of Retention Basins

The operation of retention basins should be more thoroughly explained. This would contribute to the surface water quality analysis discussed above.

The retention basins collect runoff from application fields and discharge the collected water through gates during periods usually between a few hours to 2 to 3 days. Sometimes, however, the gates are left opened for longer periods. For example, the MSD monthly report for March, 1976, shows that of the 14 basins opened during the month, three were left opened 30.19 days each and 6 others were left opened between 13 and 16 days.

One must wonder why these gates were left opened so long. It can hardly be because the hydraulic capacity of any gate is so limited as to need 30 days to empty its basin. It must be presumed that the reason was that it was merely inconvenient for the operators to close the gates sooner. In this case, leaving the gates opened for 30 days apparently resulted in runoff from the 1.5" of rainfall reported in the weather information for the 27th and 28th of the month running right through the gates with no retention.

It is also notable that no pumping back of retention basin water to application fields is reported or even mentioned in the monthly reports. Condition #11 of the March 7, 1974, operating permit (reproduced in Appendix A of the EIS) required records to be kept of pumping back. The lack of pump-back data in the reports supports the conclusion already reached by IEPA from its contact with the project that pumping back has never been practiced.

MSDGC is now operating at Fulton County without an IEPA permit. The March 7, 1974 permit has expired and IEPA has not yet issued a new permit. The IEPA has declined to issue a new permit because of the present odor problems generated by the project. Upon the resolution of current litigation, a new permit will be considered. At that time, a new evaluation of permit conditions will be made. Issuing a permit with any less stringent permit conditions will, of course, depend on proof that such operation will not pollute the streams downstream of the project. Thus, a thorough examination of current operation and current surface water impact is essential to the IEPA. The IEPA offers its aid to the EIS contractor in a re-evaluation of operating practices.

Providing the demonstration of non-pollution of streams, as discussed above, is made, future permits could be revised as follows:

1. Runoff collection basins would have no effluent standards if tributary fields received sludge only at agronomic rates. These rates will have to be individually calculated for each crop but will probably be between five and twelve dry tons per acre per year.

2. Re-evaluate the background concentrations used in the March, 1974, permit.

There are two errors in the EIS regarding runoff collection basins we want to rectify here:

1. The IEPA used a runoff coefficient of .77 in setting up design criteria for basin capacity, not the 100% used in the EIS. Thus, the basin inadequacies shown in Table VII-11 are not correct by IEPA criteria. This point is minor, however, when the existing conditions of the basins are examined. In practice, basin capacities have been reduced by overlong retention and/or by siltation.

2. The comment (page VII-58) about inappropriateness of "averaging effluent quality as required by State standards" is not correct. While 24-hour composite samples are required of sewage treatment plants, single grab samples are acceptable for these large retention basins, whose concentrations of BOD, SS and fecal coliform would not fluctuate much. Thus, the MSD reported values are single grab samples and considered representative. A BOD_5 of 73 mg/l is a gross violation of the effluent standards imposed by the March, 1974, permit.

Groundwater

The Fulton County Sludge project is very important not only to the local residents, but to everyone involved with sludge disposal. A thorough, conscientious analysis of the impact of the project on groundwater is needed.

The draft EIS does not satisfy that need. The IEPA identifies the following deficiencies in groundwater data and analysis:

1. The map, Figure IV-9, indicates in a crude way groundwater flow directions. What is needed is a piezometric surface map. Figure IV-9 does not allow conclusions about eventual migration of pollutants into groundwater sinks.

2. It is especially interesting that some arrows of groundwater flow in Figure IV-9, especially in the southeastern part of the project, exit the project area, but there are no sampling wells shown which could sample groundwater down-gradient of the arrows.

3. Page VII-70 recommends the use of tracers to help identify sources of contaminants. This Agency's experience with tracer studies indicates such studies are generally unreliable because their success depends on properties of aquifers not determined in most subsurface investigations.

4. On the crucial matter of groundwater flows and gradients, page VII-70 refers to the "absence of complete groundwater flow data . . .". We can only say that if the data is not complete, it should be made complete. The same page also states "Groundwater quality monitoring and analysis should be continued to detect possible contaminants from the project." We suggest that a mere continuation of what has been done will not relieve present uncertainties.

5. Table VII-13 (page VII-65) summarizes groundwater effects by presenting ranges of values for each constituent for all wells. It would be more meaningful to indicate trends for individual wells.

6. The statement that "variations in their concentrations are influenced primarily by the geochemical characteristics of abandoned strip mines. . ." (page VII-68) is a tenuous conclusion if based on Table VII-13.

The draft EIS suggests an independent agency be brought in to to study existing data and formulate an improved research and monitoring program (pages I-29 to 31). The IEPA feels that such a study of the existing groundwater data with the purpose of recommending improvements in the monitoring program is needed. Whether or not an independent agency is necessary can be determined by an initial study by the EIS consultant (if such additional demands on the consultant are considered appropriate by the USEPA) with the assistance of groundwater specialists of this Agency.

Air Pollution

The odor potential of the project is dependent upon several variables, including sludge quality, quantity and operating methods. Because of current unresolved litigation, it is difficult to see what changes there will be in those parameters.

The outcome is at this date unpredictable. We hope the legal complications will be resolved within the next few months for the sake of all parties, including local residents, IEPA and MSDGC. It is especially important to MSDGC to have the legal uncertainties of their Fulton County project eliminated so they can proceed with sludge processing/disposal planning on a more firm basis.

Considering the situation described above, the IEPA will withhold recommendations regarding the odor problem until the need for additional IEPA action is better defined.

Miscellaneous

1. Page I-13, bottom, states that increased fertility of the former strip-mined land will "possibly make row-crop production economically feasible." The presence of large rocks in the plow layer, however, may make it difficult for the average farmer to prepare and cultivate these fields. MSD has been using special, expensive, equipment to overcome this problem.

2. MSD has stopped (as of approximately March, 1976) barging supernatant back to the WSW plant. MSD has just (as of August, 1976) begun applying supernatant to land by discharging it through gated pipes. The EIS should discuss this method, for which MSD has hopes of eventually using for sludge as well as supernatant. This method, if successful, may reduce odor generation from sludge application to fields.

3. The cost at the bottom of page V-52 should be $22.83, not $27.83. (It is taken from the table on page V-53).

4. The IEPA suggests the cost of the EIS be given. Other agencies and the general public have the right to know how much public funds are being spent to produce each EIS.

5. The information on MSD sludge processing and disposal should be expanded and enlarged. MSD has been working on a short term (approximately three years) sludge study which is to be released shortly. MSD is also planning a long range study, which may have already produced some tentative alternatives not reported in the draft EIS.

Summary

The following are improvements in the IEPA wishes to see in the final Fulton County EIS:

1. Explain the context of the EIS, as discussed above.
2. Do a more thorough analysis of the surface water quality impact of the project, using 1) IEPA effluent and stream sampling data as well as MSD data, and 2) using the times of retention basin discharge as a variable, as discussed earlier. IEPA is willing to participate in doing this analysis.
3. Evaluate the adequacy of the groundwater monitoring program. IEPA geohydrologists can assist in this task.
4. Make other corrections and additions listed under "Miscellaneous", above.

UTILIZATION OF SEWAGE SLUDGE ON LAND

Paul Parish November 18, 1975

Our country is faced with a problem of what to do with all the waste materials we have created. One of the problems is what to do with all of the sewage wastes our large cities are creating each day. Chicago flushes 1.5 billion gallons of raw waste into the city's sewer daily. These flushings go to city sanitation plants where they are processed. There are a combination of mechanical and chemical processes involved with one of the end products being sludge. Sludge is the solid material produced by water and sewage treatment processes. Sludge has been disposed of by ocean in inland dumping, sanitary land filling open dumping, and atmosphere disposal by incineration.[1] During the past years tougher laws and close surveilance by the Environmental Protection Agency have curtailed or closely regulated much of the past methods of disposing of sewage wastes. Agencies throughout the United States are looking to soils as a major way of disposal of sewage sludge. Milwaukee and Chicago have been selling activated sewage sludge since the early forties. Sludge can be a useful source of nitrogen and phosphate.

A county in central Illinois learned supposedly of the value of sludge and the problems Chicago was having with disposal. Chicago has more sludge than they have outlets for disposal. Most large cities throughout the U.S. seem to have the same problem, large quantities of sludge and no real good means of disposal. Since Fulton County in central Illinois has forty thousand acres of unusabble land due to strip mining of coal; it seemed to county officials as a good place for Chicago to dispose of their sludge. County officials hoped that Chicago would level land which coal mining companies were allowed to leave in a state of disaster. Meaning the land that was stripped was some of the best farm land in the United States, six and seven percent organic matter content in the soil was quite common. After strip mining, the land was allowed to remain in large hills and gulleys with the top soil covered with hundreds of feet of rock and clay. Since 1971 Chicago has beenbringing their sludge by truck and barge to Fulton County. In fact, The Greater

Chicago Metropolitan Sanitary District Prairie Plan, as it is called, is under the watchful eye of large cities throughout the United States. Since the U.S. already contains two million acres of similarly ruined land, sewage sludge appears at first glance a good way to restore scarred land.[2]

Unfortunately, residents of Fulton County were not informed of the possible and proven hazards of sludge. Soil scientists throughout the United States and Europe warn of the problems of sludge as a source of nutrients to plants. Sludge can be a useful source of nitrogen and phosphate, but is extremely variable in composition, depending on the contribution made to the sewage from idustrial sources. It is often found to contain remarkably high levels of zinc, a trace element which can have toxic effects on plant growth.[3] There have been other trace elements found in municipal sludge which plants have frequently contained in excessive or toxic amounts. These are: Cu, Mo, Ni, Co, Pb, and Cd.[4] Officials working for Metropolitan Sanitary District claim the soil has an absorption capacity for trace elements and that trace elements are unavailable to plants at a high pH level. This generalization is simply not completely true. Mo for example becomes more available with increasing pH level.[5] It should also be pointed out that soils having appreciable amounts of organic matter, the availability of copper is more closely associated with organic content of the soil than with pH.[6] Soils are known to have an absorption capacity for most trace elements; however, the exact nature of this effect, especially in chelated system, is not completely understood.[7] LeRiche (1968) has published data from plot experiments indicating enhancement of the levels of available copper, Chromium, nickel, lead and zinc in soils resulting from sludge applications. The levels found in the majority of sludges are so high that their use as fertilizer must inevitably lead to contamination of soil with trace elements. Apparently, once the retentive capacity of this soil for trace elemtns from sludge has been reached, enhanced solubility in the soil occurs.[8] Research for long term effects of sludge containing high levels of trace elements is very limited in the United States. Reason being the soil has only recently been considered as a major site for the disposal of sludge.

Research in Europe where sewage sludge application has been in practice for many years has many results of long term effects of sewage sludge. J. B. Patterson of England studied the effects of sewage sludge application for thirty years on market garden soils in Somerset and concluded that there is no doubt that the application of sewage sludge containing trace elements can contribute to soil contamination. Evidence of the contamination of the soil with respect to copper, lead and zinc appears to be virtually permanent, for the levels of these elements were not substantially reduced on leaching columns of two heavily contaminated sludge treated soils with a volume of distilled water equivalent to 40 m rainfall.[9]

Most of the research done in the United States has been done under controlled greenhouse conditions where researchers have tried to obtain long-term effects by increasing the speed of reactions that naturally occur over a period of years. Research results printed in the 1975 Journal of Environmental Quality by Bradford, Page, Lund and Olmstead all soil scientists from the University of California indicate toxicity problems envolved with sewage sludge trace element contamination. The data discussed showed that the extracts from the sources of sludge used in the greenhouse experiment all contained at least one and more often several elements available at toxic concentrations to bean, barley and tomato plants.[10]

Research done by Pennsylvania State University indicates that sewage sludge should not be used as a fertilizer until an effective monitoring system keeps track of heavy metals added to soils and taken up by plants. Dr. Dale E. Baker and associates showed plots of corn and grain sorghum fertilized with sewage sludge as part of a recent Penn State field day (fall of 1974). The fertilizer value of sewage sludge was demonstrated. Sludge samples were analyzed every two weeks since April 1 for elements and potentially toxic heavy metals. The results show the need for accurate systems of monitoring sewage sludge as a fertilizer. Composition of sludge varies greatly with time and is generally higher in copper, zinc, and cadmium than is desirable, Dr. Baker stated. The research is supported in part by fair funds from the Pennsylvania Department of Agriculture. Traces of some heavy metals are needed in soil for healthy crop growth, Dr. Baker explained. Nine pounds per acre per year are recommended for zinc, for example. But common sludge increases the zinc in soil to about 200 pounds per acre. Mention was made of feeding trials carried out with chickens to assess the content of cadmium in meat and eggs. Cadmium was fed at 3, 12, and 48 parts per million. Even 48 parts per million produced no significant change in cadmium content of eggs. However, cadmium accumulated in the livers and kidneys of chickens from all levels of feeding. Cadmium content in the muscles was much lower than in livers and kidneys. Heading up the experiments with cadmium fed to chickens were Dr. Roland M. Leach and associates. Under low concentrations of heavy metals, Dr. Baker and associates believe sewage sludge can be used safely as a fertilizer for at least three years at rates not exceeding 10 tons of dry matter per acre per year. The kicker, of course, is the concentration of heavy metals in parts per million of dry matter. From Penn State experiments, zinc should not exceed 1500 parts per million. Copper concentration should be no more than 750 parts per million. With lead it should not exceed 500 parts per million. Nickel's concentration is considered safe at 150 parts per million.[11]

It is apparent from past and present research sludge application on the soil should be closely monitored. Pressures should be put on industries to recycle their trace elements. Laws should be enacted to prevent elements from industries to enter sewage systems. More research is needed for possible economical conversion of sludge to methane gas. If large municipalities are allowed to continue to apply sludge with trace element contamination on soils, it is evident that soil contamination is going to occur.[12] Citizens in Fulton County as well as the citizens throughout the United States should be concerned with the exact composition of sludge being applied to the soil. We need to stop overlooking environmental problems that are occuring due to greed. We could ruin the one resource that has caused our country to reach a standard of living never enjoyed in the history of man; that resource is our precious soil.

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Because I have been made aware in the last four years, that in many cases outsiders view rural dwellers as unqualified to opinions other than what they (the outsiders) consider emotional, particularly when it comes to issues being decided for us, I have decided to give what I consider my qualifications for speaking here tonight. I am Barbara Luthy, I was the first Co-Chairman of the Fulton County Citizens for Better Health and Environment, I am an alderman in the city of Canton, I hold a Bachelor's Degree in Education from the University of Illinois, my husband, Charles, and I are Fulton County taxpayers, I am a wife and the mother of five children.

It is an interesting thing to me that the "Draft" cover is entitled "Sludge Disposal AND Land Reclamation". Indeed, they are two separate entities as it relates to the Prairie Plan. I should, at this point, make it clear that I am not opposed to sludge application on strip-mined land for the purpose of land reclamation, but as a disguise for disposal, which no one, surprisingly denies it is, is a totally different situation and one to which this impact statement does not address itself!

In early Prairie Plan literature, MSDGC cites figures of reclamation at the rate of 2000 acres a year. Roughly 100 acres of pre-law strip-mined land have been leveled as of July, 1976. There is no row crop production on any pre-law strip-mined land, courtesy of the Prairie Plan. I highly resent slide presentations which MSDGC uses around the country which lead the viewer to the conclusion that corn is growing on pre-law strip-mined land which they, in the last four years, have leveled!

Most people today are concerned with their environment. We are only too aware of the problems of urban areas, and we sympathize. But what's happened to honesty and integrity? Is the Prairie Plan so impalatable that it has to be presented and implemented in lies and half truths? Is the project unable to speak for itself? Let's call a spade a spade, WHEN will land reclamation take place? Mr. Hearing Officer, I respectfully request that you seek answers to basic questions such as these! I further suggest that the proof of land reclamation lies with MSDGC.

I would like to point out that on the summary sheet, i, you say that, "An analysis of the methodologies utilized by the Metropolitan Sanitary District of Greater Chicago for the application of sludge on strip mined land in Fulton County, Illinois is presented." Is this to say that you are not considering the application of sludge to the non-strip-mined land in Fulton County which MSDGC owns? Any form of crop now growing on MSDGC owned land is growing on land which was returned to good pasture/or crop production by previous owners.

All sections of the Draft EIS relating to "Land Use" are pointless considerations, as MSDGC plans to own the land into perpetuity and does not, by their own admission, plan to return it to private individual owners by way of sale. It was my understanding that it had beendetermined that MSDGC could not be in the tourism business. I suggest that the monies to be spent on Big Bluestem, $799,127 be considered. Perhaps a "grant" would not be necessary if monies being spent elsewhere on the project were spent on implementation of land reclamation. $10,000,000 in contracts have been let for the Gale and United Electric property. A vast majority of this money is for pipeline, dredges, a pump station, etc., land reclamation, if any is actually accomplished, is not the major consideration.

Referring to the foul and sickening odor as "earthy" is certainly not fair or accurate. When an odor can cancel an intended church function, drive people from their homes, make eyes water, make people sick at their stomachs, etc. it just CANNOT be described as "earthy".

I ask that the USEPA seriously take a look at the way that this project was presented and then implemented, at the amount of land reclamation being done, at the amount of money being spent and for what reasons. Any expenditure of federal money for the Prairie Plan in Fulton County when there are as many problems and unanswered questions and total willingness on the part of MSDGC to perpetuate half truths as regards the Prairie Plan would be a real step backwards for sludge disposal anywhere.

Mrs. Barbara W. Luthy (Mrs. Charles)
80 Longwood Drive
Canton, Illinois 61520

ITEM #26

George A. Syyres
Rural Route No.2
Canton, Il., 61520
August 17, 1976

U. S. E. P. A. HEARING

I would like to compliment the U.S.E.P.A. on a fine job of compiling information on the sludge disposal project of Metropolitan Sanitary District of Greater Chicago in Fulton County, Ill. The first part of the title on the impact statement is fitting for the project. However, the last part of the title which mentions land reclamation is a far cry from the actual purpose of the project. This is one of the purposes of this statement, to point out some of the misconceptions and dangers of this project.

Many acres of the land now owned by M.S.D.G.C. had already been reclaimed by previous owners. Large areas such as the Livingston and Gale farms have been providing forage and pasture for large cattle operations for many years. M.S.D.G.C. now owns these properties in their giant sludge disposal project.

M.S.D.G.C. claims to have increased the value of property in Fulton County by storing and spreading their sewage waste in Fulton County. This seems hard to believe as most of the citizens around the sludge disposal area feel differently. Due to the increased hazard imposed upon this property by the M.S.D.G.C. PROJECT, MANY PEOPLE WOULD NOT WANT TO BUY OR BUILD A HOME IN THIS AREA.

The impact statement draft implies that the increased value of this property is due to the influence of sludge disposal in the area. However, their is no chart or available information that shows how this increase in value compares to the normal inflationary rate. If this sludge project is increasing the

value of property in Fulton County then property in Fulton County should have increased much more than the normal inflationary rate. Is this true?

Much has been said about the potentional health hazards of sludge disposal. No positive proof of illness has been attributed to the M.S.D.G.C. project. Positive proof should be emphasized in this statement because of the unscientific methods used. Health records should be examined to determine the frequency, severity, and nature of illnesses of the people living near the M.S.D.G.C. sludge disposal project. Then by comparison to a control group of normally healthy people some conclusions may be made about the effects of this project on human health.

It seems that a major unknown of the M.S.D.G.C. project is the effect of trace elements on biological and botanical life in the area. These mainly are lead, mrecury, cadmium, and arsenic. The Human body has no way of coping with these poisonous elements except to absorb them. When the level of toxitity is reached the body dies. Medical science has not found a way to reverse this absorbtion of these toxic substances or revive a dead body.

M.S.D.G.S. has mentioned the control of these metals by controling the pH factor. This does not eliminate the basic heavy metal element but merely places it in another form. Heavy metals can not be eliminated, they are only ~~disolved~~ disguised by combining with other elements. The only sure way to eliminate the element would be to change the atomic structure of that element

Another danger found in the composition of sludge is the mineral asbestos. This mineral in aerosol form is very irritating to the human respiratory system. So much so that many industrial disabilities and deaths have been attributed to asbestos spraying. Some time ago a mysterious grey substance was found on vehicles parked at the Spoon River College, Which is near the M.S.D.G.C. project. Could this have been residue from asbestos?

Little has been said about radioactivity in sludge from M.S.D.G.C. There seems to be a possibility that radio active material could be found in sludge. This could come from careless disposal from industries or medical facilities using radioactive materials. This could enter the sewer system accidentally. Medical science has not found a cure for maladies caused by radioactivity, as we have seen in Nagasaki and Hiroshima.

The aforementioned toxic substances may be transmitted to humans who are not involved in the immediate project by aerosolisation, water contamination, or consumption of crops raised on contaminated soil. Aerosolisation has been reduced by the reduction of the spray method of application. However as I am sitting here writing this in my own home I occasionally smell the pungent odor of sludge. Many times these odors have been reported to the local health Department. Usually due to the time laps between reporting and actual investigation no odors are confirmed.

Toxic and undesirable substance also can be transmitted by water: both ground and surface. Surface water occasionally recieves run off from M.S.D.G.C. property. I personally have seen many of these violations, such as broken berms which were allowing water to flow into VanWinkle lake near Canton, Il. Also a broken berm, allowing water from field No. 45 to flow into a corn field on a private farm. Could this sludge contaminat d water

pollute this lake and corn?

Ground water is also a possible form of transmission of contaminants, such as heavy metals, bacteria, and fecal coloform. This can be caused by leaching and percolating of water into the ground. Many wells in the area have become contaminated in the past few years. Again due to the lack of controlled data it is not possible to confirm how these wells have become contaminated, however this problem was not evident prior to the introduction of sewage sludge into Fulton County, Il., by the Metropolitan Sanitary District of Greater Chicago. Most of the wells near the project used by private water supply are shallow wells. Monotoring wells used by M.S.D.G.C. are deep wells. By the time contaminants have reached the depth of the monotoring well they would already have contaminated the shallow wells. Once a family's water supply has been contaminated, it is hard to replace it.

These are a few of the potential hazards that could come from the normal spreading of sludge in Fulton County, Il. This is considering the application of the sludge is done in the manner prescribed by the U.S.E.P.A. and I.E.P.A. and the Fulton County Health Department. The following statements are from observations made around the M.S.D.G.C. Prairie Plan, Which show that the guide lines set forth by these control organizations have not been followed.

Pending is to be disallowed or kept to a minimum. This should not happen on fields where the incorperation method has been used. This does happen in many fields on the M.S.D.G.C. property where the injection method is used. This seemd to be an indication that much more than the normal agronomic rate of application is used. This exposing of sludge to the atmosphere increases the chance of aerosolization for potential air contamination and odors. Ponding also offers a place for the habitation of larvae which cause mosquitoes.

If this project is allowed to continue with or without federal funding, it should be more closely monitored. This should be done by agencies other than the Metropolitan Sanitary District of Greater Chicago, and the Local Health Department.

Other methods of disposal should be considered. One of these is the incineration of sludge making use of methane generated by the digestion of raw sewage. Burn off of this gas is a waste of energy that could be used for other types of recycling.

Due to the alleged mis-handling of funds by members of the M.S.D.G.C. employees and trustees it is a question whether the money will be properly applied. This is another reason caution should be used in supplying federal funding to the M.S.D.G.C.

Obviously I am against giving any federal money to such a project as the M.S.D.G.C. Fulton County, Il. operation.

NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS 60201

THE TECHNOLOGICAL INSTITUTE
DEPARTMENT OF CIVIL ENGINEERING

July 12, 1976

Mr. Valdas V. Adamkus
Deputy Regional Administrator
Region V, U.S. Environmental Protection Agency
230 South Dearborn Avenue
Chicago, IL 60604

Re: Comments on Draft Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County, Illinois

Dear Mr. Adamkus:

Improvement of environmental quality through the use of engineering and analysis has been my professional concern for the past twenty years. I am presently professor of civil engineering and coordinator for environmental health engineering at Northwestern University in Evanston, Illinois. The Draft Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County, Illinois, came to my attention recently. The Prairie Plan, the subject of the Draft EIS, was judged to be one of the outstanding civil engineering achievements several years ago by a prominent national organization, the American Society of Civil Engineers. The Prairie Plan potentially represents a significant advance in waste treatment. The restoration of marginal land for agricultural use and the recovery of fertilizer value from human waste are important benefits. Since the project is a very large scale one, it is also important to identify, quantify, and mitigate potentially adverse effects. I'm pleased to learn that the Draft EIS has attempted to do this. However, the technical quality of the EIS is disappointing for a project of this magnitude and potential significance. The careless style used in the Draft EIS does not engender confidence in the EIS.

More seriously, the Draft EIS does not contain sufficient description of the methods and data used for the reader to rationally evaluate many of the conclusions in the EIS. In addition, the EIS contains many technical errors.

The comments I wish to present for your consideration deals with potential odors and adverse effects associated with aerosol transmission.

1. p. VII-11 - The definition of sludge storage time is incorrect. The expression presented is not even dimensionally correct.

2. p. VII - 23 -- The discussion of the odor complaint data is misleading and is not substantiated by information in the EIS. The wind direction shown probably refers a wind direction sector of either 22.5° or 45°. If this variance is shown, one could make a good case that the cattle feed lot is associated with many of the odor complaints.

3. p. VII - 33 -- The legend is incorrect and the pattern does not appear to be consistent with the wind rose pattern in Chapter IV.

4. p. VIII - 4 -- The arithmetic leading to the numbers of the last column is apparently incorrect. The numbers should be 0.3, 6, 2, 0.006, and 0.8.

5. p. VIII - 5 -- Paragraph three does not recognize that toxic effects are different depending on whether material enters the body via the lung or the GI tract.

6. p. VIII - 7 -- Same comment as item 5.

7. p. VIII -10 -- Stability Class B is not the average meteorological condition at the project site.

A factor of 0.01 is missing in the calculations, leading to a 100 fold error on p. 10 and in Tables VIII-5 on page 12.

8. p. VIII -13-- The same 100 fold error discussed in item 7 is propagated here. The conclusion on toxic risks is in need of reconsideration.

9. The consequences of fallout of sludge particles from spraying operations onto soils and other surfaces in the vicinity where people live and play and the consequences of accumulation of this material on surfaces over long periods have not been examined. A recent case of wind borne dispersion of lead dust from slag storage piles of a smelter and the consequent massive lead poisoning of children in the vicinity via the soil is cause for concern.

In summary, I would like to urge a much more careful evaluation of the potential odor problem and its mitigation; and of the consequences of long term accumulation of certain heavy metals in the soils of the surrounding region.

Other potentially adverse environmental effects also deserve careful evaluation. The Draft EIS does a generally good job of describing the existing situation, but is generally careless in its assessment of potential impacts.

The illegibility of many photos and figures and technical inaccuracies detract from the value of the EIS.

Thank you for the opportunity to comment.

Sincerely yours,

J. E. Quon, Ph.D.
Professor of Civil Engineering and
Coordinator for Environmental Health Engineering at
Northwestern University

JEQ/ms

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Telephone (816)

ITEM 020

AUG 1976

753-76

August 5, 1976

Mr. James Masters
Public Health Administrator
Fulton County Health Department
530 South Main Street
Canton, Illinois 61520

Dear Mr. Masters:

MRI has reviewed the environmental impact statement for the MSD Chicago sludge disposal operation in Fulton County and has the following comments: First, [redacted] with the statement in the EIS that the MRI GC technique for analysing odors has not been proven to be capable of pinpointing the source of an odor. The more rigorous interpretation of results obtained with the odor sampling and analysis technique consists of a positive identification of a source as the origin of airborne constituents. The analysis per se does not, of course, identify these constituents as the odorous constituents. The burden of proof of odor rests principally with olfactory sense by complainants with confirmation by the on-site sampling crew, who additionally have the task of characterizing the odor as one which is typical of a suspect source, which can be the MSD operations as well as other potential sources in the area. As you are aware, meteorological conditions must also be judged to be reasonable (site of odor complaint not upwind of suspect source). The overall procedure thus provides for verification of the odor by smell, and positive identification of airborne constituents as to origin. In MRI's view, this procedure provides positive identification of both the existence of odor and its source.

Second, [redacted] to the universal description in the report of the odors as having an "earthy" smell. Such a descriptive term signifies that the odor perhaps should not offend one's sensibilities when, in fact, they do. We should think that a more realistic descriptor might be "sewage sludge odor."

Finally, we have some thoughts regarding statements in the EIS about the likelihood in the statistical sense that an odor complaint can be attributed to the MSD operation. It is indeed true that the data upon which the conclusion (probability of 0.71 that odor comes from MSD) is based do support such a conclusion. By the same token, the battery of samples analyzed in the 1975 season gave results which one can interpret as indicating that all the

complaints were traceable to MSD operations, although some of the samples were unofficial (did not meet requirements for duration of odor), and others contained a limited number of GC peaks that are typical of other sources. All the samples correlated either with MSD or with MSD plus another source, which might be interpreted statistically as signifying that the probability is 1.0. Such a conclusion would undoubtedly be in error for the entire area in question for there are other sources of odor. One would appear to be justified in concluding that a high proportion of the complaints can be attributed to MSD. In this sense, the quoted probability of 0 71 seems to be conservative.

Mr. Bergman is on vacation so I do not have his reaction. He may wish to amplify this statement, particularly with regard to source identification.

Very truly yours,

A. D. McElroy

A. D. McElroy, Head
Treatment and Control Processes Section

ADM:mjw

ITEM #29

647-1134

FULTON COUNTY HEALTH DEPT. — MAYBE WE CAN HELP

502 NORTH MAIN STREET
CANTON, ILLINOIS 61520

August 11, 1976

Mr. George R. Alexander, Jr.
Regional Administrator
U.S.E.P.A.
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Alexander:

The Environmental Health Staff of this Department has reviewed the USEPA Environmental Impact Statement for Sludge Disposal and Land Reclamation in Fulton County, Illinois. The statement emphasizes many of the concerns of the Fulton County Health Department in 1973. (refer to Board of Health and Sewage Sludge Hearings) Subsequently many experts have described Fulton County as the benefactor and the victim. The Fulton County Health Department is very concerned about the disregard of some of the vital data (especially in 1975) that relates to the MSD project and the interrelating of non-corresponding data throughout the Report. Perhaps sharing of information may be a problem, but the review and interpretation of the data is the real stumbling block.

Our review is primarily concerned with the data and documents that have been promulgated by the Health Department subsequent to the implementation of this project.

> Referring to the odor from sludge as an "earthy smell" is not consistent with the people complaining or the trained odor investigator of the Health Department. Certainly it would be more realistic to describe the odor as a "sewage sludge odor"
>
> The report states "In the absence of documented evidence" when discussing odor in the report we suggest you review the attached Health Department Data.
>
> The process described within the report as it relates to the odor identification program of the Fulton County Health Department is misleading and not accurate.

> The Health Department investigates odor complaints directly from a HOTLINE on a seven day a week, twenty-four hour a day basis. From the time the Health Department receives the complaint until the trained odor investigator is at the site ready to sample is about thirty minutes. At that time the trained odor investigator verifies the odor, collects odor sample, and collects meteorological data.
>
> Regarding the finger printing approach, the report states "this approach was proven to be unsatisfactory in correlating odor complaints with any of the individual odor sources sampled". Refer to the attached MRI letter dated August 6, 1976 which voices strong objection to this conclusion. It is imperative to consider very carefully the 1975 Health Department Report and the 1975 MRI Report before concluding the approach was unsatisfactory.
>
> In defining the problem in 1973 it became apparent that control on the quality of sludge was necessary. Standards for Sludge Quality were subsequently adopted by the County. The Health Department samples daily the sludge arriving at the Liverpool Docks. Subsequently laboratory analysis assured that only a good quality of sludge was being shipped to Fulton County. (enclosed are synopsis of these results)

Attached to this letter are item comments to the EIS Report and a letter received from MRI on August 10, 1976. The Health Department has considerable experience in developing a REAL approach to the identification and quantification of sewage sludge quality and odor nuisance. It is imperative that the Fulton County Health Department be a cooperating party for the collection and publicizing of all existing and future information regarding the Fulton County Project.

Sincerely,

James Masters
Public Health Administrator

Enclosures:
- 1974 Final Report by MRI
- 1975 Final Report by MRI
- 1974 Health Dept. Annual Sludge Report
- 1975 Health Dept. Annual Sludge Report
- Odor Complaint Forms for 1975
- 1973 Public Hearing on Sludge
- 1973 Board of Health Minutes
- Synopsis of Events Aug. 1972-March 1973
- Fulton County Board Ordinance
- Fulton County Board of Health Rules and Regulations

Mr. Alexander
Page 3
August 11, 1976

Enclosures cont: 1974-75-76 FCHD Air Samples and Complaints
1974-75-76 FCHD Monthly Reports
1974-75-76 Sludge Quality Sampled at Liverpool by FCHD and analyzed via contract with FCHD
1973-74-75-76 Holding Basin Samples and Analysis by FCHD

B-70

Summary Sheet

ii, 3, a Water

1) [redacted] not available to support statements regarding insufficient capacity of retention basins, causing them to be ineffective in removing suspended solids and causing excess dissolved oxygen depletion in receiving waters.

2) [redacted] of effluents from septic tanks contributing to pollution.

ii, 3, b Soils

1) in the past IEPA permits soil loading rates have been based on nutrients such as nitrogen. This part states soil loading rates will be based upon heavy metals.

ii, 3, c Odors and Noise

Refer to citizens comments at hearing.

I-3 A sludge analysis program is designed to insure adequate treatment of the sludge before shipment to the holding basins.

1) The Fulton County Health Department has sampled daily the sludge arriving at the Liverpool Docks for laboratory analysis to assure only good quality sludge is shipped to Fulton County.

c.e. pp. I-26 "A procedure should be implemented to insure that only good quality sludge is shipped to Fulton County".

I-8 [redacted] that sludge contributes significantly to water pollution from cadmium.

I-15 The [redacted] is requested reflecting actual violations of environmental standards or substandard project design, as well as project conformance, are used to bolster judgements based on fundings from similar sludge experiments elsewhere.

I-15 More recent and valid information is attached for your review.

I-18 Paragraph 2--septic tank effluents contribute to local pollution, [redacted].

I-19 [redacted] Paragraph II---"numerous violations of TSS and BOD standards for retention basin effluents"

I-23 [redacted]--Paragraph III that cadmium enrichment may be the most limiting single factor in sludge loading rates.

II-22 This section does not take into consideration the Fulton County Health Department sampling and test results for sewage sludge---reflects only MSD data as it relates to the Health Department Standards. Attached is a copy of our [redacted].

II-37 The Bibliography [redacted] the Fulton County Board of Health Ordinance and Regulations.

VII-7 Refers to [redacted] talks about applicable standards
(whose)
Standards for alkalinity have been ammended (attached)

[redacted].

I-25, 1, Sludge Quality Paragraph II--

1) Refers to operating permit
   a) ~~Who issued the permit~~?
   b) ~~Is permit attached~~?

2) Refers to violated alkalinity standards
   a) [redacted]?
   b) ~~Who determined they were in violations~~?
   c) [redacted].

I-26 Paragraph II--enclosed ordinance and test results of sludge are submitted for your review. The report should specifically suggest additional procedures that should be implemented.

11-7 Paragraph II--talks about complaints says "may subsequently complain" the data collected by the Fult n County Health Department documents the nature of the problem.

11-11 This ~~data does not reflect the local peoples response~~ to the Board of Health Meetings. This included an official Board of Hearing to hear the aggrieved persons. The permit was not issued by the Board of Health which resulted in sludge not being shipped

[redacted] ~~is not even related to the MR~~I information.
Where did data come from?

VII-32 [redacted] ~~data come from~~? The FCHD gathers meleorlogical data at the time of the odor investigations.

The 0.71 success rate referred to is not identifiable.

VIII-22 Any added retention time increase should be in the Chicago Holding Basins-Reduce amount's, time of holding in Fulton County.

IX Fulton County Health Department has generated considerable experience in developing a real approach to the identification and quantification of sewage sludge quality and odor nuisances.

APPENDIX C

Response to Comments

USEPA has responded to the many comments that were received from the public on our Draft Environmental Impact Statement. The "Item" number preceding the comment refers to the Comments which are found in Appendix B. Many of of the comments have been extremely helpful and have been incorporated in the production of this Final Environmental Impact Statement.

RESPONSE TO ITEM #1

Illinois Wildlife Federation

1. The Will County Study data is contained in the background data presented to the USEPA by MSDGC. Also, the main University of Illinois participants were active in bringing their experience and knowledge to the project. The project was not on strip-mined soils; therefore, the use of their data was only put into the national data base for nutrients and fate of metal cations in the environment.

2. Acknowledge. Remember, however, the Fulton County Board also wanted to control the land, but individuals sold their land very quickly to MSDGC and left Fulton County.

3. Acknowledge

4. The Cook County Forest Preserve System could not logically be used because access can not be controlled and there are insufficient areas of open land for spreading.

5. No Comment

6. This statement is mostly untrue. There are some management problems that MSDGC must learn to control, but overall the data clearly indicates that streams exiting the MSDGC property are of higher quality than the water upstream of the project.

7. This statement may be too simply stated. If the project actually builds soils while producing row crops, the soil would become a natural biological filter, holding pollutants in certain zones until they are naturally degraded. There are no data to indicate the discrete impacts of sludge versus the contaminants from past strip mining. The impacts are described in some detail within the Final EIS.

8. Utilization of the project site could cause increased exposure to heavy metals and sludge contaminants. However, the risk to human health would be relatively small.

9. The concerns expressed would be the normal concerns for any sludge disposal project. The Draft EIS indicated that surface and groundwater contamination were not major problems in the MSDGC project. The air pollution issue has been largely resolved due to modified application techniques. Control of the crops grown on sludge amended soil should significantly reduce any hazard to human health. Our introductory comments to this Final EIS have tried to portray the relative risks and benefits of the project. While no one could accurately state who is receiving the most benefit or the most risk, the project certainly is benefiting the majority of the people involved either through work opportunities, tax base, reclaimed land, disposal opportunity, nutrient recycle, and overall energy. A recent suggestion that could be made to the MSDGC is to use the corn grown on site for gasohol production, thereby even further reducing the risks to human health or agricultural animals.

10. Runoff basins generally do work. There is a management problem associated with operations of the basins. Valves must be correctly operated to obtain the desired benefits. Some operations have recently taken place to rectify the sedimentation problems that have filled in the basin. To date, no records of pump back onto the fields have been produced to analyze this proposed aspect of the project. Again, the water quality of Big Creek is better after exiting the project site than when it first enters the site. There is a self-purification process taking place. There are no impoundments along the stream that could be eutrophied.

11. This statement has no foundation.

12. This statement has no real foundation. Studies from the University of Illinois have been inconclusive as to cause and effect relationship using forage grown on sludge amended soils.

13. We are currently unaware of any data on this topic.

14. Since the Fulton County Board amended the alkalinity and pH standards for sludge in November 1975, there have been no violations of sludge quality. Please refer to text on this item.

Due to the imprecise language of the Draft EIS some of your conclusions could be reached. However, the misconceptions of the Fulton County experience must be overcome. The project began in 1971, so there now is plenty of data to indicate that no major harmful effects have occurred. The lack of any substantiated health-related problems in either fish, human or wildlife resources is a significant piece of information. The MSDGC has used a steering committee throughout the project to obtain input and define goals. To date major positive achievements have been reached with no significant environmental impact. When viewing this project you must realize the goals that both Fulton County and the MSDGC were trying to achieve. Both parties wanted to return land back to its former productivity. Their goals are certainly being attained.

RESPONSE TO ITEM #2

VOLUME I - Thorne

Your comments on Agronomy Fact Sheet SM-29 have been utilized in the Final EIS. There were certain production errors. We also gave credit to the University of Illinois for the materials contained within the fact sheet.

The error on percentage of strip-mined land in Fulton County has been corrected to say 6 percent.

The issue of production of sludge in dry tons by MSDGC has been confusing. The current figure we are using is 1250 dry tons per day for this Final EIS.

RESPONSE TO ITEM #3

Dale Vaughn

The Environmental Protection Agency has not awarded any Federal funds to the MSDGC project to date. There have been some expenditures for health-related impact studies.

A letter was written to Mr. Dale Vaughn shortly after we received his comments asking if he could provide further information to document the death of cows in his pasture. No response was received.

There certainly are mixed reactions to the project by persons living along the perimeter. Some people have never objected, some people have continually objected to odors. There is no positive way to respond to the odor complaints.

RESPONSE TO ITEM #4

Bureau of the Budget and Department of Conservation
State of Illinois

While there has not been much research on fate of heavy metals in the Fulton County environment, no problems have been identified. This Agency would support the suggestion to do further research to determine impacts on fish and wildlife on the project site. Some caution is necessary because it would be difficult to sort out the impacts of ambient metal problems due to strip mining versus sludge application.

The MSDGC has agreed to keeping certain pot hole areas on the property to support water fowl. Also the major surface water resources are being left intact. It is not necessarily the intent of this study to analyze the loss of marsh land through recontouring practices. The joint goal of Fulton County and MSDGC was to return these lands to agricultural productivity. This meant loss of some marsh land while developing a land use plan to conserve the rest of the land. There are no figures available to indicate how much diversity was lost since 1971. Therefore it is difficult to provide a definitive answer to these types of questions. If the project area is expanded, the opportunity to have these questions addressed is certainly possible.

RESPONSE TO ITEM #5

Marvin Schmidt, MD.

This Agency has put together several publications on the relative risks and potential health hazards of sludge application projects on humans. Pertinent information has been incorporated into the Final EIS.

While your suggestion that a controlled study be performed on humans to obtain answers is very good, sludge disposal activities must continue. There are no easy answers in disposal activities. We must evaluate the present alternatives and make wise choices. There is no reason at present to discontinue the project since no adverse impacts have been defined. More research and work in the area may result in a change of attitude. The Willoughby Farm in Australia has been applying sludge to land for 150 years without significant impacts.

RESPONSE TO ITEM #6

USDA

The comments of your Agency have been incorporated into the Final EIS text. They have been extremely helpful. Please note that the text has been extremely modified and therefore pages noted in your text are not the same in the final EIS.

RESPONSE TO ITEM #7

Soil Enrichment Materials

The figures used in the Draft EIS were from national averages available at the time of EIS preparation. Your new data is extremely helpful in updating the existing data. We are happy to include this data in the text. It is hard to obtain good, suitable data because of varying rail conditions and secrecy surrounding contracts.

The 3.5 percent figure was provided by the MSD as their average for earlier shipping. They are installing new dewatering facilities and should be able to ship higher solids in the future.

RESPONSE TO ITEM #8

Ledbetter Letter

The whole section on aerosolization of sludge particles and dispersion calculations has been redone. There were many errors. The latest text has dealt with those errors, but has been reduced substantially because spray application is not the current mode of sludge application. This has been replaced by direct incorporation of sludge.

Your main comments are addressed point by point as follows:

Comment: pp VII-33 and 34...
p I-16 and p VII-35...

The figures in VII-33 and 34 are concentration isopleths normalized to unity and are incorrectly labeled. Also the text on VII-32 indicates that the normalization factor for Fig. VII-14 is 4.75 ppm and for Fig. VII-15 is 0.50 ppm. Since both figures should represent the same source strength Q, the normalization factor should be identical for both figures.

At a quick glance Ledbetter's calculations seem correct. However the error in figure titles suggests a confusion in the meaning of dilution ration and therefore the Ledbetter number may not be what the EIS is attempting to illustrate in the figures.

Since definitions, input numbers, and sample calculations are lacking in the EIS, resolution of the raised questions must come from the EIS's authors.

Comment: pp. VIII-7 to 15—The 1 percent aerosolization....

This comment refers to an error in the calculation of the source emission rate. On page VIII-8 it states that "1 percent of the total sludge sprayed becomes airborne" and the mass is used as the emission rate for the dispersion analysis. On page VIII-10 the source emission rate (Q) is numerically calculated. The calculation however is based on 100 percent of the sprayed sludge becoming the emission rate for the dispersion analysis.

The 1 percent assumption was not utilized in the numeric calculation resulting in an emission rate Q being a factor of 100 too large. The resulting ground level concentrations will likewise be a factor of 100 too large.

This office makes no comment on the validity of the 1 percent assumption nor the interpretation of the health hazards, if any, of the numerical ground level concentrations predicted.

RESPONSE TO ITEM #9

No Comments

RESPONSE TO ITEM #10

MSD Comments:

Due to the nature and extent of the comments from the Metropolitan Sanitary District, major changes in format and information have been instituted in the Final EIS. The basis of the Final EIS is now the 1975 plan with updated figures on land utilization and incorporation methodologies. Because of the extreme changes in text and content, we are not providing detailed answers to the MSD comments. It is hoped that sufficient information transfer has occurred to correct errors contained within the Draft EIS.

RESPONSE TO ITEM #11

Lydia Downs letter

The draft EIS did note that malodorants in sludge have an earthy smell. It is hard to characterize the smell exactly, so that term was chosen. There apparently is a petroleum-like smell also. Most malodorants are contained within the perimeter of the project area now due to modified application techniques. Better incorporation of sludge into soil would reduce dispersion of malodorants even further. The goals of the MSD at the project site should be closely examined.

The influent into the MSD system does contain a wide range of pathogens. Many of the pathogens are either inactivated or killed by the treatment process. Others remain in activated states. Most of the pathogens found in sludge shipped to Fulton County are commonly found in all human beings. The rate and degree of exposure to pathogens would dictate the risk of being infected and subsequently being ill. The greatest risk occurs to the farm operators at the site. However, there is no evidence that the farm operators are any sicker than other local people who live in the Canton area. Again methods of treatment, storage and application over the past few years have decreased the risk that a resident along the farm perimeter would be adversely exposed to pathogens.

The MSD has experienced a wide variety of problems in the early stages of sludge application. In the strip-mined areas, soils were destroyed, parent soil materials and shale were mixed with top soil and subsoils. These mixed soils did not absorb moisture well, thereby creating ponds or dump soils. Wet soils can cause seeds to rot, not germinate. The MSD has learned this lesson and now uses fields on an alternating basis to obtain two goals: nutrients recycle through row cropping and utilizing/disposal of sludge solids. Place land, never strip-mined, was a prime target for early application because no major preparation of soil was needed. However, the greatest amount of land owned and farmed is strip-mined land. The land partially reclaimed by others prior to MSD experiences the same needs as unreclaimed land - a lack of sufficient soil structure and nutrients to support row crops. It makes good sense to upgrade the previously recontoured areas to provide row crops and therefore wider tax base in Fulton County.

The MSD is monitoring groundwater around the site. The results are made available to both the State of Illinois and Fulton County. Two aquifers are found on the site; a shallow aquifer which has been contaminated by the strip-mining activities and a deep aquifer which is used for drinking water supplies. There is no evidence that the MSD project has adversely affected either of these aquifers. There is evidence to show that on-lot systems at We-Ma-Tuk Hills has adversely affected the surface waters in the small ponds.

We have no comment on the Big Bluestem project.

The final EIS has been streamlined and hopefully is more readable. We are unaware that anyone has called the local farmers illiterate.

It would be an overstatement to assume that local Fulton County people may incur a high risk from the consumption of fish and wildlife found on the project site. Most people do not have access to hunting on the property. The fishing at the local recreational area should be approached with extreme care. The site is apparently pleasant enough to attract visitors, even though surrounded by sludge application fields, from many local towns. Fishing is an opportunity at the site and while there is no evidence that fish are tainted from sludge constituents, every fish should be tested prior to consumption. Note that this is not a requirement of this Agency.

RESPONSE TO ITEM #12

Department of Interior

Regarding the State Historic Preservation Officer contact, an initial contact had been made with the office. The project is found in a rural setting that had been almost totally impacted by strip-mining activities. The reclamation of this land will not further adversely impact cultural resources. It will provide additional recreational and work opportunities within the area.

The draft EIS did state that the land within the project area fell into three categories; unreclaimed strip-mined land, partial reclaimed stripmined land and existing farm lands. Each of these categories has potential for wildlife habitat. In the case of unreclaimed land, there were many potholes which provided water fowl cover. Many of these have been left intact due to input at steering committee meetings. On the United Electric property, there exists a scrub forest that provides ample cover for deer. Much of this cover is being preserved. The MSD provided land for fishing and other recreation and this is fully explained in the text. Most box end cut lakes on the site are being preserved. In short, no major fish and wildlife habitat is being lost due to this project. The row crops will provide food for wildlife and proper contouring and soil conservation procedures should enhance the fish habitat in the major streams traversing the area.

The MSD project, although on strip-mined lands, currently is unrelated to the remaining coal beds. This statement can not deal with future, unanticipated unrelated activities.

The corrections in numerical values throughout the EIS have been modified.

We regret the initial errors.

The major portion of the project area is strip-mined land. The tables within the text clearly indicate the undisturbed place lands from stripped land. There is not a lot of good data on ground water movement within the strip-mined soils. It is even difficult to differentiate between the impacts of the coal shale and the sludge constituents at the site. This Agency suggests that the MSD design a better ground water testing program to reliably indicate impacts to ground water and provide further data.

The Draft and Final EIS both contain a map showing recreational sites in relation to the project. The impacts are explained in the text.

RESPONSE TO ITEM #13

Peter Ferro Sr.

There is no application for Federal funds at this time for the MSDGC project.

Insofar as this Agency can determine, standard health and environmental procedures have been adhered to within Fulton County. See Chapter V for full description.

We are in receipt of several petitions from people and they are published as part of this Final EIS. Funding of aspects of the project are at this point uncertain and should not proceed until litigation is final.

This Agency feels that the MSDGC has made significant progress in leveling land and utilizing solids for fertilizer value, while building soils by contributing organic matter to the disturbed soils.

The MSDGC has no plans at this point to abandon the farming practices in Fulton County. Various Federal and local agencies, plus the University of Illinois, are watching this project closely. To date no significant environmental problems have been surfaced, except the air issue.

RESPONSE TO ITEM #14

Clarence Oswald Letter

No Comment

RESPONSE TO ITEM #15

Petitions

No Comments

RESPONSE TO ITEM #16

Citizens' Statements

No Comments

RESPONSE TO ITEM #17

Rachel Schmidt

For answers concerning sludge quality see the appropriate section of the EIS. MSDGC has met all applicable standards set by the Fulton County Health Department.

Thank you for your good research into heavy metals and other compounds. We viewed the material and changed some details in our rewrites.

Spraying of sludge has been stopped by the united efforts of the citizens. This is very positive and should help in the long run by decreasing any risks associated with the practice and also decrease visual blight.

The wildlife in the area could be adversely impacted by the project. There could, on the other hand, be beneficial impacts. No study design has been put together to measure the overall impact on non-game animals:

There is evidence that animals are abundant on the land. They seem to be in almost all areas of the project site. From personal sitings and from collected data, it would appear that there are relatively no external impacts on populations of animals. If disease and abnormal behavior is occurring in the populations, a study should be undertaken. The loss of some habitat has been noted. However, much of the most important habitat has been and will be preserved by the project.

If people examine the record carefully the MSDGC has completed many major tasks that were negotiated by the Fulton County Board. They added to the tax roles, they created employment, both full time and seasonal.

RESPONSE TO ITEM #18

Joanne Alter Statement

Acknowledged

RESPONSE TO ITEM #19

League of Woman Voters' letter

Acknowledged

RESPONSE TO ITEM #20

Melba Ripper
Citizens For a Better Environment

The MSDGC would have to continually expand their land application holdings if they were to apply all sludge to land from all of their plants. Current operations do include several land application areas outside of Fulton County. Some sludge has been shipped to Florida for application. There has been some discussion about expansion of land application at other sites on both strip-mined land and other land. In the recent past, MSDGC worked in cooperation with the U. S. Forest Service in southern Illinois to reclaim land where acid mine drainage was a problem. The exact extent of project needs may be unknown. However, the important issue is to create and operate projects in productive harmony and limit the amount of risk incurred.

Since the time of the draft EIS, MSDGC has made extensive changes to the existing environmental barriers and holding structures. We agree that a better monitoring system should be developed and constantly checked to obtain desired results.

The capacities of retention basins have been redocumented and in many cases resolved. Operational recommendations have been suggested to remedy the project.

Since spraying operations were terminated from the project and more sophisticated application methods employed, odor complaints have decreased. Certainly the new operations and ponding created some odors. It is difficult to determine the exact impacts of normal farm odors such as manure spreading, hog farming and then the land application practices. An attempt was made. This agency recognizes that odors exist, but we are unable to say they are a nuisance.

The information dealing with aerosolization was incorrect in the draft EIS. It has been corrected.

RESPONSE TO ITEM #21

Norbert J. Schommer

The Fulton County site water cycle assumes that precipitation is equal to evaporation. The addition of water (and sludge) is a type of irrigation system that should ultimately help crop production. Some crop results now show that strip-mined land is producing nearly the same crop yields as place land.

RESPONSE TO ITEM #22

Illinois Department of Conservation

We acknowledge that more studies could be done on the MSDGC project, however this is already the most monitored project of its kind in this nation.

Sources of heavy metals and other contaminants in the localized environment include and are not limited to the following sources: the MSDGC project site itself because of past stripmining activities; sludge that was transported to the site by MSDGC; atmospheric fall out from industrial and residential sources; etc. A very sophisticated study design to determine exact quantities of contamination from all sources has not been undertaken. It sould be noted however, that water quality in Big Creek does improve as it flows through the project site. There is some data available on fish flesh analyses, MSDGC should try to upgrade this aspect of their monitoring.

Contained in the 1975 land use plan for the site were several aspects of land management and tradeoffs that would be undertaken to protect resident waterfowl. It was decided by MSDGC in conjunction with the steering committee to protect pothole areas and certain marsh areas to provide adequate habitat. Not all areas were preserved. Lakes and retention basins built into the project augment the existing habitat and provide some mitigation for the losses. MSDGC does provide a stabilized situation which should ensure use by waterfowl for many years in the future. It must be kept in mind that the project did meet many of the County's objectives to return the site back to row crop production and provide an increased tax base. Secondly, the row crop production may become a source of food for waterfowl and other wildlife.

This Agency is not aware of any new data on the potential hazard of direct ingestion of sludge on mammals or birds at this point. The University of Illinois did some preliminary studies on pheasant populations and their ingestion of crops grown on sludge-amended soils. This is referred to in the EIS text.

The EIS text does address the loss of water resources based upon the 1975 land use plan. All efforts were made to protect the best water resource; however not all resources could be protected. The MSDGC actions did provide several new areas such as the supernatant basins which provide habitat for waterfowl. A better discussion is now provided.

At this point several rare plant species were identified. The areas were and are currently protected by MSDGC from farming and construction activities. The MSDGC is also developing new areas for rare and important prairie species under the Big Blue Stem program. Further information is available from the MSDGC.

RESPONSE TO ITEM #23

Illinois Environmental Protection Agency (IEPA)

There is no proposed EPA action at this time. This is addressed in the forward of the final EIS.

The items suggested by the IEPA were used as part of a substantial rewrite on the surface water quality. This is also true concerning the operation of retention basins. We are grateful to IEPA for such in-depth comments.

The ground water section comments are hard to accommodate in certain respects. Since the land has recently been disturbed, in geological terms, patterns of ground water flow are emerging and contamination of ground water could be from a variety of factors which include the MSDGC project. No attempt was made by USEPA to do a detailed analysis of ground water, therefore the general trends presented by MSDGC were used to the extent possible. If the IEPA is requiring this study, they should inform the MSDGC of that fact.

Maps were changed when a better data basis was available. The other IEPA comments are valid. A detailed study should be recommended by IEPA and negotiated with the MSDGC as part of their continuing operational permit.

Comments on air pollution are acknowledged.

The main body of the EIS was rewritten and does incorporate, where possible, IEPA comments. A preliminary final was provided to IEPA for review and comment and hopefully will satisfy all State requirements.

RESPONSE TO ITEM #24

Paul Parish

It is inaccurate to state that Fulton County did not understand the project or the consequences of sludge disposal. Mr. Charles Sandberg of the County had presented an overall position paper which discussed favorable and unfavorable aspects of the project.

As far as toxicity is considered, two points must be made. If the constituents applied to the land are toxic to plants, the plants die and then some caution should be taken in using the land. If one considers toxicity of constituents to humans, it must be pointed out that the MSDGC is not growing crops for human consumption. There are tests being conducted on animals either on the site or being fed with crops grown on the site. To date no negative conclusions have been reached.

The discussion in the final EIS does address and verify the items you discussed in your very interesting presentation of fate of heavy metals and their impacts on organisms. It must be noted that the MSDGC project is the most heavily monitored project in the United States. The results of the project are national discussion items and to date no substantial adverse impacts of sludge application other than odors at the project perimeter have been found.

There have been many beneficial aspects of land application at Fulton County and nation-wide. And these benefits appear to outweigh the potential risks of sludge application.

RESPONSE TO ITEM #25

Barb Luthy

Major strides have been made since the early years of reclamation activities at the Fulton County site. The MSDGC naturally took advantage of the existing nonstrip-mined land to begin implementation of their project. It takes a great deal of time to recontour the strip-mined land and apply sufficient nutrients to grow crops. It is premature to judge the final outcome of the project. New fields have been created since late 1975 and early 1976 that were being readied for crop production. The final EIS states that many fields can not produce row crops annually. But you are correct in stating that initial row crops were grown on undisturbed lands.

The draft and final EIS both addressed the application of sludge on nonstrip-mined land. There are different rates of application for place land. The rates are based upon fertilizer needs and not reclamation rates. To the best of our knowledge much strip-mined land has been recontoured and is being used for application of sludge and crop production. This is evident from existing aerial photographs.

There was a tremendous initial investment in equipment at the site. But since the equipment is related to the transportation and distribution of sludge solids they can not be separate from other reclamation costs such as recontouring, wages and environmental monitoring equipment.

RESPONSE TO ITEM #26

George Spyres Letter

We recognize that there were previous attempts to reclaim the project lands. However, these early projects did not build soils or bring the land back to its former productive level. The MSDGC is now growing row crops, providing construction and farming jobs, and paying county taxes. This is a positive move for the Fulton County area. The draft EIS was clear in pointing out the increased taxes that the MSDGC paid on the land. They are not what undisturbed land values are but do indicate a positive trend.

There has not been a study directed at health impacts in Fulton County. However, the best indication is the lack of evidence that people living near the site or working on the site have not reported any abnormalities or sustained health impacts.

Crops are not grown for human consumption at the site, therefore the risks to human health are considerably reduced.

Radioactive substances are strictly controlled and there is no conceivable way for the substances to reach the waste streams in Chicago and therefore the sludge at the treatment plant.

There were many areas within the site that needed modification and repair due to changing methods of sludge and supernatant application. This is a continuing maintenance practice which deserves better documentation. It is true that runoff from the site could contaminate water. Good maintenance procedures are aimed at minimizing the occurrences and impacts of accidents. It must be noted that not all probable contamination should be attributed to this action. The land was destroyed by strip-mining operations which contaminated many of the existing wells and surface waters in the areas. Also, residential developments in the area are a major source of excessive nutrients and sedimentation in the area. The soils are generally not acceptable for the construction of septic systems and maintenance of such systems should be questioned.

As soils are worked they are more capable of absorbing the nutrients put on the ground. Also many fields have been recontoured to remove depressions which created ponds. However, the MSDGC should further analyze their operations so that they maximize loadings without creating ponding situations. This is described expecially in relation to rainfall events.

The MSDGC had investigated many systems prior to developing the Prairie Plan. In their opinion this project created a great opportunity to bring land back to a level approximating its former use while allowing a major metropolitan area to utilize its waste by-products. The costs of energy are increasing monthly and incineration of sludge does not appear to be a wise use of oil.

RESPONSE TO ITEM #27

Dr. Quon Ph.D
Northwestern University

There was substantial error in the presentation of aerosol transmission at the Fulton County Site. These errors have been corrected and the associated graphics were either corrected or deleted from the final EIS.

The issues of storage time, odor complaints and wind rose configuration have been resolved. New data inputs were used to give correct information.

The EPA does recognize that toxic effects are different depending upon the person and the mode of material entering the body. People may become infected with pathogens and not become physically ill. The human body is also capable of warding off deleterious materials depending upon where they enter the body.

The Stability Class and missing 0.01 factor in calculations have been corrected.

One very positive thought should be considered when reviewing the success or failure of the Fulton County project. The MSDGC has taken land that was essentially unusable and put it back to productive use. If crops are monitored and precautions taken, the relative risks of the project should remain in the acceptable range. We do acknowledge that heavy metals and organics will continue to accumulate in the soils receiving sludge, this is part of risk and good management should ensure that the risk is small, not nonexistant.

RESPONSE TO ITEM #28

Midwest Research

As in the response to the Fulton County Health Department, many of the statements in the draft EIS were unclear or misrepresentations of fact. The major topics of air quality, aerosolization and odors have been completely rewritten.

Midwest Research Institute was correct to point out the technical errors. Please refer to the appropriate sections of the final EIS for revised discussions.

We essentially agree that the probability of some odor arising in the project area was generated by the project. The MSDGC has taken steps to reduce sources of odor on site. Since that time odor complaints have been reduced.

RESPONSE TO ITEM #29

Comments
Fulton County Health Department

The final EIS will address many aspects and correct data calculations throughout the entire document. The more specific comments raised are addressed in summary below.

1. It is really difficult to characterize the odors from sludge due to the nature of the constituents and the psychological impressions. In most cases the term sewage sludge odor has now been applied.

2. This matter of documentation has been corrected after visits to the Health Department offices.

3. The odor identification methodology has been rewritten.

4. Corrections on the finger printing methodology have been made in the final document.

5. This comment is acknowledged and a corrected statement appears in the final document.

The items on the summary sheet served as a basis for a complete rewrite of data as it pertains to the Fulton County Health Department.

Many of the sections in the draft EIS were changed drastically. Please refer to the Table of Contents for the topics. There were many misleading statements in the draft that were clarified.