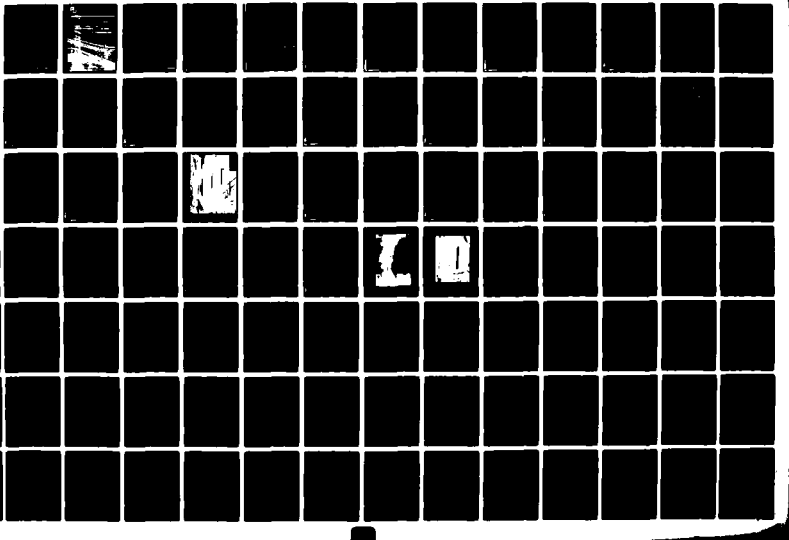
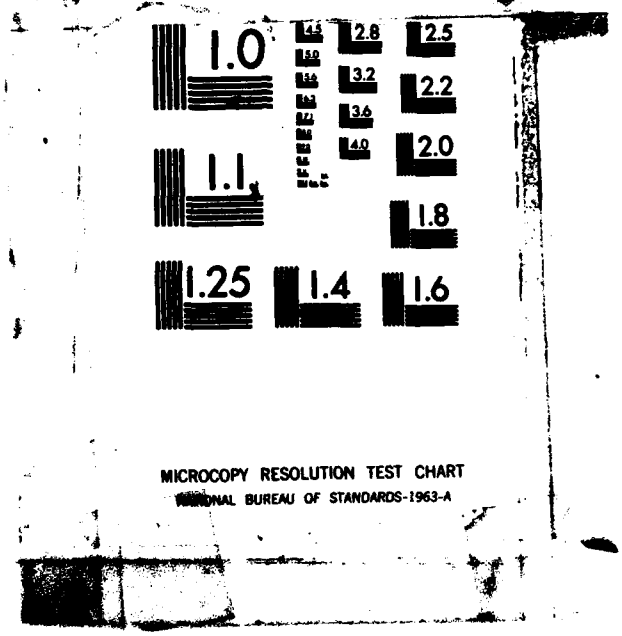
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St. Anthony Falls Locks & Dams
Mississippi River

FEASIBILITY REPORT
ENVIRONMENTAL ASSESSMENT
HYDROPOWER

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

HYDROELECTRIC POWER
MISSISSIPPI RIVER
LOCKS (WATERWAYS)
Minneapolis, Minnesota

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents a more detailed evaluation of the additional hydropower potential at both Upper and Lower St. Anthony Falls than an earlier reconnaissance level report. This study was conducted assuming Federal development of additional hydropower at St. Anthony Falls. Project costs, economic parameters, and other information would be different when assuming development by the present hydropower licensee, Northern States Power Company.

It is concluded that added hydroelectric capacities of 21.0 MW at Upper St.

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Anthony Falls and 5.4 MW at Lower St. Anthony Falls are the optimum amounts that could be added at these two sites. The upper and lower sites would produce additional average annual energy of 65,120 and 18,900 MWh (megawatt-hours), respectively. This added energy developed from these two sites would be equivalent to 143,000 barrels of oil or 39,000 tons of coal per year.

The total investment first cost for the upper and lower sites would be $25,207,000 and $10,320,000, respectively; and the net annual benefits are $1,499,000 and $98,900 respectively. Benefit-cost rations are 1.65 and 1.10, respectively, are are based on a 8 1/8-percent interest rate, a 100-year project life, and October 1983 price levels.

Hydropower is one of the more ecological sound means of producting electricity because it uses a nonpolluting, renewable energy source- falling water- allowing nonrenewable energy sources to be conserved. Significant environmental impacts would not be expected to result from construction of the proposed plants. Many of the impacts normally associated with hydropower development would not occur, since no new impoundment or regulation of the river flow would be required.

The plan includes provision for adequate base flow (determined to be 700 cfs) and rustication of the upper falls horseshoe and main spillway to preserve the aesthetics and mystique of the upper falls.

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FEASIBILITY REPORT
FOR HYDROPOWER

ST. ANTHONY FALLS LOCKS AND DAMS
MISSISSIPPI RIVER
MINNEAPOLIS, MINNESOTA

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FEASIBILITY REPORT
FOR HYDROPOWER
ST. ANTHONY FALLS LOCKS AND DAMS
MINNEAPOLIS, MINNESOTA

SYLLABUS

This report presents a more detailed evaluation of the additional hydropower potential at both Upper and Lower St. Anthony Falls. An earlier evaluation in a reconnaissance level report dated September 1981 showed preliminary feasibility for added hydropower development at both locations. There are existing hydropower plants at each location that are owned and operated by Northern States Power Company. The existing units generate at nameplate capacities of 12.4 MW (megawatts) at Hennepin Island (Upper St. Anthony Falls) and 8.0 MW at Lower Dam (Lower St. Anthony Falls).

This study was conducted assuming Federal development of additional hydropower at St. Anthony Falls. Project cost data, economic parameters, and other information would be different when assuming development by the present hydropower licensee, Northern States Power Company.

This study concludes that added hydroelectric capacities of 21.0 MW at Upper St. Anthony Falls and 5.4 MW at Lower St. Anthony Falls are the optimum amounts that could be added at these two sites. The upper and lower sites would produce additional average annual energy of 65,120 and 18,900 MWh (megawatt-hours), respectively. The added energy developed from these two sites would be equivalent to 143,000 barrels of oil or 39,000 tons of coal per year.

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The total investment first cost for the upper and lower sites would be $25,207,000 and $10,320,000, respectively, for a total of $35,527,000. The net annual benefits for the upper and lower sites are $1,499,000 and $98,900, respectively, for a total of $1,597,900. Benefit-cost ratios are 1.65 and 1.10, respectively, and are based on a 8 1/8-percent interest rate, a 100-year project life, and October 1983 price levels.

Hydropower is one of the more ecologically sound means of producing electricity because it uses a nonpolluting, renewable energy source - falling water - allowing nonrenewable energy sources to be conserved. Significant environmental impacts would not be expected to result from construction of the proposed plants. Many of the impacts normally associated with hydropower development would not occur, since no new impoundment or regulation of the river flow would be required.

The District Engineer recommends development of added hydroelectric power generation at both the Upper and Lower St. Anthony Falls sites in accordance with the plan proposed herein. The plan includes provision for adequate base flow (determined to be 700 cfs) and rustication of the upper falls horseshoe and main spillway to preserve the aesthetics and mystique of the upper falls. The District Engineer further recommends authorization of both sites for Federal construction without prejudice to other non-Federal development of these sites.

PERTINENT DATA

HENNEPIN ISLAND (UPPER LOCK)
ST. ANTHONY FALLS, MINNEAPOLIS, MINNESOTA

Normal upper pool (feet)	Elevation 799.2
Normal minimum tailwater (feet)	Elevation 750.0
Nominal lift (feet)	49.2
USGS gage number	05-2885
Location	Anoka, Minnesota
Gage drainage area (square miles)	19,100
Project drainage area (square miles)	19,680
Project pool area (acres)	354
Maximum flood flow (April 1965) (cfs)	91,000
Average flow (cfs)	7,600
Median flow (50 percent) (cfs)	5,200
Minimum flow (August 1976) (cfs)	529
Concrete spillway, crest length (feet)	425
Spillway crest (feet)	Elevation 785.1
Horseshoe dam crest (feet)	Elevation 796.8
Normal upper pool (with flashboards) (feet)	Elevation 799.2
Tailwater (intermediate pool) (feet)	Elevation 750.0
Top of lock wall (feet)	Elevation 806.0
Flood crest, pool (April 1965) (feet)	Elevation 803.43
Flood crest, tailwater (April 1965) (feet)	Elevation 751.42

PROPOSED HYDROPOWER ADDITIONS

	Existing installation	Alternative 5U	Total site
Site capacity (kW)	12,500	21,000	33,500
Dependable capacity (kW) (July-August)	11,500	8,800	20,300
Plant factor	0.85	0.35	-
Average annual energy (MWh)	87,200	65,120	152,320
Investment first cost ($1,000)	-	25,207	-
Benefit-cost ratio (for addition)	-	1.65	-

UNIT DESIGN PARAMETERS FOR ADDITIONAL UNITS

Number of units	Two
Turbine type	Vertical propeller turbines with fixed blades
Runner diameter	132 inches (3.35 meters)
Synchronous speed	163.64 rpm
Design head (net)	49.0 feet (14.9 meters)
Design flow (total)	6,200 cfs
Generator nameplate capacity (each)	10,500 kW
Horsepower	14,400
Turbine efficiency	0.835
Generator efficiency	0.98

PERTINENT DATA

LOWER LOCK AND DAM, ST. ANTHONY FALLS, MINNEAPOLIS, MINNESOTA

Normal upper pool (feet)	Elevation 750.0
Normal minimum tailwater (feet)	Elevation 725.1
Nominal lift (feet)	24.9
USGS gage number	05-2885
Location	Anoka, Minnesota
Gage drainage area (square miles)	19,100
Project drainage area (square miles)	19,680
Project pool area (acres)	50
Maximum flood flow (April 1965) (cfs)	91,000
Average flow (cfs)	7,600
Median flow (50 percent) (cfs)	5,200
Minimum flow (August 1976) (cfs)	529
Tainter gates (including auxiliary lock)(56 by 20.5 feet)	4
Top of tainter gate upper sill (feet)	Elevation 731.0
Top of apron (feet)	Elevation 710.0
Top of lock wall	Elevation 755.0
Flood crest, pool (April 1965) (feet)	Elevation 751.42
Flood crest, tailwater (April 1965) (feet)	Elevation 739.02

PROPOSED HYDROPOWER ADDITIONS

	Existing installation	Alternative 2L	Total site
Site capacity (kW)	8,000	5,400	13,300
Dependable capacity (kW) (July-August)	6,800	2,300	9,100
Plant factor	0.76	0.40	-
Average annual energy (MWh)	51,000	18,900	69,900
Investment first cost ($1,000)	-	10,320	-
Benefit-cost ratio (for addition)	-	1.10	-

UNIT DESIGN PARAMETERS FOR ADDITIONAL UNITS

Number of units	One
Turbine type	Horizontal bulb Kaplan turbine
Runner diameter	132.0 inches (3.35 meters)
Synchronous speed	116.1 rpm
Design head (net)	22.0 feet (6.7 meters)
Design flow (total)	3,100 cfs
Generator nameplate capacity	5,400 kW
Horsepower	7,400
Turbine efficiency	0.855
Generator efficiency	0.98

(Rev. 3/84)

FEASIBILITY REPORT FOR HYDROPOWER
ST. ANTHONY FALLS LOCKS AND DAMS
MINNEAPOLIS, MINNESOTA

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Technical Report - North Pacific Division

FEASIBILITY REPORT FOR HYDROPOWER
ST. ANTHONY FALLS LOCKS AND DAMS
MISSISSIPPI RIVER AT MINNEAPOLIS, MINNESOTA

STUDY AND REPORT

SCOPE OF THE STUDY

The studies presented in this report represent feasibility level detail. The feasibility study is designed to formulate a viable small hydro project design and implementation strategy and provide the basis for an implementation commitment. Significant legal, institutional, engineering, environmental, marketing, economic, and financial aspects are defined, investigated, and definitively assessed in support of an investment decision. A feasibility study is a decision document that defines and recommends a course of action. The findings of a feasibility investigation should determine whether a commitment to implementation is warranted. If the finding is positive, the feasibility study defines the steps needed to assure implementation.

A positive economic feasibility finding is normally necessary for further implementation to be initiated. However, other concerns can be equally important in serving the broad public interest, and a feasibility study should be performed in the modern spirit of wise natural resource management and multiobjective planning principles.

The study encompasses the locale known as St. Anthony Falls which contains the upper and lower dam areas. The upper dam consists of the Corps of Engineers Upper St. Anthony Falls lock and dam, a horseshoe dam, a limestone and concrete wall (dam), and two utility owned hydropower plants, one of which is operating. The lower dam area contains the Corps of Engineers Lower St. Anthony Falls locks and dam, an intermediate dam, and an existing utility owned hydropower plant. A

site photo in the Existing Conditions section of this report shows the study area.

This study assumes Federal development of additional hydropower at St. Anthony Falls. Project cost data, economic parameters, and other information would be different when assuming development by the present hydropower licensee, Northern States Power Company (NSP). Although the study did not specifically address development by NSP, comparative assumptions are discussed for informational purposes within various sections of this report. A general discussion of development considerations from NSP's perspective is included with their 10 November 1983 letter in the Environmental Assessment, Exhibit section.

STUDY AND AUTHORITY

Recognizing the importance of continued and successful operation of completed projects, Congress provided the Corps with the authority to study possible modifications to existing projects. The study is being done under the authority contained in the House Committee on Public Works resolution, dated 11 December 1969, which requests the Corps of Engineers:

> "...to review the reports of the Chief of Engineers on the Mississippi River between Coon Rapids Dam and the mouth of the Ohio River...with a view toward determining whether any modifications of the existing project should be made at this time in the interest of providing increased flood control, and for allied purposes on the Mississippi River."

Because of the integral nature of the upper and lower dam areas and the physical connection between the Corps and utility owned structures, the entire St. Anthony Falls area was studied in the earlier reconnaissance and current feasibility studies. Hydropower improvements were considered on both Federal and non-Federal lands, recognizing that optimal siting for improvements could be discovered on either or a

combination of Federal and non-Federal property. National economic development would best be met by selection and development of additional hydropower at the most economical site regardless of ownership.

COORDINATION AND STUDY PARTICIPANTS

An intensive public involvement program was not conducted because of the site specific nature of the study and the apparent lack of interest in an earlier 1981 reconnaissance level report which was distributed for public comment in May 1982. Agencies and interests were informed of the initiation of the study and were invited to participate. A copy of an initial notice and pertinent responses to the September 1981 reconnaissance level report are included in the Environmental Assessment, Exhibit section.

Northern States Power Company, owner and operator of existing hydropower facilities at St. Anthony Falls, was a partner in the study. NSP participated by providing data and comments regarding the study and this report. The cooperation and assistance provided by Northern States Power Company are sincerely appreciated.

Other primary participants in the study include the FERC (Federal Energy Regulatory Commission), FWS (Fish and Wildlife Service), and the St. Paul District, Corps of Engineers. Under the Federal Power Act and other legislation, FERC has broad responsibilities related to planning, construction, and operation of water resource projects, particularly in regard to power development. One of those responsibilities is establishment of values for power that might be produced at St. Anthony Falls locks and dams. Correspondence related to power value determination is included in the Environmental Assessment, Exhibit section.

The FWS, under the authority of and in accordance witn the Fish and Wildlife Coordination Act, is the primary agency from which the Corps of Engineers obtains Federal fish and wildlife resource data and planning input. The FWS has prepared a planning aid letter and a Fish and Wildlife Coordination Act Report. They are included in the Environmental Assessment, Exhibit section.

The Department of Energy, Office of Power Marketing Coordination, is responsible for all marketing of Corps-produced power. This office has been officially contacted regarding distribution of any additional power that may be produced at St. Anthony Falls. Coordination will be maintained regarding power marketing.

The St. Paul District, Corps of Engineers, is chiefly responsible for this study and the report. The feasibility report will serve as an authorization document for approval by Congress. The report will be distributed to all interested Federal and State agencies and the public for comment prior to finalization.

STUDIES OF OTHERS

The Upper and Lower St. Anthony Falls sites are not eligible for the loan program for small hydropower feasibility studies under Title IV of the Public Utility Regulatory Policies Act of 1978. The main reason for exclusion is that the site is currently licensed and is being used to generate power (Northern States Power Company). Therefore, no proposals for additional hydropower development are likely to compete with Corps of Engineers and/or Northern States Power Company hydropower expansion plans. The upper and lower sites presently generate with installed capacities of 12.4 and 8.0 MW, respectively.

Northern States Power Company completed a "Report on Hydroelectric Redevelopment Study at Hennepin Island" dated May 1980. That report

showed apparent technical feasibility for a range of 12 to 24 MW at the upper dam area.

The Minneapolis Riverfront Development Coordination Board had a report prepared by an architect-engineer consulting team in July 1981. The report identified the feasibility of rehabilitating the Northern States Power Company Main Street Hydro Station for use as a hydroelectric interpretive center. The proposal would cost $2.9 million and include reactivation of one 600 kW (350 cfs) rope-driven generator unit.

The National Hydropower Study was authorized by Section 167 of the Water Resources Development Act of 1976 (Public Law 94-587). The study provided a general but comprehensive appraisal of the potential for incremental or new hydropower generation at existing dams and other water resource projects, as well as undeveloped sites in the United States. The study was managed by the Institute for Water Resources of the Corps of Engineers. It was completed in 1982 and indicated apparent economic feasibility for additional hydropower at both Upper and Lower St. Anthony Falls.

The St. Paul District completed a reconnaissance level evaluation of the two St. Anthony Falls sites in September 1981. This study determined that incremental capacity of up to 15.0 MW at Hennepin Island (Upper) and 8.4 MW at Lower Dam was economically feasible.

THE REPORT AND STUDY PROCESS

Results of the feasibility study are contained in this report including recommendations for authorization for construction by Congress. The report consists of a main report (including plates showing drawings of the most feasible alternatives) and technical appendix. The St. Paul District completed a reconnaissance level evaluation of the two St. Anthony Falls sites in September 1981. This study determined that

incremental capacity of up to 15.0 MW at Hennepin Island (Upper) and 8.4 MW at Lower Dam was economically feasible.

The feasibility study was started in September 1982. The final feasibility report for hydropower additions at St. Anthony Falls will be completed in 1984 and submitted to Congress. Authorization and funding by Congress are necessary before any recommended actions could be taken for Federal development at St. Anthony Falls.

PROBLEM IDENTIFICATION

NATIONAL OBJECTIVE

The Proposed Principles and Guidelines for Planning Water and Related Land Resources, published in the Federal Register on 22 March 1982, have the following objective:

- o The Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the Nation's environment pursuant to national environment statutes, applicable executive orders, and other planning requirements.

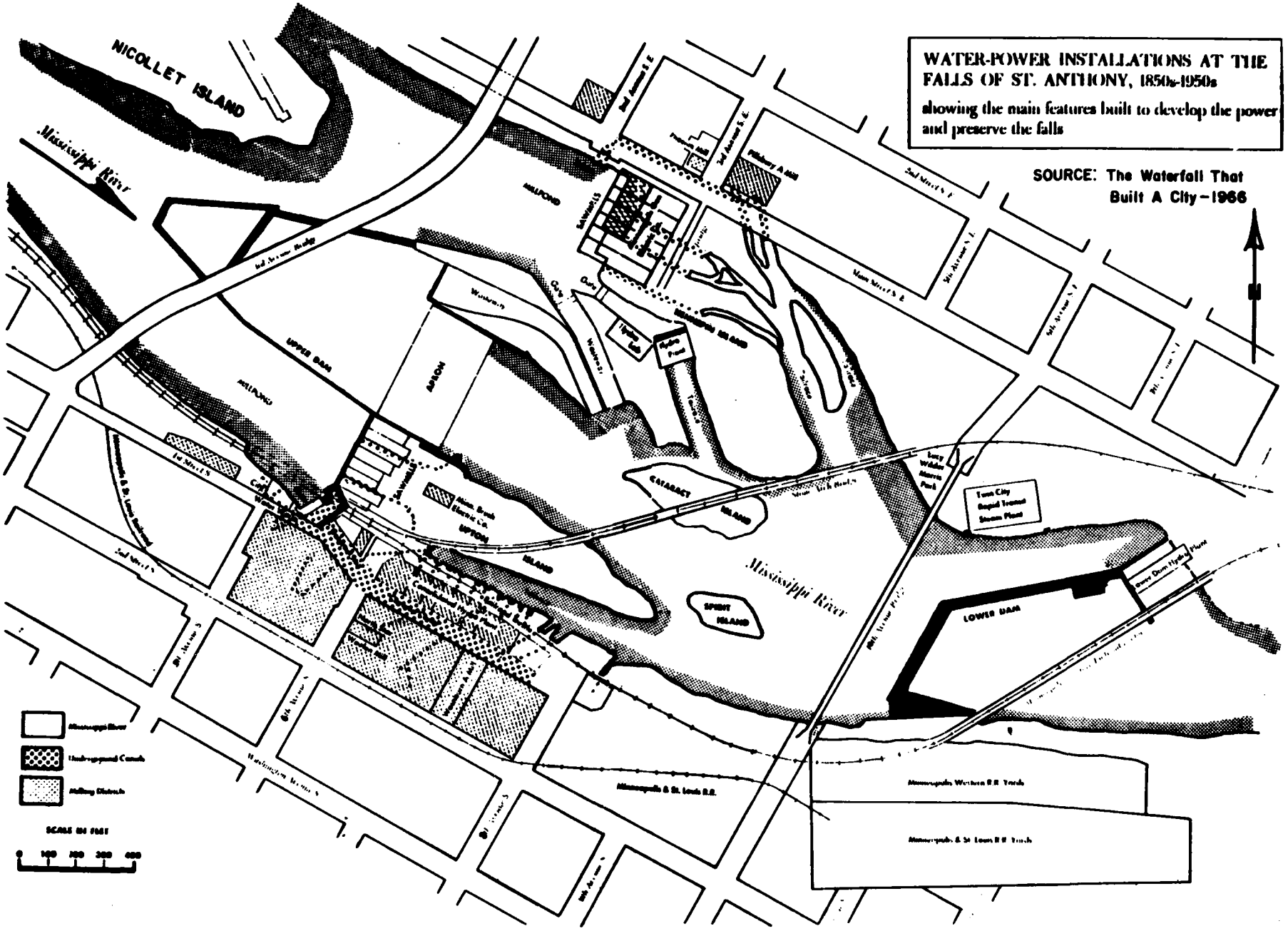
This single objective combines the previously coequal National Economic Development (NED) and Environmental Quality (EQ) objectives of the former Principles and Standards (P&S).

The social well-being and regional development accounts are also considered important. Viable alternatives to solve current and prospective water and related land resource problems will be evaluated and examined in light of the goals of increasing national and regional economic gains, enhancing the quality of the environment, and improving social well-being.

PROJECT HISTORY

The Falls of St. Anthony, originally about a 40-foot cascade, was formed by the jutting edge of a hard layer of limestone which was very limited in thickness, varying from about 10 to 13 feet, overlying a bed of soft sandstone. In prehistoric times, the falls was located near the junction of the Mississippi and Minnesota Rivers, about 8 miles downstream from its present site. Through the years, as sections of the protective limestone layer broke off, the falls gradually receded. If this natural process had continued upstream another 300 yards, the upper end of the limestone shelf would have been reached, and the falls would have disappeared. (The base of the protective limestone rises above the bottom of the river near the lower end of Nicollet Island, exposing the underlying St. Peter sandstone which is easily erodible.)

In 1849 Franklin Steele developed the first dam and millpond at St. Anthony Falls. The dam, built of timber and rock, extended only halfway across the river from the east bank and diverted water and logs to Steele's sawmill. In 1856 a dam was started from the west bank and angled upstream to join the original dam. This project resulted in raising the height of the falls to 48 feet, and the configuration of the resulting upper dam structure gave it the name of Horseshoe Dam. On the west bank, a 945-foot canal drew water from the new millpond to a series of powerhouses, and energy was produced until the mid-1950's. See the following figure.



WATER-POWER INSTALLATIONS AT THE FALLS OF ST. ANTHONY, 1850s-1950s

showing the main features built to develop the power and preserve the falls

SOURCE: The Waterfall That Built A City – 1966

8

An event which occurred in 1869 nearly resulted in disaster for the St. Anthony Falls area. A group of promoters undertook construction of a tunnel from Hennepin Island, below the Horseshoe Dam, to Nicollet Island, above the dam, for the purpose of obtaining water to generate additional power. When the tunnel had nearly reached its upper terminus, the overlying limestone layer collapsed, exposing the soft sandstone beneath. The current rapidly scoured a large opening which, if allowed to increase, would have destroyed all the power installations at the falls. In an effort to plug the break and the tunnel, the Federal Government erected a cofferdam to enclose the damaged area. This temporary solution remained in place until a concrete cutoff wall, extending about 40 feet below the limestone ledge into the sandstone and traversing the entire width of the river near the lip of the falls, was constructed by the Federal Government between 1874 and 1876. The project to save the falls also included two roll dams and protecting works below the Horseshoe Dam. These emergency additions continue to protect St. Anthony Falls.

In 1895 the Main Street station, a combination steam-hydro plant, was erected at the east end of the St. Anthony Dam. This plant supplied nearly all of the electricity for the street lighting system of the city of Minneapolis until 1911 when a fire gutted the station. Rebuilt, the plant is still in use as a substation, and one of its three hydroelectric generators continued to produce electricity until the late 1960's.

The year 1895 also saw construction of the lower dam, half a mile downstream from the falls. Built of large blocks of granite and limestone, the V-shaped dam impounded water for a 7,000 kW (kilowatt) power station which generated the electricity to drive the streetcars of the Twin City Rapid Transit Company. In 1903 that company added another structure, still standing, to the St. Anthony waterfront, the Southeast steam generating plant with its four steam units, each producing 3,500 kW of electricity. In 1908 the Hennepin Island

hydroelectric plant, the last to be built at the falls, was completed. Its foundations were cut into the limestone of the riverbed, and penstocks piped water to four 2,250 kW generators.

Water power at the falls had enabled the city of Minneapolis to become a leader in the flour and lumber industries. However, in the first decades of the 20th century, Minnesota was stripped of its timber, the milling industry was shifting eastward, and the electrically operated streetcars were abandoned for motor buses. In 1923 Northern States Power Company acquired the two companies that were the original developers of much of the industry in the St. Anthony Falls area and assumed responsibility for the dam, the falls, and the hydroelectric generators. At present, NSP still operates the Hennepin Island and Lower Dam plants which are now the only producers of electricity in the St. Anthony Falls area.

The four hydro generating units in the Hennepin Island plant were rebuilt in 1955, and a fifth unit was installed. The total capacity of the revitalized Hennepin Island plant then totaled 12,400 kW as it does today. The various developments in the St. Anthony Falls area prior to the construction of navigation locks and dams are shown on the preceding figure.

The Minneapolis-St. Paul area had always been interested in extending navigation to the St. Anthony Falls area. This was eventually accomplished by means of a "High Dam" located downstream near Fort Snelling, and known locally as the "Ford Dam" of lock and dam 1, completed in 1917. Additional locks and dams were constructed at St. Anthony Falls with the lower lock completed in 1956 and the upper lock completed in 1963.

The St. Anthony Falls lock project work was initiated in 1950 and the upper lock was started in 1959. The lock construction obliterated the Minneapolis Mill Canal, Consolidated Hydro generating stations, and

other installations in the West Bank of the Falls area. In addition, the Washburn "A" mill closed about 2 years after the locks were built, and Spirit Island disappeared with the completion of the project. The present location layout is shown on plate 2.

EXISTING CONDITIONS

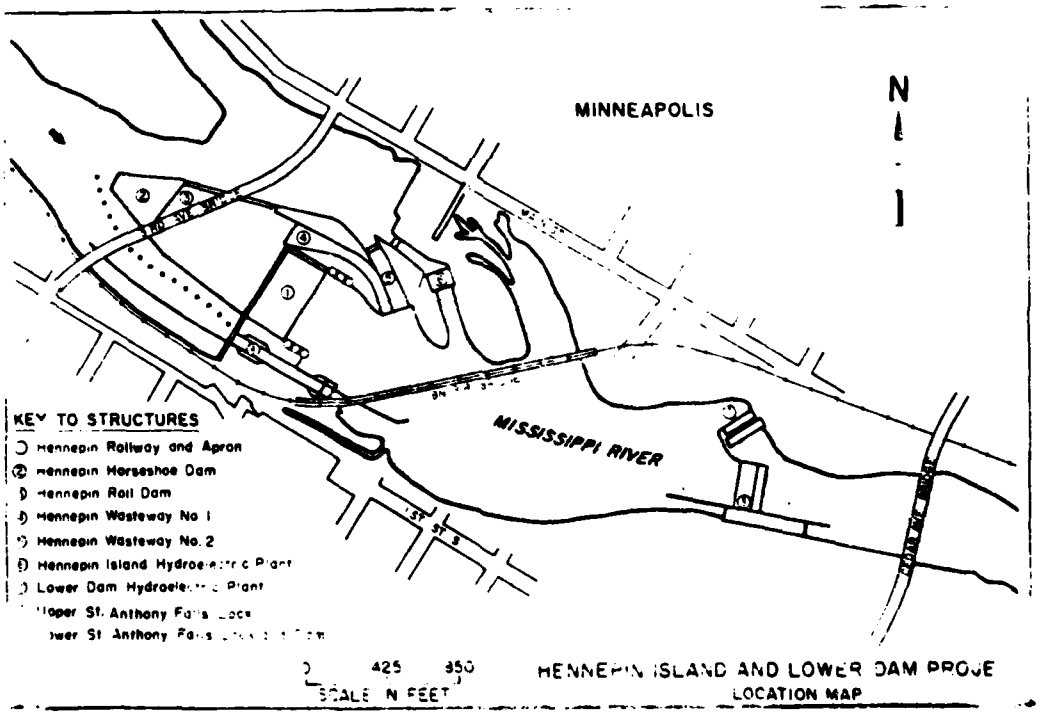
GENERAL

The study area is located in Minneapolis, Minnesota, on the Mississippi River between river miles 853.3 and 854.0 above the mouth of the Ohio River. The area is historically known as St. Anthony Falls. The general location in Minneapolis is shown on plates 1 and 2.

The reach of river under consideration actually comprises two "falls," an upper and lower, which have a combined water surface elevation drop of about 74 feet. The upper falls is held by the Corps of Engineers upper lock; a horseshoe-shaped dam and concrete spillway; a limestone and concrete wall (dam); and two utility owned hydropower plants, one of which is operating. The functioning hydropower facility is known as the Hennepin Island Hydroelectric Plant. Adjacent to it is the Main Street Station built as a combination steam and hydropower facility. This is no longer in operation as a generating facility, but it houses Northern States Power Company offices and maintenance equipment and serves as a distribution substation. Other development in the area includes the University of Minnesota Hydraulic Laboratory on Hennepin Island adjacent to the Hennepin Island Hydroelectric Plant and two nonfunctioning wasteways.

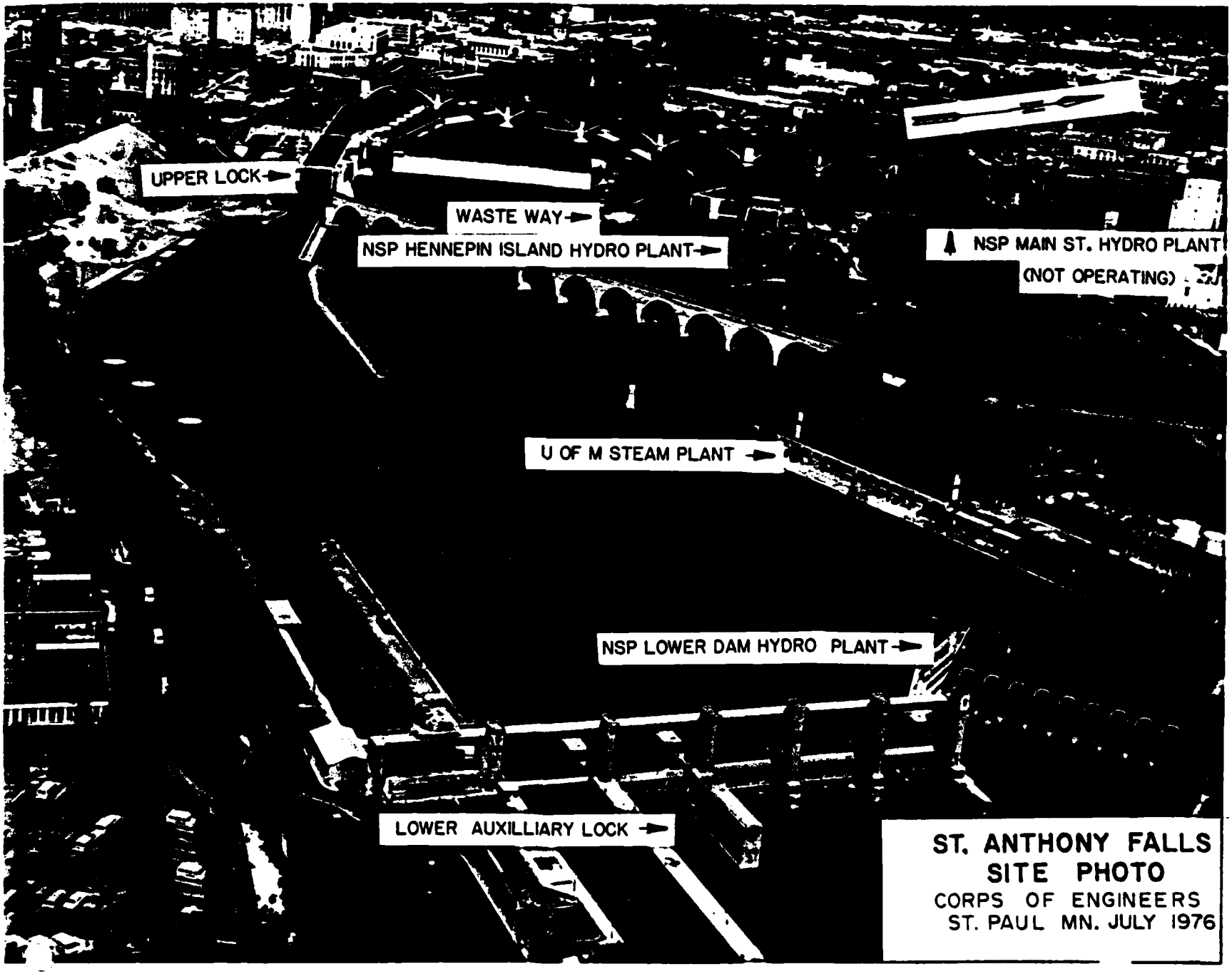
The lower falls area contains the Corps of Engineers lower lock and dam on the right riverbank, an intermediate dam, and the Lower Dam Hydroelectric Plant on the left bank.

The Upper St. Anthony Falls lock was built by the Corps of Engineers in 1963. It is 56 feet wide by 400 feet long and provides a lift of 49 feet, allowing river craft access to the center of Minneapolis industry. The horseshoe dam and hydroelectric plant adjoining the Upper St. Anthony Falls are owned and maintained by Northern States Power Company. These facilities, commonly known as the Hennepin Island hydroelectric project, are described in later report sections. The Hennepin Rollway and Apron (lower roll dam) and Hennepin upper roll dam were constructed from 1872 to 1876 by the Corps of Engineers (see the following figure). The roll dams were emergency works to preserve the falls and prevent them from degenerating into a series of rapids. The two roll dams are presently maintained by Northern States Power Company but a title search is required to establish definite ownership and definite maintenance responsibilities.



HENNEPIN ISLAND AND LOWER DAM PROJECT
LOCATION MAP

The Lower St. Anthony Falls lock and dam was completed in 1956 by the Corps of Engineers. It provides a lift of 25 feet and has the same chamber dimensions as the upper lock. Provisions for future addition of an auxiliary lock were incorporated into project designs. The auxiliary lock bay now serves as a spillway with tainter gate control. The Corps dam consists of a concrete control structure operated by three additional tainter gates. The Lower Dam Hydroelectric Plant is an integral feature with the Corps lock and dam.


UPPER LOCK
WASTE WAY
NSP HENNEPIN ISLAND HYDRO PLANT
NSP MAIN ST. HYDRO PLANT
(NOT OPERATING)
U OF M STEAM PLANT
NSP LOWER DAM HYDRO PLANT
LOWER AUXILLIARY LOCK
ST. ANTHONY FALLS
SITE PHOTO
CORPS OF ENGINEERS
ST. PAUL MN. JULY 1976

Northern States Power Company is the existing hydropower licensee at botn the upper and lower sites. Northern States Power Company provides the electrical service to the Corps lock systems without charge, up to a certain maximum demand, at botn the upper and lower falls sites. The without charge limits are:

Upper St. Anthony Falls	
Maximum demand	300 kW
Maximum consumption	550,000 kWh

Lower St. Anthony Falls	
Maximum demand	375 kW
Maximum consumption	550,000 kWh

Electrical service above these maximums is provided to the Corps under rates specified in Contract No. DACW37-70-C-0031.

Both the existing upper (Hennepin Island) and lower dam hydroelectric developments are described in the following sections.

HENNEPIN ISLAND AND LOWER DAM DEVELOPMENTS (PROJECT NO. 2056)

These hydroelectric developments are owned and operated by the Northern States Power Company and are located on the Mississippi River in Minneapolis. Both developments are licensed by the Federal Energy Regulatory Commission as Project 2056. The license expires 31 December 2000.

Hennepin Island

The Hennepin Island development utilizes 49 feet of riverfall. The main features of the licensed project are a powerhouse and horseshoe-shaped ungated spillway. Also, part of the licensed development is an

arrangement of miscellaneous energy dissipaters, wasteways, gate structures, and waterways.

The ungated horseshoe-shaped gravity spillway is founded on limestone ledge rock at the head of the falls. It comprises various combinations of concrete, rubble masonry, and rock-filled timber crib construction. The original dam at this site was constructed in 1857. However, the dam has since been reconstructed with some sections of the existing dam dating back to 1870, while some sections have been recently reconstructed.

The Hennepin Island Hydro Plant, originally completed in 1908, consists of a 300-foot-long intake canal with head gates and a bridge, an operating hydro plant, and a 250-foot-long discharge canal. A trash sluice on the east side and a log sluice on the west side are located at the plant. Wasteways Nos. 1 and 2 have been permanently plugged by earth and concrete dams, respectively.

The powerhouse contains five turbine and generator units for a total of 12,400 kW (kilowatt) site capacity. The average annual hydroelectric generation of the plant is about 87.3 million kWh (kilowatt-hours).(1) The four horizontal turbines were rebuilt by installing new runners, shafts, motor-operated gate mechanisms, and draft-tube vents in 1955. Each of these rebuilt turbines is rated 3,200 hp (horsepower), 240 rpm (revolutions per minute), and 48-foot head. Unit No. 5, installed in 1955, is a vertical turbine of the Kaplan adjustable blade type rated 3,500 hp, 277 rpm, and 48-foot head, mounted in a concrete flume and provided with a governor, steel-plated draft tube liner, wheel-pit drain, and draft tube vent. A 13-foot diameter steel penstock conveys water to the unit, with flow controlled by a timber slide gate and wicket gates.

(1) Calculated with USGS flow records and verified by NSP energy production records.

The rebuilt horizontal turbines are directly connected to 60-cycle, 2,750 kVa (kilovolt-ampere), 0.9 power factor, 240 rpm, 13.8 kV (kilovolt), 3-phase horizontal generators, with belt-driven exciters. The vertical turbine is directly connected to a 60-cycle, 3,125 kVa, 0.8 power factor, 277 rpm, 13.8 kV, 3-phase vertical generator with a direct connected exciter.

Although the development is considered a run-of-river plant, the Hennepin Island plant may draw its pool down 1 foot for operational purposes, which would also increase the flow immediately downstream at the Lower Dam Hydroelectric Plant during the operating period. However, drawdown can, at times, result in upstream navigation problems. Streamflow at the project is affected by the six Federal headwaters reservoirs and the various upstream lakes and recreation reservoirs, but these reservoirs and lakes are not and cannot be regulated specifically for nydropower production.

Normal controlled pool elevation at Hennepin Island is 799.2 feet msl (mean sea level), 1912 adjustment. However, for the past several years, Northern States Power Company has maintained the pool level at an elevation 1 foot lower to preclude losing flash boards at that level because of weak spots in the horseshoe dam. Loss of flash boards means loss of pool and power for a minimum of 3 days up to a period of 9 months at a time, depending on river flow conditions.

The Hennepin Island pool has a surface area of 354 acres. The pool experiences occasional periods of poor water quality from occasional combined storm and sanitary sewer overflows. There are no recreation facilities associated with the licensed project.

The Corps of Engineers Upper St. Anthony Falls lock is constructed integrally with the south end of the ungated horseshoe spillway section. The lock is not part of the licensed project.

Lower Dam

The lower dam hydroelectric development is about one-half mile downstream from the Hennepin Island development and includes a powerhouse and its appurtenances. The original development at this site was constructed in 1895-97. It consisted of a masonry dam and a powerhouse containing eight 35-cycle alternating and two direct current generating units that utilized a head of 19 feet and were used exclusively for railway purposes. Shortly before the license for the project was issued in September 1951, the Corps of Engineers served notice that the dam would have to be removed to provide for the authorized new lock and dam which would develop an additional 5 feet of head at the site. Therefore, the licensee decided to reconstruct the plant to benefit from the increased head.

In 1952, the forebay of the old powerhouse was modified to accommodate the present 10 vertical fixed-blade turbines coupled to outdoor-type 60-cycle generators, each rated at 800 kW. The superstructure of the old plant now houses the electrical gallery and operator's office. The average annual hydroelectric generation of this run-of-river plant is about 51.3 million kWh. The lower dam plant may draw its pool down 0.4 foot for operational purposes, but is operated as a run-of-river plant with only a minimum amount of daily storage. Its operation does not significantly affect the operation of any downstream facilities. Streamflow at the project, however, is partly regulated by the six Federal headwaters reservoirs, the various upstream lakes and recreation reservoirs, and the small drawdown from the Hennepin Island hydroelectric plant located immediately upstream.

STRUCTURAL INTEGRITY AND FUTURE CONSIDERATIONS

The stability and structural integrity of both the upper lock and the lower lock and dam are considered excellent. Little is known, however, concerning the structural stability and integrity of the Hennepin

Island plant and the Lower Dam plant. Detailed design studies would require a detailed analysis of those facilities. Plates 10 and 11 show foundation conditions at the sites.

A dangerous vortex condition exists at the lower lock intakes. Siting of a future hydropower addition adjacent to the lock could aggravate or perhaps relieve the condition. A physical model study may be necessary should an addition appear most feasible in an area at which the hydropower flows would likely influence the vortex.

HYDROLOGIC POWER EVALUATION

The flow available for hydropower at St. Anthony Falls is estimated from 49 years of data from the gage at Anoka, Minnesota (USGS 05-2885). The gage is at river mile 864.8 from the mouth of the Ohio River and is 11.8 miles upstream of St. Anthony Falls. The total drainage area upstream of the project is 19,680 square miles, which is 3.1 percent greater than the area upstream of the gage. There are no major tributaries between the gage and St. Anthony Falls. The project at St. Anthony Falls consists of two sites. One is St. Anthony Falls, also called Upper Dam, which is the site of the Hennepin Island plant of Northern States Power Company. The other site is Lower Dam, where Northern States also has a hydropower site.

The average monthly flows at Anoka are shown in the table below.

Average monthly flows, Mississippi River at Anoka

Month	Flow (cfs)	Month	Flow (cfs)
January	3,800	July	7,900
February	3,700	August	5,700
March	6,400	September	5,200
April	17,100	October	5,400
May	14,500	November	5,500
June	11,200	December	4,200

Annual average flow - 7,600 Median flow - 5,200

The production of power from the force of falling water follows from basic principles of physics. Work (energy) can be expressed as a force moving through a distance:

$$E = \text{Force} \times \text{Distance} \quad \text{(lb-ft)}$$

In the case of hydropower production, the force is the weight of the water, and the distance is the vertical fall, or "head," which is the difference between pool and tailwater elevations.

$$E = F \times D = (\text{unit weight of water}) \times (\text{volume of water}) \times (\text{net head})$$

$$E = \gamma_w \cdot (V) \cdot (H) = 62.4 \cdot (V) \cdot (H) \quad \text{(lb-ft)} \qquad (1)$$

Power is the rate at which the energy is produced. If the head is presumed constant over a short interval, then the power available is:

$$P_a = \frac{dE}{dt} = 62.4 \times \frac{dV}{dt} \times H = 62.4 \cdot Q \cdot H \quad \frac{\text{ft-lb}}{\text{sec}} \qquad (2)$$

where Q represents the flow in cfs.

Expressed as horsepower: (1 HP = 550 ft-lb/sec)

$$P_a = \frac{62.4}{550} \times Q \times H = \frac{(Q)(H)}{8.81} \quad \text{(HP)} \qquad (3)$$

or as kilowatts: (1 HP = .746 kW)

$$P_a = \frac{Q \times H}{8.81} \times .746 = \frac{(Q)(H)}{11.82} \quad \text{(kW)} \qquad (4)$$

To take into account the efficiency of the machine, a factor "e" is added to the equation for each "transfer point" in the process:

e_t = turbine efficiency
e_m = speed increaser efficiency
e_g = generator efficiency

$e = e_t \times e_m \times e_g$
and the net power is $P_{net} = \frac{Q \cdot H \cdot e}{11.82}$ (5)

For preliminary calculations involving modern machinery, an average overall efficiency of about 0.86 is often used. Then:

$$P = \frac{(Q)(H)(0.86)}{11.82} = \frac{(Q)(H)}{13.7} \quad \text{(kW)} \qquad (6)$$

Power is the rate of production of energy, so the total energy produced in a given period is found by multiplying the average power during the period, in kilowatts, by the length of the period in hours.

E = Power (kW) x time (hours) = Kilowatt-hours (kWh) (7)

Sometimes energy is expressed as megawatt-hours (MWh) or gigawatt-hours (GWh):

1 MWh = 1,000 kWh
1 GWh = 1,000,000 kWh

Since the flows at a given site are usually quite variable, it would be useful to store excess volumes for use during lower flow periods. The St. Paul District's navigation dams have only minimal storage (pondage) available. For several reasons, including navigation, wildlife habitat, recreation, and business interests, pool fluctuations are kept

to a minimum. Without pool fluctuations, the useful storage is negligible. The pool above the upper dam has only enough storage for about 1 hour of plant operation. The intermediate pool has negligible storage and is very sensitive to changes in streamflow, gate settings, and power plant operations. Considerable coordination is required between the power plant and the lock and dam to utilize flows most efficiently.

ENVIRONMENTAL SETTING

The following section describes the environmental setting in the study area. A more complete description can be found in the environmental assessment at the end of this report.

Terrestrial Resources

Man has significantly affected the area around St. Anthony Falls since the early 19th century, and alterations of the aquatic and terrestrial resources have occurred since then. Today, the St. Anthony Falls area is surrounded by urban developments including commercial and light industrial buildings, railroads, and highways. Very little terrestrial habitat remains in a natural state. Vegetation is confined primarily to landscaping and parks and along wooded bluffs. Small mammals and birds may be found in these areas. Waterfowl occasionally use areas of the upper pool outside of the main channel.

Aquatic Resources

The development of the area around St. Anthony Falls for urban and industrial purposes resulted in lock and dam construction, changes in pool levels and flows, dredging, barge traffic, and combined sewer overflows. Because of these developments, habitat for aquatic life has been reduced. The oxygenation of water by dams and recent efforts to improve water quality somewhat offset these habitat losses.

St. Anthony Falls has always presented a barrier to the dispersal of fish species. Therefore, the fish community is less diverse above the falls. The installation of locks has made upstream movement possible but only to the Coon Rapids Dam about 9 miles upstream. Fish populations are limited in the pools because of the lack of shallow water habitat, the pools' small size, and occasional periods of poor water quality. Fishing is popular in the area, however, due to the proximity of the urban area.

Water quality is now considered generally good through the area. Aeration provided by the dams helps maintain quality. Short-term declines occur during periods of high runoff when storm and sanitary sewers are combined and overflow into the river when their capacity is exceeded.

Recreation

For clarity, the recreational setting is divided into two descriptions -- existing recreational uses and potential/probable future recreational uses.

Existing recreational uses occurring within the study area fit into four general categories: sightseeing (interpretive visits), walking for pleasure, bank fishing, and recreational boating. Open space and public use areas currently exist along both banks of the riverfront. There is open space along the east bank on Nicollet Island, adjacent to the Main Street Bridge, and Father Hennepin Bluffs Park is located between the upper and lower falls. These open spaces provide passive recreational opportunities. The most prominent existing public use area is located on the west bank adjacent to the Upper St. Anthony Falls Lock and Dam. This facility is known as the Morgan J. Tschida Visitor Center. The visitor center offers interpretation of the lock operation and provides history of the Mills District Area, as well as facilitating an excellent vantage point for viewing the upper falls

area. Recreational boating and fishing occur in this segment of the river but are not intensive due to access limitations, water surface constraints, boating safety hazards, and marginal water quality and fisheries.

Potential and probable future recreational uses of the study area are great. This is due to the proximity of the study area to a large population (market) and the quality location and configuration of public/open spaces near the riverfront. The fact that the study area is located in a historic district, is adjacent to a large falls, and is located along the Great River Road system also provides significant potentials for future interpretation and a multi-dimensional recreational experience.

The most probable future recreation developments for the study area are difficult to identify. Many ideas for improving public accessibility to the falls area and the river have been proposed. These include plans for a kayak course between the upper and lower falls and an aerial tram linking the east and west banks. The Minneapolis Park and Recreation Board is beginning the design phase for extending the West River Road along the river through the falls area. A focal point of this parkway is Upper St. Anthony Falls. Overlooks are being planned along the route to take advantage of views of Upper St. Anthony Falls. A large park development is also being proposed between the Corps lock structures which would offer opportunities for interpretation of the mill ruins in the area, public access to the waterfront, and views of the falls. The Stone Arch Bridge has recently been turned over to the city by Burlington Northern Railroad. Future development plans call for the bridge to be a link across the river. The mode of movement, either walking, bicycling, or trolley, has yet to be decided. The future would likely include continued development of a recreational roadway with adjoining park areas along the west bank. The Corps has plans to upgrade and expand its existing visitor center. However, expansion is unlikely in the near future due to budgeting constraints.

Cultural Resources

Native Americans began inhabiting this vicinity between 10,000 and 12,000 years ago. Historic use of the land in and around St. Anthony Falls has probably led to the destruction of most of the prehistoric sites along this portion of the Mississippi River. Historic sites, however, abound. The upper falls area is situated in the St. Anthony Falls Historic District, which is on the National Register of Historic Places (see plate 1). The lower hydro station, two city blocks outside of the St. Anthony Falls Historic District, is considered by the Minnesota State Historic Preservation Officer to be eligible for inclusion in the district on the basis of its architectural and historic attributes. The St. Paul District has submitted a Determination of Eligibility for this structure to the National Register of Historic Places. As of November 1, 1983, no additional properties listed on or determined to be eligible for the National Register will be impacted by the proposed hydropower development.

Social Resources

The study area is located within the city of Minneapolis and Hennepin County which are part of the Minneapolis-St. Paul Standard Metropolitan Statistical Area. The population of the Minnesota portion of the metropolitan area in 1980 was estimated at 2,070,271, which represents a 7.2-percent increase from the 1970 estimate. However, the populations of Hennepin County and the city of Minneapolis have declined. The population of Hennepin County was estimated to be 960,080 in 1970 and 941,411 in 1980, representing a 2-percent decrease. It was estimated that during the 1960's the city of Minneapolis lost 10 percent of its population. During the 1970's the trend continued and population decreased by 14 percent, from 434,400 in 1970 to 340,951 in 1980.

In 1979, the mean family income in Minneapolis was $22,509 and approximately 9 percent of the families had incomes below the poverty level. Thirty-eight percent of the Minneapolis work force is employed in the service industry and 18 and 17 percent are employed in manufacturing and retail trade, respectively. These industries are also the major employers in Hennepin County and the greater Minneapolis-St. Paul metropolitan area. It is expected that they will continue to be major sources of employment for metropolitan residents in the future.

Existing land use in the study area has been thoroughly documented by the city of Minneapolis. Design guidelines for future development have been prepared by the City Planning Department and were adopted by the city council in December 1981. Developers, landowners, and the city are currently collaborating on several development projects in the study area. The goal of these developments is to reorient the city of Minneapolis to the river. The projects involve renovating old and historic buildings and developing condominiums and apartment units, office space, hotel rooms, and retail space. The Minneapolis Community Development Agency has estimated that the developments, if realized, could amount to an expenditure of approximately $800 million in future development. The locations and names of the developments are shown on plate 2, and comments of the individual developers are included in the Environmental Assessment, Exhibit section.

Examples of existing and planned developments in the project area include Riverplace, the Mills District Plan, the Great River Road, and the Central Mississippi Riverfront Regional Park. The Mills District Plan alone includes the development of: (a) 1,400 condominium and apartment units, (b) 720,000 square feet of office space, (c) 200 hotel rooms, and (d) 275,000 square feet of retail and restaurant space. It is expected that the project will provide: (a) $250 million in private investment, (b) 4,000 construction jobs, and (c) 5,000 permanent jobs (Mills District Plan, January 1983).

The Department of Transportation has proposed that the Great River Road parallel the west bank of the Mississippi River in the Upper and Lower St. Anthony Falls area. The Great River Road is a scenic, recreational, and historic roadway along the Mississippi River from the Gulf of Mexico to Lake Itasca in Minnesota. The location of the proposed Great River route is shown on plate 2.

The Minneapolis Park Board is planning a Central Mississippi Riverfront Regional Park in conjunction with the proposed Great River Road on the west bank of the Mississippi River in the St. Anthony Falls area. The regional park would include 150 acres of land paralleling the Mississippi River between Plymouth Avenue on the north and Interstate 35W on the south. (Plymouth Avenue crosses the Mississippi River north and upstream of Nicollet Island, outside of the proposed hydro project area.) About 44 acres of private land would be acquired in combination with publicly owned lands to develop a continuous riverfront park along the St. Anthony Falls west bank area.

Aesthetic/Visual Resources

The considerable flow during the summer months and the significant vertical drop which are characteristic of the upper falls site create an impressive visual and sensual resource. There is no similar feature at the old lower falls site, approximately one-half mile downstream. The lower falls now consists of a navigation lock, gated structure, and powerhouse.

Under existing conditions, the upper falls (spillways) has water flowing over it approximately 60 percent of the time. In an average year, this flow over the falls occurs during the summer recreation season (i.e., the flow over the falls "dries up" in the winter months). In truth, the magnitude of flows over the falls varies greatly on a yearly, monthly, and even daily basis. Generally, when there are dry years, the falls are dry during summer, fall, and winter, and water

flows over the spillways only during the wet spring months. Even so, on the basis of statistical data, present average flows observable over the falls can be described as ranging from 1,400 cfs to 11,800 cfs.

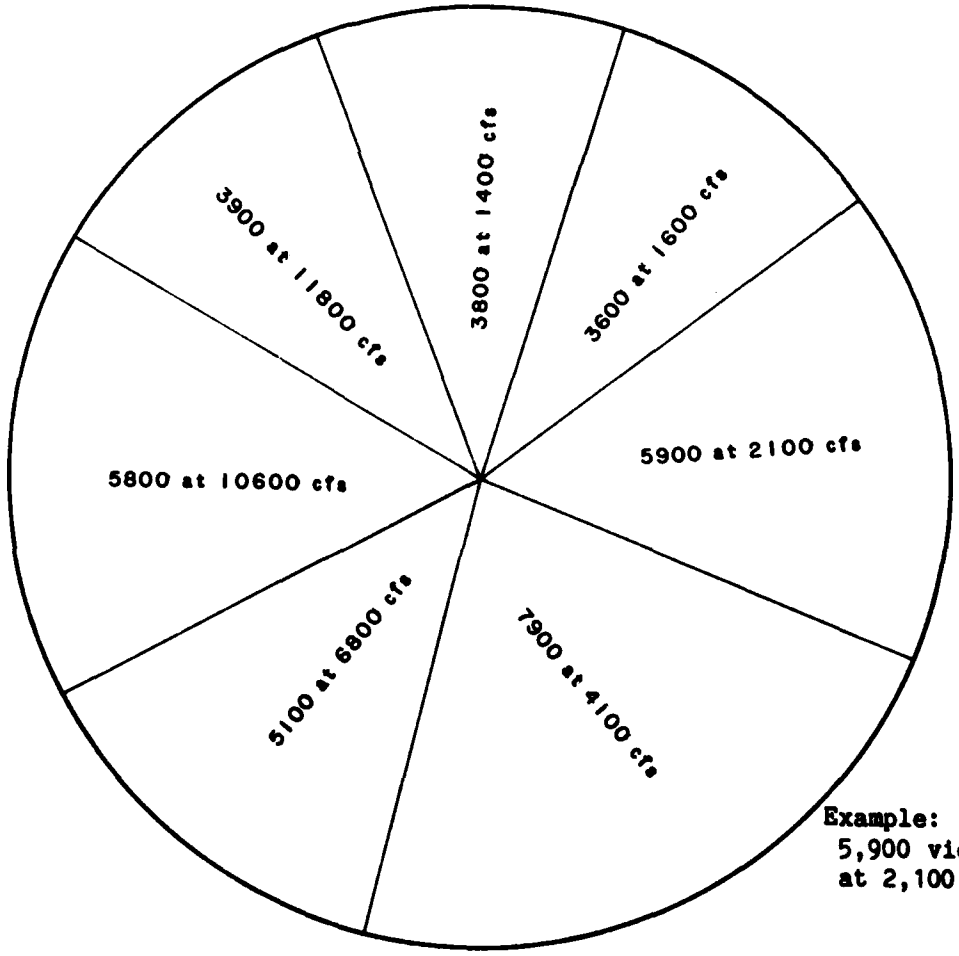
The Upper St. Anthony Falls consists of several structures including a navigation lock, overflow spillways, and two powerhouses (only one is functional). A horseshoe and lower concrete roll dam (spillway) are the principal aesthetic overflow spillways. These structures are not natural features. The natural stone falls seriously deteriorated and had to be stabilized with these existing structures in recent history. Even though the new structures are not natural, viewers of the current upper falls feel strongly that water flowing over these features is aesthetically very appealing and an important historical feature that gives the study area identity and interest.

Currently, there are a limited number of good vantage points from which to view the upper falls location. The best and currently most heavily used is the platform of the Morgan J. Tschida Visitor Center. From the platform, approximately 36,000 visitors annually view the falls. Because this is the prime existing vantage point, further elaboration of views for this platform is described in the following table and chart.

St. Anthony Falls - Data Analysis
Existing Conditions (Without Project)

Average Year Flows	Apr	May	June	July	Aug	Sep	Oct	Nov
Anoka, Minnesota, gage (actual flow in cfs)	15,600	14,400	10,600	7,900	5,900	5,200	5,400	5,400
Flows over spillway (Anoka minus existing hydro)	11,800	10,600	6,800	4,100	2,100	1,400	1,600	1,600
Visitation at St. Anthony Falls (36,000 persons total)	3,900 (11%)	5,800 (16%)	5,100 (14%)	7,900 (22%)	5,900 (16%)	3,800 (11%)	2,600 (7%)	1,000 (3%)

Annual visitors viewing St. Anthony Falls from Corps Visitor Center under existing condition



Example:
5,900 viewers
at 2,100 cfs.

The magnitude of average flows over the upper falls during a portion of the summer season approaches and exceeds 7,000 cfs. At flow rates of this magnitude, visitors observe a "roar" of churning whitewater that can be heard some distance away. This multi-sensual effect, which often includes a misting of water in the air, leaves observers with an impressive sense of the power of nature and is aesthetically noteworthy.

There are other lesser vantage points to view all or portions of the upper falls. Included are the end of Nicollet Island, open space along tne east bank (only horseshoe falls can be seen), tne Fuji-Ya Restaurant (only horsesnoe falls can be seen), and the Third Avenue Bridge.

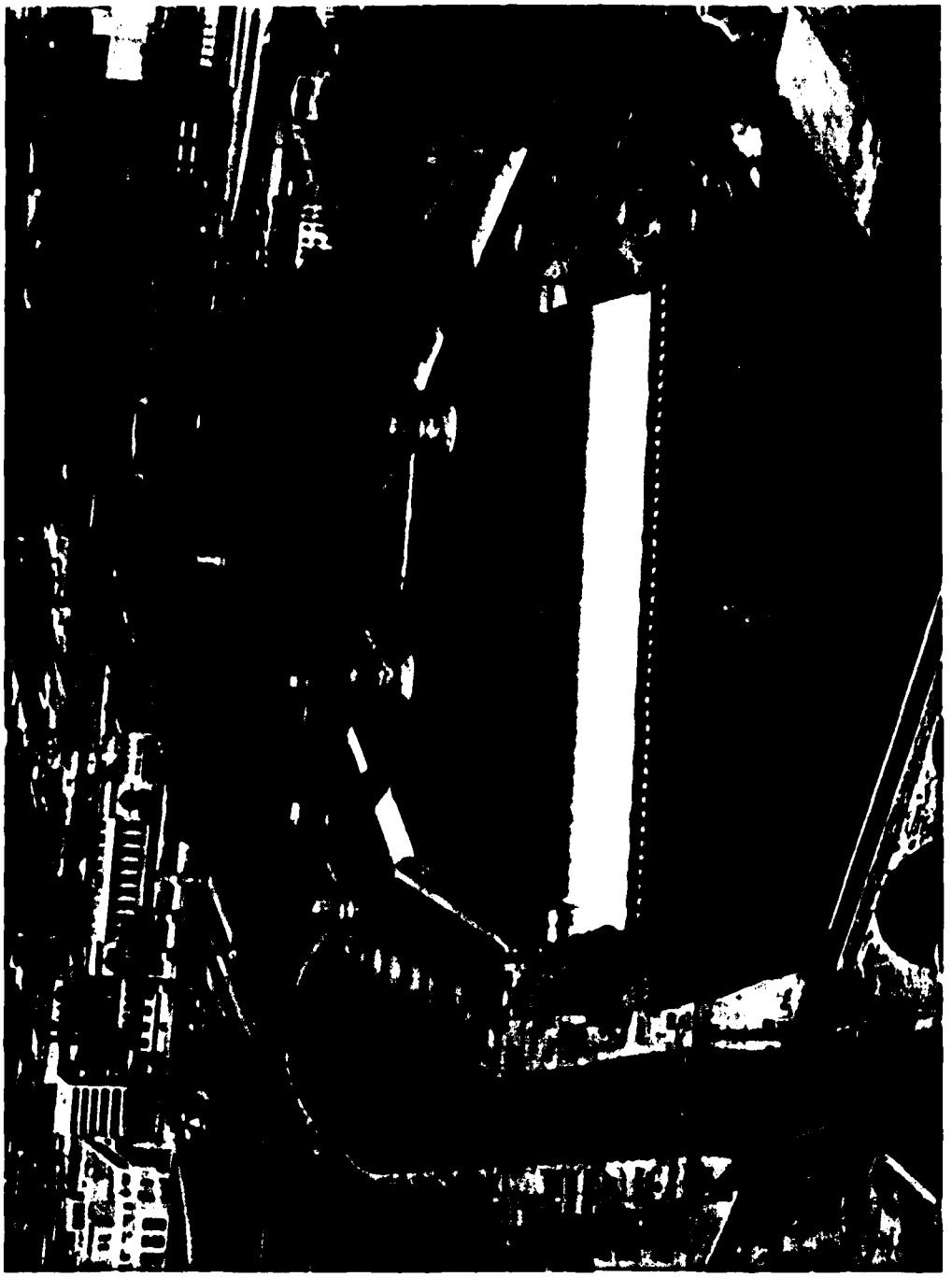
Potential vantage points to view the upper falls are numerous because of the proposed vertical (high rise) construction of new riverfront developments, expansion of the West River Road near the falls, location and configuration of adjacent public open space, possible future expansion of the existing visitor center, development of the Great River Road System, and plans to utilize the Stone Arch Bridge as a transportation link.

Another noteworthy consideration in describing the upper falls is that the horseshoe falls nas visual appeal at much lower river flow rates tnan the main roll dam. This is due to the more vertical drop and other structural differences of this feature.

The following photo shows the existing upper falls main spillway (lower roll dam) with a relatively high overflow in August 1983. Another photo shows the horseshoe and main roll dams on 7 July 1976 with an estimated 1,100 cfs flow over the spillways.



Upper St. Anthony Falls Main Spillway (Lower Roll Dam) With Estimated 2,200 to 2,600 cfs Flow



Upper St. Anthony Falls - July 7, 1976

ROLE OF AREA HYDROPOWER

The role of hydropower in the geographical area encompassing Upper Mississippi River navigation dams of the St. Paul District can best be explained by referring to the National Hydropower Study (NHS). The study was accomplished by the Corps of Engineers Institute for Water Resources (IWR) during the period 1978-1980. The NHS was conducted by Electric Reliability Council Regions.

Electric power systems are divided into nine Electric Reliability Council Regions in the United States. The navigation dams in the St. Paul District are presently all included in the Mid-Continent Area Power Pool (MAPP) system which assumed all of the former Mid-Continent Area Reliability Council Agreement (MARCA) responsibilities in 1982. However, the NHS was conducted while MARCA organization was still in effect. Both MAPP and the former MARCA include a 400,000 square mile area in the United States that includes all of Minnesota and the western half of Wisconsin plus Iowa, North Dakota, South Dakota, Nebraska, and eastern Montana. The Canadian Provinces of Manitoba and Saskatchewan are associate members of MAPP/MARCA.

The MARCA Council was originally organized in 1968, and membership consisted of 22 larger electrical systems. There were, and still are, 11 investor-owned, 8 generating transmission cooperatives, 2 public power districts, and a Federal agency in the council region. The purpose of the council region is to enhance electric reliability of the region and to effectively use the combined resources of the member systems in the event of an emergency in one of the systems.

The following extract from volume XIX of the September 1981 NHS Regional Assessment clearly presents the role of hydropower in the former MARCA (MAPP) region.

ROLE OF HYDROPOWER WITHIN THE EXISTING SYSTEM

Conventional hydropower currently plays an important role in the MARCA generation system. About 12.2 percent of the total 1979 summer generating capability was provided by hydropower. As of January 1, 1979, there were 57 hydropower plants in the MARCA system. The plant capabilities range from less than 1 MW to more the 650 MW. The majority of MARCA hydropower facilities provide a capability of less than 30 MW each. However, there are eight large Federal hydropower plants which provide approximately 84 percent of the MARCA hydropower capability. Of the eight Federal hydropower plants, six located on the Missouri River were constructed and are operated by the Army Corps of Engineers. The remaining two are Water and Power Resources Service projects - one on the Missouri River and one on the Big Horn River. . . . . About 84.2 percent of the total MARCA hydropower generating capability is located within the Dakotas and Montana with the remaining 11.6 percent, 4.1 percent, and 0.1 percent located in Minnesota-Wisconsin, Nebraska, and Iowa, respectively.

There are no hydropower additions or retirements scheduled for MARCA during the 1979-1988 period; however, a slight decline in hydropower capacity during this period is projected. This reflects the conservatism in forecasts which anticipate future water supplies and capacity to be less than experienced in the good water year of 1978.

Magnitude

According to utility reports, the 1979 summer hydropower capability was 2970 MW. The total 1978 hydropower generation in the MARCA area was 15,495 million kilowatt-hours, representing 16.5 percent of the total MARCA net generation. Utilities indicate by 1988, hydropower generation is expected to decline to 7.5 percent of the net total, or 12,074 million kilowatt-hours. Table 3.6 shows the expected decline, according to utility forecasts, in hydropower generation in comparison to the MARCA total through the 1978-1988 period. Hydropower capability is expected to decline from 2970 MW or 12.2 percent of MARCA total, in summer 1979 to 2790 MW or 8.5 percent in the summer of 1988. The 206 MW reduction occurs entirely within the Dakotas-Montana subarea. These projections are predicted on estimated future water supply and do not reflect less hydroelectric machinery.

Table 3.6
HYDROPOWER GENERATION PROJECTIONS 1978-1988
(Millions of Kilowatt-Hours)

	Generation	Percent of MARCA Net Generation
1978 (Actual)	15,495	16.5
1979	13,902	13.2
1980	13,174	11.9
1981	12,922	11.0
1982	12,972	10.2
1983	12,972	10.1
1984	12,974	9.7
1985	12,072	8.6
1986	12,072	8.2
1987	12,072	7.7
1988	12,074	7.5

Type of Energy

The Federal hydropower plants in MARCA except Gavins Point can be operated essentially as peaking or intermediate plants fully integrated with the base loaded thermal plants in the area.

Gavins Point is generally base-loaded to provide steady flows for navigation. The marketing agent purchases off peak energy from thermal resources to meet off peak demands of their customers. The hydropower resources are concentrated on peak to meet firm loads and to replace generation by high cost oil in the MARCA area. Other hydropower plants in the MARCA area are relatively small and essentially are run-of-river providing thermal replacement capacity and energy as river flows make them available.

The MARCA/MAPP Council is a summer peaking system and is expected to remain that way in the future. Within MARCA/MAPP, utilities have annual load factors varying between 50 and 66 percent. Future annual load factors are expected to average 57 percent.

PREFERENCE CUSTOMERS

The most likely purchasers of federally produced power in this area would be the 16 municipalities and 10 electric cooperatives identified

in the following table. Eleven of the municipals and 8 of the cooperatives are not capable of generating all of their power needs and could utilize the extra power production capability from the two St. Anthony Falls sites. Two Minnesota municipalities and two cooperatives have expressed interest in possible added power generation at St. Anthony Falls (see Environmental Assessment, Exhibit section).

CONDITIONS IF NO ADDITIONAL FEDERAL ACTION IS TAKEN

If no Federal added hydropower is recommended and subsequently developed, one of two futures is probable. One future is no action or no change from existing conditions. This case would have no or social impacts other than those expected under present conditions. However, with no action, several opportunities would be foregone, including full use of a renewable and clean energy source and capitalization on a relatively economical source of energy.

A more probable future is the more complete development of St. Anthony Falls by Northern States Power Company, which holds the FERC license for hydropower development at the site. NSP has already looked at possible expansion of generation at the upper falls. A "Report on Hydroelectric Redevelopment Study at Hennepin Island, Northern States Power Company," dated May 1980, prepared by Stone and Webster Engineering Corporation under contract to NSP, found apparent technical feasibility to essentially double or triple existing capacity. NSP may utilize the current Federal feasibility study to request a license modification from the FERC.

Future added development at both upper and lower dams depends on (1) projected future costs of fuel for thermal generation which is the option to hydropower and (2) financial attractiveness for further development which is influenced by the projected price at which future power can be marketed and by the cost of financing the hydropower additions.

Potential Preference Customer Data(1)

Utility	Number of customers	Peak demand (mw) Summer	Peak demand (mw) Winter	Power purchased (mWh)	Energy sales (mWh)	Capacity resources (mw)	Diesel gen (mw)
MINNESOTA							
Municipalities							
Anoka	7,096	30.4	23.5	128,400	118,800	0	0
Arlington	790	2.9	2.0	11,900	109,780	0	0
Buffalo	1,859	6.8	5.7	28,490	25,300	0	-
Chaska	2,476	13.5	8.2	52,400	47,600	0	-
Delano	1,050	3.4	3.3	12,700	13,900	4.8	4.8
Elk River	2,167	7.7	8.2	29,000	40,300	9.1	9.1
Glencoe	1,936	12.6	13.1	30,100	41,980	21.1	21.1
Kenyon	1,114	2.3	2.1	9,341	9,760	1.9	1.9
Le Sueur	1,620	9.6	6.3	35,800	33,950	3.3	3.3
New Prague	1,230	7.8	6.1	18,900	36,800	11.9	11.9
North St. Paul	4,887	14.6	10.3	55,640	48,400	0	-
Princeton	1,356	3.4	3.4	16,185	14,500	0	0
Shakopee	3,544	15.1	10.4	57,600	54,100	0	0
Cooperatives							
Anoka Cooperative	40,123	120.3	111.1	533,040	500,900	0	0
Power Assoc.	0	0	0	0	0	16.8	16.8
Faribault County	1,339	4.6	5.9	23,180	21,020	0	0
Goodhue County	3,402	11.6	15.8	65,500	60,600	0	0
McLeod County	5,046	18.4	22.7	98,400	89,960	0	0
Minnesota Valley Electric	10,412	34.0	37.1	169,990	154,300	0	0
United Power	0	0	0	0	0	309.8	23.3
Wright-Hennepin	16,610	41.1	49.7	215,100	202,000	0	0
Minnesota total	**108,057**	**360.1**	**344.9**	**1,591,666**	**1,623,950**	**378.7**	**92.2**
WISCONSIN							
Municipalities							
Centuria	365	0.7	0.9	4,040	3,710	0	-
New Richmond	1,858	7.4	6.5	33,900	32,300	0	0
River Falls	2,914	10.8	10.6	47,000	52,500	13.1	12.7
Cooperatives							
Pierre-Pepin	4,186	9.7	15.2	107,990	101,850	0	0
St. Croix County	3,946	13.3	18.1	75,900	71,100	0	0
Wisconsin total	**13,269**	**41.9**	**51.3**	**268,830**	**261,460**	**13.1**	**12.7**
Grand total	**121,326**	**402.0**	**396.2**	**1,860,496**	**1,885,410**	**391.8**	**104.9**

(1) Power Marketing, Great Lakes Area, U.S. Department of Energy, January 1981, Appendix A (50-mile radius).

PLANNING CONSTRAINTS

Any possible added hydropower development plan proposed for St. Antnony Falls must be technically and economically sound, socially and environmentally acceptable, and capable of being implemented. Technical factors include the following constraints:

1. The plan must fit in with the geometric configuration of the existing structure and not adversely affect navigation, a principal and primary purpose of the existing St. Anthony Falls project.

2. The plant must operate in conjunction with the existing hydropower plants and utilize only excess flows not required for existing prior uses.

3. The plant must operate as a run-of-river facility. (Run of the river, in this case, would encompass the limited 1 or 0.4 foot allowable fluctuation at the upper and lower sites, respectively.)

4. To be recommended for further study, the selected plan must be economically justified. In other words, the benefits of the installation must outweigh the costs for construction and maintenance.

5. Significant adverse impacts on wild and scenic rivers, historic sites, and endangered species, migratory fish, wildlife, and other environmental amenities must be assessed. Significant impacts should be eliminated if possible and mitigated when they cannot be eliminated.

6. Finally, the authority for this reevaluation study limits the area of consideration solely to that of the original existing project. Any other options not associated with the Corps existing facilities would have to be addressed under other authorities. (For example, no attempt was made to evaluate an alternative which would involve added releases for hydro from upstream reservoirs.)

PLANNING OBJECTIVES

The objectives of the study are derived from problems identified for the area and from Federal, State, and local laws and regulations. In addition, the "Principles and Guidelines for Planning Water and Related Land Resources" require that all federally assisted water resource projects be planned to achieve the national objectives stated earlier.

Specific planning objectives are definite needs, opportunities, and problems that can be addressed to enhance national economic development or environmental quality. Specific planning objectives for this study include:

1. Increase the national economic efficiency through the development and full utilization of a renewable and less costly energy source, thus helping to reduce dependence on foreign fuels in the Nation and study area during the period of analysis.

2. Contribute to a maximum reduction in the use of nonrenewable fossil fuels in the study area and the Nation during the period of analysis, resulting in conservation of those resources and in the enhancement of the environment by reducing air pollution associated with plant emissions and terrestrial degradation associated with fossil fuel discovery and mining.

3. Minimize site-specific environmental effects of added hydropower development (particularly, those effects dealing with barriers to fish migration and entrainment or impingement of aquatic biota.

4. Minimize adverse effects to the historic and aestnetic environment.

FORMULATION OF PRELIMINARY ALTERNATIVES

PLAN FORMULATION RATIONALE

The purpose of the formulation of preliminary plans is to identify and evaluate alternative measures for fulfilling the national and specific planning objectives. Plan formulation is iterative and designed to identify and evaluate all possible solutions so that the best and most feasible solution can be selected. The level of detail for this report is designed to identify one or more feasible solutions that can be designed in detail for eventual preparation of plans and specifications for construction.

An interdisciplinary team was assembled in the earlier reconnaissance study to develop a strategy for selecting sites in the vicinity of St. Anthony Falls at which installation of hydropower might be most practical, from all viewpoints of the team. The same team was used in the current feasibility study.

Additional site locations for hydropower additions were developed in the current feasibility study, through the joint efforts of the study team and designated NSP personnel (see plate 3).

After the sites were selected early in the feasibility study, they were formulated using comparable standard tube type units. Those sites that indicated the greater economic feasibility were selected for more detailed evaluation by the North Pacific Division, Corps of Engineers,

under contract to the St. Paul District. The North Pacific Division personnel used different scales of development and different turbine types in their evaluation. The evaluation also used cost estimate data from the St. Paul District, information obtained from Northern States Power Company, and a planning aid letter from the U.S. Fish and Wildlife Service.

The following report sections provide more detail on how the preliminary plans for hydropower additions at St. Anthony Falls were developed.

LOCATIONS CONSIDERED

As discussed under Existing Conditions and as shown on plates 1 and 2, two general locations exist for hydropower addition at St. Anthony Falls (upper and lower falls). Additional units or replacement of existing units could be sited at the upper falls area in conjunction with the existing Hennepin Island hydropower development and/or at the lower falls area in conjunction with the existing lower dam hydropower development.

The upper falls general area has four principal sites that were considered for development: (1) the existing powerhouse area; (2) the wasteway area; (3) the lock area; and (4) the old Main Street station area. Within these sites, 12 alternatives were evaluated as described in the next section.

The lower falls general area has two principal sites that were considered for development: (1) the existing powerhouse area; and (2) the existing lock area. Five alternatives within these sites were evaluated as described in the next section.

The 12 upper and 5 lower site alternatives are summarized on plate 3.

ALTERNATIVES CONSIDERED

The existing plant at Hennepin Island has a 12.4-MW capacity and generates at a plant factor of 0.85 (power generated 85 percent of the time). The lower dam facility has an 8.0-MW capacity and generates at a plant factor of about 0.76.

The 1978-1980 National Hydropower Study first determined that an added increment of capacity would be feasible at both Hennepin Island and Lower Dam. The September 1981 reconnaissance report confirmed that existing development at both locations was economically feasible. The reconnaissance report evaluated several additions at each location up to a capacity which would result in a plant factor ranging from about 0.50 to 0.70.

The reconnaissance report evaluations all used Allis Chalmers tube turbine units which were standardized and which would be most economical for low-head installations. The units would have a 3,000-millimeter (9.84-foot) runner diameter. This diameter was initially selected because of existing head and flow characteristics.

Preliminary formulation evaluations in the current feasibility study used this same type of installation. However, final feasibility report evaluations were made by the Hydroelectric Design Branch of the North Pacific Division, Corps of Engineers, using a computer optimization routine. This optimization approach included other types of installations such as propeller Kaplan, standardized horizontal tube type, and double regulated bulb turbines, and ultimately resulted in a greater installed capacity (21.0 MW) at the upper site.

The feasibility report site alternatives had to be reduced to a manageable number prior to North Pacific Division's involvement. This preliminary work was carried out by the District using cost and benefit data developed from the earlier reconnaissance study. The cost and

benefit data from these preliminary evaluations were accomplished with January 1981 price levels, 7-3/8 percent interest rate, and 100-year project life, and provided a ready comparison with earlier reconnaissance report results. However, final alternative analyses were accomplished at current October 1982 price levels, 7-7/8 percent interest rate, and 100-year project life.

The alternatives included in the evaluation process, and their disposition, are discussed in the following paragraphs. The alternatives are shown on plate 3.

HENNEPIN ISLAND OPTIONS

- Hennepin Island Alternative 1U - Replace the four older existing twin tube turbines at the Hennepin Island plant with four 3.0-meter horizontal tube turbine units. This alternative would increase capacity at the site by 8.1 MW.

- Hennepin Island Alternative 2U - Rewind armatures, replace runners, and other related work on all five existing units. Site capacity would be restored to the original 12.5 MW capacity if that capacity is not presently available (may be done in combination with other alternatives).

- Hennepin Island Alternative 3U - Install two 3.0-meter horizontal tube turbine units on the east side of the present generating station. The site capacity would be increased by 10.0 MW. The present building and inlet raceway would be enlarged.

- Hennepin Island Alternative 4U - Install two 5.0-megawatt, 3.0-meter horizontal tube units in the abandoned hydroelectric (Main Street) station. This station originally had three generators with 1 MW total capability and used rope-driven turbines. Site capacity would be increased by 10.0 MW.

- Hennepin Island Alternative 5U - Install two 3.0-meter horizontal tube turbine units in wasteway No. 2, which would increase site capacity by 10 MW.

- Hennepin Island Alternative 6U - Install two 3.0-meter vertical propeller or horizontal tube generating units immediately west of the 5U alternative location. The units would pass beneath the bottom of the existing wasteway No. 1 and outlet into the Mississippi River downstream of the existing lower roll dam. Total site capacity would be increased by 10 MW.

- Hennepin Island Alternative 7U - Install two 3.0-meter horizontal tube turbine units along the landward side of the existing right bank Corps lock facility. The two units would be at the downstream end of one 17-foot diameter penstock which starts at the upstream side of the existing dam. The two units would increase site capacity by a total of 10 MW.

- Hennepin Island Alternative 8U(a) - Install four new 20-foot diameter penstocks and a new powerhouse at the Lower St. Anthony Falls station. The existing upper (12.4 MW) and lower (8.0 MW) facilities would be removed. Four generating units with a combined capacity of about 36.0 MW would be installed in a new powerhouse, adjoining the existing Lower St. Anthony Falls generating station. The new units would increase total capacity by 14.6 MW.

- Hennepin Island Alternative 8U(b) - Install one new 17-foot diameter penstock and add to the existing Lower St. Anthony Falls generating station. The existing upper (12.4 MW) and lower (8.0 MW) facilities would be retained. Two new Kaplan or horizontal tube generating units would be installed, adjoining the existing Lower St. Anthony Falls powerhouse. The new units would increase total site capacity by 17.5 MW.

- Hennepin Island Alternative 8U(c) - This alternative would be identical to 8U(a) except that a different route would be used, and the intake of the penstocks would be just upstream of the old Main Street station. A covered canal or tunnel along Main Street would connect to the present Lower St. Anthony Falls station. Four generating units with a combined capacity of about 36.0 MW would be installed. The new units would increase total capacity by 14.6 MW.

- Hennepin Island Alternative 8U(d) - This alternative would be identical to 8U(b) except that a different route would be used, and the intake of the penstock would be just upstream of the old Main Street station. A covered canal or tunnel along Main Street would connect to a new powerhouse adjacent to the present Lower St. Anthony Falls station. The two new units would increase total capacity by 17.5 MW.

- Hennepin Island Alternative 9U - Install two horizontal or vertical generating units northeast of the existing upper pool generating station. The units would be installed in the abandoned outlet channel from the old Main Street station. Total site capacity would be increased by 10.0 MW.

LOWER DAM OPTIONS

- Lower Dam Alternative 1L - Replace the 10 existing vertical fixed-blade turbines at the Lower St. Anthony Falls plant with three 3.0-meter horizontal tube units. Each tube unit would have a 2.8 MW capacity, giving a total of 8.4 MW new capacity in place of the present 8.0 MW capacity.

- Lower Dam Alternative 2L - Install two 3.0-meter horizontal tube turbine units landward of the Lower Dam plant. Existing site capacity would be increased by 5.6 MW.

- Lower Dam Alternative 3L - Install two 3.0-meter horizontal tube units in the unused auxiliary lock chamber of the existing Corps operated Lower Dam. Existing site capacity would be increased by 5.6 MW.

- Lower Dam Alternative 4L - Replace 2 of the 10 existing 0.8 MW units at the present generating plant with two new 2.8 MW units in the south end of the building. Total site capacity would increase by 4.0 MW with this arrangement.

- Lower Dam Alternative 5L - Rewind armatures, replace runners, and other related work on all existing units. Site capacity would be restored to the original 8.0 MW, if currently not available. (This work may be done in combination with other alternatives, similar to Hennepin Island alternative 2U.)

PLANS OF OTHERS

1. Northern States Power Company was involved in the current study process and in the selection and evaluation of the alternatives. A number of the alternatives were suggested by NSP, such as the "end-around" or combined proposal 8U a, b, c, d, and a peaking operation proposal.

2. The Stone and Webster Engineering Corporation developed preliminary plans for a wasteway alternative location in its May 1980 report. This proposal was developed for Northern States Power Company and presented two 12.0 MW units in wasteway No. 2, similar to alternative 5U in this study.

3. Northern States Power Company, in its letter of 15 June 1982, suggested that the St. Paul District look at a peaking proposal for Upper St. Anthony Falls. The proposal would include added pond

control by adding a gated section to the existing Hennepin Rollway (lower roll dam).

4. The Mills District Plan (January 1983) for the St. Anthony Falls area would restrict added major hydropower development in the present St. Anthony Falls Historic District. The Mills District proposal would develop more recreation potential in the area, including a hydropower museum, waterfall garden, kayak course, and milling museum. This proposal is still in the planning stage also, and could infringe on the existing established water rights and hydropower operation of Northern States Power Company, the existing hydropower licensee.

5. The University of Minnesota, St. Anthony Falls Hydraulic Laboratory at one time considered an expansion of its experimental research facilities utilizing the wasteway No. 2 area. The Hydraulic Laboratory envisioned an underground building with a park on the roof, combined with added hydropower development that would utilize penstocks in place of an intake canal. This expansion proposal has not been actively pursued.

REVIEW OF ALTERNATIVES

The following is a list of advantages and disadvantages of each of the alternatives investigated.

- 1U - Replace four existing units with new larger units (recon report alternative 2)

  Advantages

  1. Increased capacity of 8.1 MW.
  2. More efficient units.
  3. Location close to substation.
  4. Concentrates all generation capability.
  5. Access good.

  Disadvantages

  1. Disruption of service during replacement.
  2. Need to modify powerhouse.
  3. Intake canal requires modification to carry added flows.
  4. Minor inconvenience to Hydraulic Laboratory during construction (parking).

- 2U - Rehabilitate five existing units (may be done in combination with other alternatives)

  Advantages

  1. Minimizes future maintenance.
  2. Minimum new construction cost.
  3. Maintains generating capacity in localized area.
  4. Possible increased efficiency.
  5. Access good.

  Disadvantages

  1. No increase in rated capacity.
  2. Questionable need. Existing units are serviceable.
  3. Disruption of service during rehabilitation activities.
  4. Minor inconvenience to Hydraulic Laboratory during construction (parking).

- 3U - Add new unit(s) to existing hydro station

  Advantages

  1. Increase capacity with two 5.0 MW units.
  2. Location close to substation.
  3. Concentrates all generation capability.
  4. Access good.

Disadvantages

1. Difficult placement due to small space.
2. Intake canal would need larger capacity.
3. Some existing plant shutdowns required.
4. Space for addition is limited.
5. Would interfere with existing transmission towers.
6. Inconvenience to Hydraulic Laboratory during construction.

o 4U - Install new unit(s) in abandoned hydroelectric (Main Street) station

Advantages

1. Increase capacity with two 5.0 MW units.
2. Good access.
3. Close to existing substation.
4. Existing building above ground in fair condition.

Disadvantages

1. Significant outlet channel work required (previous flow generated only 1.2 MW from two 600 kW units.
2. Building substructure would require extensive and costly renovation. (Dam Safety Program may require this also.)
3. Building is being considered for historic site designation.
4. Upstream dredging required plus inlet work.
5. Powerhouse part of main dam - cofferdam required.

o 5U - Install new unit(s) in wasteway No. 2 (recon report alternatives 1, 3, and 4)

Advantages

1. Increased capacity of 10.0 MW (two units).
2. Upstream cofferdam already in place - requires only small cofferdam downstream.
3. Open space for construction is good.
4. Close to substation.
5. Maintains integrity of adjoining wasteway No. 1 (must be maintained to pass emergency flows in the event the lower roll dam is closed for emergency or operation and maintenance).

Disadvantages

1. Access is somewhat limited for construction.
2. Inconvenience to Hydraulic Laboratory during construction.

o 6U - Install new unit(s) with cross island feed

Advantages

1. Increased capacity of two 5.0 MW units.
2. Open space for construction is good.
3. Close to substation.
4. Maintains integrity of wasteway No. 1 except during construction.

Disadvantages

1. Access is somewhat limited for construction.
2. Both upstream and downstream cofferdams are required.
3. Inconvenience to Hydraulic Laboratory during construction.
4. Added design problems resulting from high velocity flows over lower roll dam.

o 7U - Install new unit(s) parallel to lock

Advantages

1. Increased capacity of 10 MW.
2. No adverse effects on Hydraulic Laboratory or existing power generation.

Disadvantages

1. Upstream and downstream cofferdams required.
2. Limited construction access.
3. Difficult construction involving tunneling under a portion of the existing dam and Stone Arch Bridge.
4. Not as convenient to the existing substation.
5. Adverse effects on upstream tows.
6. Upstream dredging required

o 8U(a) - Install penstock(s) to feed new units at Lower St. Anthony Falls hydroelectric station (powerhouse) (complete replacement)

Advantages

1. Simplifies hydro vs. locking and operating requirements.
2. Takes full advantage of available head at St. Anthony Falls.
3. Would completely eliminate the need for existing upper and lower hydro plants (36 MW all at one site).
4. Would reduce overall maintenance to one generating plant instead of two.

Disadvantages

1. Difficult construction, especially in the steam plant area, near the lower hydro station.
2. Upper and lower cofferdams required.
3. Disruption to existing service during construction (upper and lower).
4. Some disruption to Hydraulic Laboratory during construction.
5. Above ground portion of penstock would interfere with existing park aesthetics.
6. Other landowners (Pillsbury) (city) involved?
7. Major disruption to the lower plant during construction.

o 8U(b) - Install penstock to feed added units at Lower St. Anthony Falls hydroelectric station (powerhouse) (retain existing units)

Advantages

1. Simplifies hydro vs. locking and operating requirements.
2. Takes full advantage of available St. Anthony Falls head.
3. Would retain existing upper and lower hydro plants.
4. Added capacity of 16.6 MW.

Disadvantages

1. Difficult construction, especially in the steam plant area, near the lower hydro station.
2. Upper and lower cofferdams required.
3. Disruption to existing service during construction (upper and lower).
4. Some disruption to Hydraulic Laboratory during construction.
5. Above ground portion of penstock would interfere with existing park aesthetics.
6. Other landowners (University of Minnesota; city of Minneapolis) are involved.

o 8U(c) - Install penstock(s) to feed new units at Lower St. Anthony Falls hydroelectric station powerhouse using Main Street route (complete replacement)

Advantages

1. Simplifies hydro vs locking requirements.
2. Takes full advantage of available head at St. Anthony Falls.

3. Would completely eliminate the need for existing upper and lower hydro plants (36 MW all at one site).
4. Would reduce overall maintenance to one generating plant, instead of two.
5. Main Street route is aesthetically less objectionable than 8U(a) route.
6. No land acquisition required through park areas.

Disadvantages

1. Disruption of Main Street during construction unless tunneling was used.
2. Upper and lower cofferdams required.
3. Cobblestoned Main Street is a historic site and, if disturbed, must be replaced.
4. Permit for construction in street right-of-way required.

o 8U(d) - Install new penstock to feed added units at Lower St. Anthony Falls hydroelectric station (powerhouse) (retain existing units)

Advantages

1. Simplifies hydro vs locking requirements.
2. Takes full advantage of available head at St. Anthony Falls.
3. Would retain existing upper and lower hydro units.
4. Added capacity of 16.6 MW.
5. Main Street route is aesthetically less objectionable than 8U(b) route.
6. No land acquisition required through park areas.

Disadvantages

1. Upper and lower cofferdams required.
2. Disruption to existing service during construction.
3. Disruption of Main Street during construction unless tunneling was used.
4. Cobblestoned Main Street is a historic site and, if disturbed, must be replaced.
5. Permit for construction in street right-of-way required.

o 9U - Install new unit(s) in abandoned channel

Advantages

1. Increased capacity of 10 MW.
2. Existing upper hydro plant would not be terminated.
3. Access good.
4. Close to substation.

Disadvantages

1. Disruption of service during construction at upper site.
2. Intake canal needs modification to carry added flow.
3. Inconvenience to Hydraulic Laboratory during construction (parking).

o 1L - Replace existing units

Advantages

1. Minimize future maintenance.
2. Minimum new construction cost.
3. Increased efficiency.
4. Access good.

Disadvantages

1. Small increase in rated capacity with three units (0.4 MW).
2. Disruption of service during replacement.
3. Need to modify powerhouse.
4. Questionable need. Existing units are serviceable.

o 2L - Add new units to north end of existing hydro station (recon report alternatives 1B, 2B, and 3B)

Advantages

1. Increase capacity with two 2.8 MW units.
2. Access good.

Disadvantages

1. Some existing plant shutdowns during construction.
2. Existing coordination problems between hydro plant operation and lockages would increase.
3. A sheet-pile cofferdam is required for construction of the plant addition.
4. Upstream and downstream channel excavation required.

o 3L - Install new units in auxiliary lock (recon report alternatives 1A, 2A and 3A)

Advantages

1. Increase capacity with two 2.8 MW units.
2. No interference with existing plant during construction.
3. Upstream cofferdam not required.
4. No foundation work required - use existing lock floor.

Disadvantages

1. Cofferdam required between downstream lock walls.
2. Placement of turbines would affect operation of lock and dam during flood flows.
3. Existing coordination problems between hydro plant operation and lockages would increase.
4. Limited construction access.

- 4L - Replace units as necessary to fit additional unit at south end of existing hydroelectric station

Advantages

1. Increase capacity with two 2.8 MW units.
2. More difficult access.
3. No channel excavation required.

Disadvantages

1. Temporary disruption of generation during construction.
2. Existing coordination problems between hydro plant operation and lockages would increase.
3. Two sheet-pile cofferdams required for powerhouse addition.

- 5L - Rehabilitate 10 existing units (may be done in combination with other alternatives)

Advantages

1. Minimize future maintenance.
2. Minimize new construction cost.
3. Maintain generating capacity in localized area.
4. Possible increased efficiency.
5. Access good.

Disadvantages

1. No increase in rated capacity.
2. Questionable need. Existing units are serviceable.
3. Disruption of service during rehabilitation activity.

PRELIMINARY ASSESSMENT AND EVALUATION OF ALTERNATIVES

Economic feasibility analysis compares economic costs with project benefits. The comparison is made using a common value base. Reconnaissance report costs and benefits were stated in January 1981 dollar values, and this fixed price level was used for valuing future costs and benefits in a preliminary screening analysis. The time frame used for the benefit-cost analysis begins in 1990 when the project is assumed to be installed and extends through the 100-year economic life of the project (to 2090). Therefore, the benefit-cost comparison was prepared for the year 1990 using 1981 dollars and prices.

The Chicago Regional Office of the Federal Energy Regulatory Commission (FERC) did the benefit analysis of hydropower additions at Upper (Hennepin Island) and Lower Dam St. Anthony Falls. In its 10 September 1981 letters to the St. Paul District, benefits were calculated as explained in excerpts from those letters which follow:

> "Power values based on a coal-fueled steam-electric plant as the most likely alternative to each of the proposed hydroelectric developments are summarized in the attached table. These are 'at-market' values; no transmission line costs for the hydroelectric development have been included.
>
> The energy value for the hydroelectric development is determined by the difference in total system operating cost between a system utilizing the proposed hydroelectric installation and one using an equivalent size alternative steam-electric generating plant. Operating costs for the hydroelectric project and its equivalent alternative were simulated using a probabilistic production costing computer model. The POWRSYM Version 48 model was used for this analysis.
>
> Northern States Power Company was used as a 'typical' system to measure the annual production cost differences between future operation with the added hydroelectric capacity and its equivalent alternative. Operation of the system was simulated over the period 1980-2010 based on projected load and energy requirements for the Northern States Power Company system.

The capacity values given in the attached table are based on the annual fixed costs to install the alternative electric generating plant. A 5.0-percent credit has been given to the hydroelectric capacity to reflect its greater operating flexibility. In addition, the capacity value for the hydroelectric plant has been adjusted to reflect relative value based on its availability in comparison with the availability of the alternative steam plant. Accordingly, the capacity value given is applicable to the installed capacity of the proposed hydroelectric plant and already incorporates the consideration of dependable capacity.

Energy values are also given in the attached table which recognize the real fuel cost increases associated with multiyear operation of the system. Real fuel cost escalation factors were taken from Department of Energy data published in the October 17, 1980 Federal Register. Discount rates as specified in your letter were used to levelize these costs over the 100 year period requested.

HENNEPIN ISLAND ST. ANTHONY FALLS AT MINNEAPOLIS, MN ON THE MISSISSIPPI RIVER

Power Values at January 1981 Cost Levels:

Cost of Money %	New Capacity Added (MW)	Additional Generation (MWH)	Capacity Value $/kW-Yr.	Energy Value Current $/MWH	Energy Value Escalated $/MWH
7.375	5.0	23,700	82.10	20.9	38.6
	7.5	33,100	77.90	20.3	38.3
	10.0	40,000	70.60	20.9	39.3
	15.0	53,300	65.30	21.6	39.7
	20.0	63,800	55.80	22.5	39.9

LOWER DAM ST. ANTHONY FALLS AT MINNEAPOLIS, MN ON THE MISSISSIPPI RIVER

Power Values at January 1981 Cost Levels:

Cost of Money %	New Capacity[1] Added (MW)	Additional Generation (MWH)	Capacity Value $/kW-Yr.	Energy Value Current $/MWH	Energy Value Escalated $/MWH
7.375	10.8	9,600	64.20	22.9	39.6
	13.6	16,500	65.30	24.3	42.2
	16.4	21,400	60.00	24.1	41.4
	19.2	25,300	52.60	25.4	42.3

(1) New Capacity Added values should be 2.8, 5.6, 8.4, and 11.2 MW."

PRELIMINARY ANALYSIS

RECONNAISSANCE REPORT

The power values mentioned above, combined with alternative costs, resulted in the following conclusions in the September 1981 reconnaissance report.

September 1981 Reconnaissance Report Results

Feasible Hydropower Additions[1] - Hennepin Island

Item	Existing installation	Alternatives 1	2	3	4
Total site capacity (kW)	12,500	17,500	20,000	22,500	27,500
Dependable capacity (kW) (July-August)	11,500	14,500	15,800	16,700	18,400
Dependable capacity (kW) (December-January)	10,900	13,100	13,700	13,900	14,400
Plant factor (total site)	0.80	0.72	0.69	0.65	0.58
Average annual energy (MWh) (total site)	87,300	111,000	120,400	127,300	140,800
Construction first cost ($1,000)	-	4,870	14,280	8,510	11,920
Benefit-cost ratio (for addition)	-	3.24	1.64	3.19	3.10

Feasible Hydropower Additions[1] - Lower St. Anthony

Item	Existing installation	Alternatives 1B	2A	3A
Total site capacity (kW)	8,000	10,800	13,600	16,400
Dependable capacity (kW)(Jul-Aug)	6,800	8,100	9,000	9,600
Dependable capacity (kW)(Dec-Jan)	6,500	7,100	7,400	7,500
Plant factor (total site)	0.73	0.64	0.57	0.51
Average annual energy (MWh) (total site)	51,300	60,900	67,800	72,700
Construction first cost ($1,000)	-	3,540	6,190	8,720
Benefit-cost ratio (for addition)	-	1.88	2.05	1.90

(1) The alternative descriptions are fully described in the September 1981 reconnaissance report and are related to the current feasibility study alternatives in the following paragraphs.

Those alternatives identified and evaluated in the September 1981 reconnaissance report were reevaluated with other alternatives identified in the feasibility stage of study. (The added alternatives were developed in consultation with Northern States Power Company in several meetings, and are shown on plate 3.)

All alternatives were renumbered in the current feasibility study and the following brief resume is presented to illustrate disposition of the earlier reconnaissance study alternatives in the feasibility study.

Alternatives		
Reconnaissance report number	Feasibility report number	Summary description
2	1U	New units - existing station
1, 3, 4	5U	New units in wasteway
1B, 2B, 3B	2L	New units - existing station
1A, 2A, 3A	3L	New units - existing lock

The most feasible alternatives in the reconnaissance report were alternative 4, for the Upper St. Anthony Falls site, and alternative 3A, for the Lower St. Anthony Falls site, based on maximum average annual net benefits. These are current feasibility report alternatives 5U and 3L.

FEASIBILITY REPORT

The 17 alternatives identified in the current feasibility study process were initially evaluated using the 7 3/8-percent (January 1981) interest rate and 100-year project life, contained in the September 1981 reconnaissance report. The evaluation was made manually, and it used and expanded on costs and benefits developed in the reconnaissance report. The preliminary feasibility report alternative evaluation used

the standard tube-type units in all cases except for the rehabilitation plans 2U and 5L.

First costs, operation and maintenance costs, present worth of deferred costs, and salvage values were developed for each alternative in relation to costs previously developed for the 1981 reconnaissance report. Interest during construction assumed a 2-year construction period as did the reconnaissance report. Annualized benefits were developed from the power values provided by FERC for a 7.375 interest rate and 100-year project life. The FERC capacity and escalated energy values were then applied to each specific alternative installation proposed. The capacity value was multiplied by the installed capacity and the escalated energy value was multiplied by the added MWh generation that would result from the installation. This procedure was recommended by FERC in a letter on 10 September 1981.

Example of annual benefit derivation for a 10 MW unit alternative:

Capacity benefit = \$70.60/kW-yr x 10,000 kW =	\$ 706,000
Escalated energy benefit = \$39.30/MWh x 40,000 MWh =	1,572,000
	2,278,000

(Table uses rounded values of \$2,275,000)

The following two tables show annualized costs and benefits, plant factor, annual energy, and dependable capacity for the alternatives evaluated in the formulation stage.

ST. ANTHONY FALLS- HENNEPIN ISLAND AND LOWER DAM

Average Annual Costs and Benefits[1]

ITEM	ALTERNATIVES[2]																
	1U	2U	3U	4U	5U	6U	7U	8Ua	8Ub	8Uc	8Ud	9U	1L	2L	3L	4L	5L
First Costs[3]	13,516	0.3	9,670	9,570	8,510	8,710	9,670		16,330		13,275	9,830	8,062	6,300	6,656	6,829	0.3
Present Worth of deferred Costs[3]	42		34	33	31	31	34		48		41.5	34	37	32	33	33	
Interest during construction[3]	998		713	705	628	642	713		1204		980	725	595	465	491	504	
Present Worth of salvage value[3]	(14)		(10)	(10)	(9)	(9)	(10)		(7)		14	(11)	(10)	(9)	(9)	(9)	
Net Federal investment[3]	14,542		10,407	10,293	9,160	9,282	10,407		17,565		14,311	10,578	8,684	6,788	7,171	7,357	
Average Annual charges[3]	1073		768.1	760.1	676.1	685.1	768.1		1,296.3		1,056.2	780.8	641.0	501.0	529.0	543.0	
Operation and Maintenance[3]	0[4]		46.0	45.0	40.0	41.0	46.0		77.0		63.0	46.0	0	30.0	31.0	32.0	
Average annual costs[3]	1,073.0		841.1	805.1	716.1	726.1	814.1		1,373.3		1,119.2	826.8	641.0	531.0	560.0	575.0	
Total average (3) Annual Benefits	1,950.0		2,275.0	2,275.0	2,275.0	2,275.0	2,275.0		3,500.0		3,500	2,275.0	70.0	1,025.0	1,025.0	875.0	
Net benefits [3]	877.0		1,460.9	1,469.9	1,558.9	1,548.9	1,460.9		2,126.7		2,380.8	1,448.2	-570.0)	494.0	465.0	300.0	
Benefit/Cost Ratio	1.82		2.79	2.83	3.18	3.13	2.79		2.54		1.77	2.25	0.1	1.93	1.83	1.52	
Added Capacity (MW)	8.1	0	10.0	10.0	10.0	10.0	10.0	13.7	16.6	13.7	16.6	10.0	0.4	5.6	5.6	4.0	0
Plant Factor	0.68	0.80	0.65	0.65	0.65	0.65	0.65	0.83	0.78	0.83	0.78	0.65	0.70	0.43	0.43	0.49	0.73

— Existing Units deliver at design capacity —

Physical constraints prevent implementation

Physical constraints prevent implementation

(1) 7 3/8 - percent interest rate, January 1981 prices

(2) Alternative 8Ua,b,c,d must be compared against a combined upper and lower alternative.

(3) Amounts in thousands.

(4) No added operation and maintenance over existing conditions.

ST. ANTHONY FALLS - HENNEPIN ISLAND AND LOWER DAM

Capacities

ITEM	ALTERNATIVES																
	1U	2U	3U	4U	5U	6U	7U	8Ua	8Ub	8Uc	8Ud	9U	1L	2L	3L	4L	5L
Existing capacity (MW)	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	8.0	8.0	8.0	8.0	8.0
Added capacity (MW)	8.1	0	10.0	10.0	10.0	10.0	10.0	13.7	16.6	13.7	16.6	10.0	0.4	5.6	5.6	4.0	0
Total proposed capacity (MW)	20.6	12.5	22.5	22.5	22.5	22.5	22.5	26.2	29.1	26.2	29.1	22.5	8.4	13.6	13.6	12.0	8.0
Total annual energy (1000's of MWh)	122	87.3	127.5	127.5	127.5	127.5	127.5	190.0	199.0	190.0	199.0	127.5	68.0	68.0	68.0	64.0	51.3
Existing annual energy (1000's of MWh)	87.3	87.3	87.3	87.3	87.3	87.3	87.3	87.3	87.3	87.3	87.3	87.3	51.3	51.3	51.3	51.3	51.3
Annual plant factor (APF)	0.68	0.80	0.65	0.65	0.65	0.65	0.65	0.83	0.78	0.83	0.78	0.65	0.70	0.43	0.43	0.49	0.73
Total dependable capacity (MW)	16.5	11.8	17.2	17.2	17.2	17.2	17.2	25.6	26.7	25.6	26.7	17.2	6.9	6.9	6.9	6.8	6.9

The initial feasibility report evaluation assumed that all new installations would involve two units, except for alternatives 1U, 2U, 8Ua, 8Uc, 1L, and 5L. These alternatives either involve replacement of existing units or rehabilitation of these units. See the following table which compares the alternatives, their total first cost, and cost per kilowatt of increased capacity.

St. Anthony Falls-Hennepin Island and Lower Dam Alternative Comparison

	ALTERNATIVE	Number of new units	Size of individual units (MW)	Net increased capacity (MW)	Total first cost (3)	Increased capacity cost/kw
1U	Replace 4 older units	4	5	8.1	$13,515,900	$1,669
2U	Rehabilitate 5 existing units	existing	existing	(1)	274,300	(1)
3U	Add new units in existing plant	2	5	10.0	9,664,000	966
4U	Add new units in Main Street station	2	5	10.0	9,570,000	957
5U	Add new units in wasteway No. 2	2	5	10.0	8,510,000	851
6U	Add new units (Cross Island)	2	5	10.0	8,708,000	871
7U	Add units parallel to lock	2	5	10.0	9,666,000	967
8Ua	Complete replacement (Single powerhouse - penstocks)	4	8.3	13.7	(2)	(2)
8Ub	Add powerhouse - penstock (Retain existing units)	2	8.3	16.6	16,325,000	983
8Uc	Complete replacement (Main Street canal)	4	8.3	13.7	(2)	(2)
8Ud	Add powerhouse and canal (Retain existing units)	2	8.3	16.6	13,275,000	800
9U	Add abandoned channel power-house	2	5	10.0	9,829,000	982
1L	Replace 10 older units	3	2.8	0.4	8,062,000	20,100
2L	Add new landward units	2	2.8	5.6	6,300,000	1125
3L	Add units in Auxiliary lock	2	2.8	5.6	6,655,500	1188
4L	Partial replacement (south end of plant)	2	2.8	4.0	6,828,600	1707
5L	Rehabilitate 10 existing units	existing	existing	(1)	304,800	(1)

(1) Northern States Power Company records show that existing units are at rated efficiency so this alternative would not accomplish anything.
(2) Physical constraints prevent implementation.
(3) 7 3/8-percent interest rate, January 1981 prices, 100-year life.

The next related effort involved a ranking analysis of the 17 alternatives using net benefits and incorporating environmental and social effects in an overall ranking. Alternatives 2U and 5L, involving rehabilitation of upper and lower units, respectively, were dropped from the evaluation because the existing units can actually deliver at these design capacities.

The following summary table indicates that alternatives 8(a,b,c,d) might have some of the highest net benefits. However, these alternatives involve both the existing upper and lower power units and, thus, the net benefits for these alternatives must be compared with net benefits from other combined upper and lower alternatives (see the following table, footnote 2).

St. Anthony Falls - Preliminary Alternatives Matrix

Formulation criteria	Alternatives Considered															
	1U	2U	3U	4U	5U	6U	7U	8Ua[2]	8Ub[2]	8Uc[2]	8Ud[2]	9U	1L	2L	3L	4L	5L
Economic effects																	
Preliminary first cost ($million)[1]	13.5	0.3	9.7	9.6	8.5	8.7	9.7	>16.3	16.3	>13.3	13.3	9.8	8.1	6.3	6.7	6.8	0.3
Net average annual benefits ($1,000)	877.0	-	1460.9	1469.9	1558.9	1548.9	1460.9	<2126.7	2126.7	<2380.8	2380.8	1448.2	-570.0	494.0	465.0	300.0	-
Certainty of constructibility, at or under, estimated cost	certain	-	Less certain	Less certain	moderately certain	moderately certain	Less certain	Less certain	Less certain	Less certain	Less certain	Less certain	certain	certain	moderately certain	moderately certain	-
Ranking (most to least certain)	1	-	5	11	2	3	4	10	9	8	7	6	2	1	4	3	-
Benefits will likely support cost	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	no
NED ranking (most to least net benefit)[3]	10	-	8	7	5	6	9	4[4]	2	[4]	1	8	4	1	2	3	-
Environmental effects																	
EQ ranking (least to most damaging)[3]	1	-	7	8	2	3	6	11	10	5	4	9	1	2	4	3	
Social effects																	
Social ranking (most acceptable)[3]	1	-	5	4	2	3	7	11	10	9	8	6	3	4	1	2	
Total	13	-	25	30	11	15	26	36	31	25	20	29	10	8	11	11	-
Overall ranking[3]	2	-	5	9	1	3	7	11	10	6	4	8	2	1	3	4	-

(1) 7 3/8-percent interest rate, January 1981 prices, 100-year life.

(2) Alternative must be compared with a combined upper and lower alternative.

(3) Lower ranking is best, higher is worst.

(4) Physical constraints prevent implementation.

Alternatives 8Ua and 8Ub involve a direct route from near the existing Upper St. Anthony Falls hydro plant to near the existing Lower St. Anthony Falls hydro plant. In contrast, 8Uc and 8Ud would involve a route from the old Main Street substation, under Main Street in a covered canal, and ending near the existing lower hydro plant. The existing plants would be decommissioned with alternatives 8Ua and 8Uc but would continue to function with alternatives 8Ub and 8Ud.

Alternatives 8Ua and 8Uc are similar to 8Ub and 8Ud, except that 8Ua and 8Uc involve complete replacement of existing power facilities at the upper and lower dams. The existing facilities would be replaced with a single new larger powerhouse and delivery penstocks with 8Ua and 8Uc. However, both 8Ua and 8Uc have physical constraints that prevent implementation.

Alternative 8Ua (complete replacement-river route) would require four 17-foot diameter or three 20-foot diameter penstocks to carry the required flow. Adequate right-of-way is not physically available near the university steam plant for penstock installation. Alternative 8Uc (complete replacement-Main Street) is limited by the width of Main Street with abutting buildings. The required enclosed canal would be limited to the street width and would have to be built to a depth that is inconvenient to construct; thus, it is more expensive.

As shown on the preceding summary table, the best alternative from an overall standpoint is the combined alternative 5U (upper wasteway) and 2L (new units landward of existing plant). Alternatives 1U and 1L, replacement of the existing upper and lower units, are ranked second best overall, but 1L is not cost effective and both 1U and 1L are not within the purview of the Federal Government because of the existing private ownership and license for these units. Another problem with alternatives 1U and 1L is the lengthy interruption of existing power production that would be needed if the required units were replaced.

This cost, or negative benefit, was not included in any of the comparisons shown on the preceding table but would be significant with several years' loss in revenue during construction.

Referring again to the summary table, the best alternative from a net benefit standpoint is 8Ud (add powerhouse and canal in Main Street) followed by 8Ub (add powerhouse-penstock to existing plant). The combined alternative 5U (upper wasteway) and 2L (new units landward of existing plant) is ranked third in net benefits. These three alternatives, their net benefits, and overall rankings are repeated here for ease of identification.

Alternative	8Ud	8Ub	5U+2L
Annual net benefits ($1,000)	2,380.8	2,126.7	2,052.9
Net benefit ranking(1)	1	2	3(2)
Overall ranking (NED, social, environmental)(1)	4	10	1

(1) Lower ranking is better than a higher ranking.
(2) Physical constraints prevent construction of alternatives 8Ua and 8Uc which were previously ranked 3 and 4 in net benefits. Therefore, the 5U+2L combination would move from fifth to third place in net benefit ranking.

The summary table ranking considers other factors such as environmental and social acceptability. Each alternative was ranked in comparison to the others in terms of economic, environmental, and social acceptability. Alternative 5U (upper wasteway) appears most acceptable using this approach, as does alternative 2L (rehabilitation of lower units).

In conclusion, the plan with the best overall ranking involving the Upper and Lower St. Anthony Falls site, from the Federal standpoint, is the combined alternative 5U (upper wasteway) and 2L (new units landward of existing plant).

PEAKING

Both the Upper and Lower St. Anthony Falls hydro units are operated on a run-of-the-river basis under current licensing procedures. However, fluctuations of 1 foot and 0.4 foot are permitted at the upper and lower sites, respectively, and this amount of storage could be used for peaking, at least at the Upper Dam site. The lower site, with only a 50-acre pool, cannot reasonably rely on the 0.4 foot intermediate pool fluctuation for peaking and must be operated at a constant level as practical to prevent interference with navigation.

A peaking operation at the Upper St. Anthony Falls site produces a similar peaking operation at the Lower St. Anthony Falls location in order to hold a constant lower pool level. The peaking proposal investigated considered using 1 foot of drawdown from the authorized 799.2 elevation at the upper dam (approximately 300 acre-feet for a 300-acre pool). Drawdown would be for a 6-hour period, from 799.2 to 798.2, twice daily. (Current pool levels are consistently maintained at 798.2, or 1 foot lower than authorized, to preclude losing flashboards at the higher level. Weak spots in the horseshoe dam flashboard system can cause loss of pool and power for 3 days at a time, each time the boards go down.)

Consideration was given to installing four 100-foot long Bascule-style gates on the Hennepin Rollway portion of Upper St. Anthony Falls. Each gate would be 14 feet high and would provide a more assured control of pool level without the risk of sudden loss of pool that is inherent in the present flashboard system.

Approximate annual benefits and costs and benefit-cost ratios for this peaking proposal are summarized below. The benefits shown for lock and dam 1, or Ford Dam, can probably not be counted on, however, because Ford Motor Company has provided the St. Paul District a letter

indicating that the company is not interested in added hydro development at this time.

Costs and Benefits for Peaking Proposal

Location	Annual benefits	Annual costs	Benefit-cost ratio
Upper dam	$267,000	$437,000	0.61
Lower dam	126,000		
Upper and lower dams	393,000	437,000	0.90
Lock and dam 1	181,000		
Upper and lower dams and lock and dam 1	574,000	437,000	1.32

It would appear that a peaking proposal as suggested for evaluation by NSP would be economically justified from a Federal perspective if benefits at lock and dam 1 were available as indicated. However, lack of peaking benefits at lock and dam 1 would make the peaking proposal infeasible. Economic analysis conducted by NSP also indicates that implementation of a peaking operation would not be economical at St. Anthony Falls.

A peaking proposal was not pursued further because of the current lack of interest expressed by Ford Motor Company and, more specifically, because of stated Corps planning constraints that any new Mississippi River plants should be operated as run-of-the-river to minimize environmental impacts and not interfere with navigation.

ALTERNATIVES FOR FURTHER STUDY

As a result of the preliminary analysis, it was determined that the following alternatives would be evaluated further:

- o 5U - New units in wasteway No. 2, plus
  2L - New units landward of existing plant

- o 8Ud - End-around proposal that supplements existing power facilities

Alternative 8Ud was included in the more detailed evaluation for several reasons: (1) it had better economic feasibility than combined alternatives 5U and 2L and 8Ub; and (2) the alternative was of special interest to the existing licensee.

Site locations for the final three alternatives are shown on plate 4.

Alternative 8Ub was excluded from the final analysis even though it had the second highest net benefits. Alternatives 8Ud and 8Ub are similar, in that they both use the entire head from both the Upper and Lower St. Anthony Falls sites, using one installation. However, alternative 8Ub has more disadvantages than 8Ud and received stronger initial objections from environmental and historic interests than 8Ud. Much of the 8Ud alternative would be underground and would be more in keeping with the aesthetics of the existing St. Anthony Falls Historic District. Inasmuch as 8Ud also provides the most net benefits, 8Ub was not evaluated further to help simplify the already complex turbine selection process.

Alternatives 5U+2L and 8Ud were subsequently evaluated in more detail by the North Pacific Division, Corps of Engineers, using updated energy values provided by the Federal Energy Regulatory Commission as follows:

Lower Dam, St. Anthony Falls at Minneapolis, Minnesota, on the Mississippi River
(Power Values at October 1982 Cost Levels)

Cost of money (%)	New capacity added (MW)	Additional generation (MWh)	Capacity value ($/KW-YR)	Energy Value	
				Current ($/MWh)	Escalated ($/MWh)
7.875	2.8	9,600	116.2	24.5	40.0
	5.6	16,500	88.60	25.9	42.6
	8.4	21,400	58.10	27.3	44.6
	11.2	25,300	50.10	29.2	47.7

Hennepin Island, St. Anthony Falls at Minneapolis, Minnesota, on the Mississippi River
(Power Values at October 1982 Cost Levels)

Cost of money (%)	New capacity added (MW)	Additional generation (MWh)	Capacity value ($/KW-YR)	Energy Value	
				Current ($/MWh)	Escalated ($/MWh)
7.875	5.0	23,700	113.30	23.7	38.7
	7.5	33,100	111.30	24.1	39.4
	10.0	40,000	111.80	24.5	40.0
	15.0	53,300	95.80	25.1	41.0
	20.0	63,800	79.90	26.2	42.8

NORTH PACIFIC DIVISION EVALUATIONS

A detailed evaluation of the two previously described arrangements (alternative 5U+2L and alternative 8Ud) was then conducted by the Corps of Engineers North Pacific Division (NPD). The NPD evaluated the 5U, 2L, and 8Ud plans as three separate individual development schemes. It was understood that the 8Ud, or combined site alternative, would substitute for the alternative 5U+2L.

Costs were reevaluated at 7 7/8-percent interest rate (October 1982 prices), and benefits were derived from the October 1982 capacity and energy values provided by the Federal Energy Regulatory Commission. The evaluation involved a 100-year project life. The complete evaluation is summarized in the technical appendix and in the following report sections dealing with assessment and evaluation of detailed plans.

ASSESSMENT AND EVALUATION OF DETAILED PLANS

GENERAL

Earlier report sections described how the 17 alternatives were narrowed down to alternatives 5U, 2L, and 8Ud for further study. The North Pacific Division of the Corps of Engineers aided the St. Paul District in the next portion of the study. The following report sections deal with how the final alternatives were further evaluated by North Pacific Division and identify the selected plan.

The North Pacific Division's brief project description, operational assumptions, and summary results are presented in the following paragraphs.

EXISTING HYDROPOWER PROJECT

The existing St. Anthony Falls project consists of a navigation lock and dam and powerhouse at each of two former natural waterfall locations in downtown Minneapolis. The two falls (upper and lower) are currently dominated by man-made structures. Upper and lower falls exist separated by about one-half mile of river forebay. Each falls has a power plant, owned and operated by Northern States Power Company, a private utility. The Corps of Engineers owns and operates the navigation locks at the project. Existing hydropower data are as follows:

St. Anthony Falls - Existing Project Data

Item	Lower Falls	Upper Falls
Installed capacity	8.0 MW	12.5 MW
Plant hydraulic capacity	4500 cfs	3,300 cfs
Number of units	10	5
Average net generating head	22 feet	49 feet
Type of turbines	Vertical, propeller	4 horizontal, 1 vertical Kaplan
Existing annual plant factor	76.3%	85%
Approximate initial date installed	1895	1908
Approximate date rebuilt	1952	1955

OPERATIONAL ASSUMPTIONS FOR ADDITIONAL GENERATION

Because of the complexities of the existing project, several assumptions were made to evaluate the hydropower additions. The two existing power plants, each owned by Northern States Power Company, appear to be undersized, and additional generation would seem appropriate. The existing units, particularly in the upper falls plant, are relatively old and may not operate as efficiently as modern units. However, a key assumption in these studies was that the existing units will receive "first water"; thus, any new generating units will operate on river flows in excess of the existing hydro plants' hydraulic capacity. Alternative assumptions regarding the future operability of existing hydropower capacity at St. Anthony Falls would affect the assessment and evaluation of detailed redevelopment plans.

The dual ownership and operation of the combined old and new plants would definitely affect any economic analysis of the new plants. For these studies, a basic assumption was made: the new power plants would be constructed and owned by the Corps. Thus, the Federal discount rate (7-7/8 percent) was used in all economic analyses. A non-federally financed addition would have a different financial basis, would be scoped somewhat differently, and would have different benefits and costs associated with it.

It was assumed that any operation of a new power plant would be very closely coordinated with the operation of the existing power plants. This is especially important in the operational transition from moderately low flows, when only the old power plant can operate, to medium and higher flows, when both new and old plants will be operating. For example, it was assumed that, as the river flows increased from a low-flow state to a higher-flow state and the new plant would need to be brought on line, the old plant would momentarily

back down and the new plant would utilize all the flows available for generation at the best overall efficiencies. Once the total river flows increased beyond that transition point, both old and new plants would operate at their best efficiency. This same situation would occur when the streamflows were in a regressive state. It is beyond the scope of this study to fully evaluate this situation, but an agreement between operating entities would be necessary to accommodate this operating transition. The agreement could be relatively simple, say in the form of an exchange of energy, for example.

ALTERNATIVE LOCATION OF NEW POWER PLANTS

Three alternative power plant locations were considered. Note that, in the District's 1981 reconnaissance report, some 10 different alternatives are outlined. For this study, costs were developed only for the best locations of three different operating alternatives.

5U. Upper falls - The new plant would be located within the existing abandoned wasteway No. 2.

2L. Lower falls - The new plant would be located on the left bank, adjacent to the existing lower falls power plant.

8Ud. Combined falls - A penstock would connect the upper falls forebay with the lower falls tailwater. The new power plant would be located on the left bank adjacent to the lower falls power plant.

SCOPING ANALYSIS

Annual project benefits were prepared for a series of plant sizes for each alternative power plant location. Daily streamflows were routed through the projects for a 50-year period of record using NPD's

DURAPLOT power program. Daily streamflows were used along with forebay elevation data and tailwater elevation data. Head losses were combined to produce the net generating heads for each day of recorded streamflow.

Turbine-generator data were inputed for several different combinations of units. Power-duration curves for each month were then developed. These data were used to compute the project benefits.

Dependable capacity for each plant was computed on the basis of the critical load months of July and August. Average annual energy for each plant was then computed. Unit power values for dependable capacity and annual energy received from FERC, Chicago office, were then used to compute the total project benefits. The unadjusted power values used in the feasibility report analysis by the North Pacific Division were as follows.

Capacity - $145.22/kW-yr
Energy - 38.0 mills/kWh

These values, with appropriate adjustments to the capacity value for mechanical availability, were applied to the dependable capacity to obtain annual capacity and energy benefits.

Costs were prepared for several powerhouse sizes for each alternative location. The types of turbine-generators are described in the preceding table. Additional costs for items exclusive of the powerhouse were received from the St. Paul District. These total investment costs were then amortized; operation, maintenance, and replacement costs were included; and annual costs were produced that could be compared to the annual benefits, described in the paragraph above. The selected plant size for each alternative location was made

using a net benefit analysis. The step-by-step analysis is discussed thoroughly in chapter 6 of the technical appendix.

SUMMARY

The following table summarizes the North Pacific Division plant sizes for the upper falls (5U), lower falls (2L), and combined (8Ud) alternatives as developed by NPD. The summary utilizes a 7 7/8-percent interest rate, October 1982 prices, and a 100-year project life. These figures were subsequently modified slightly by the St. Paul District, to add in costs for real estate and preservation of visual aesthetics, and to utilize October 1983, price levels (see page 90, Benefit-Cost Summary table).

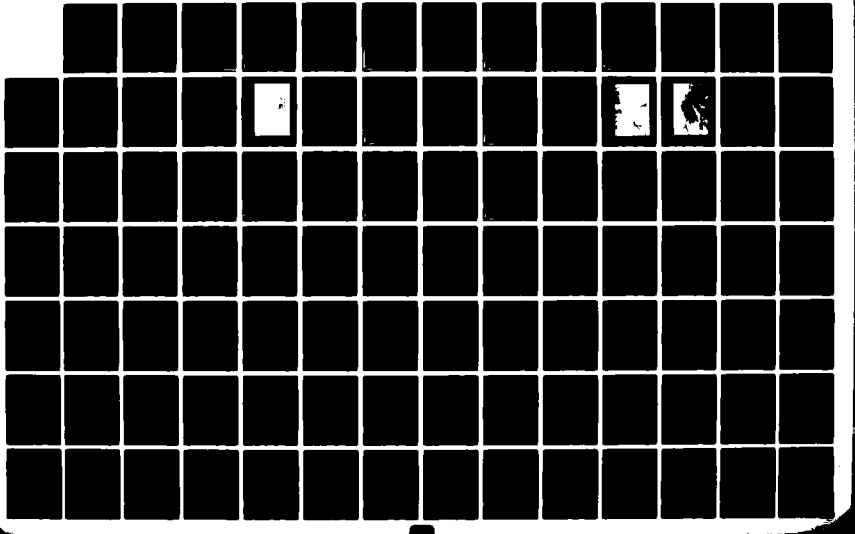
St. Anthony Falls - Summary of Selected Plant Sizes[1]

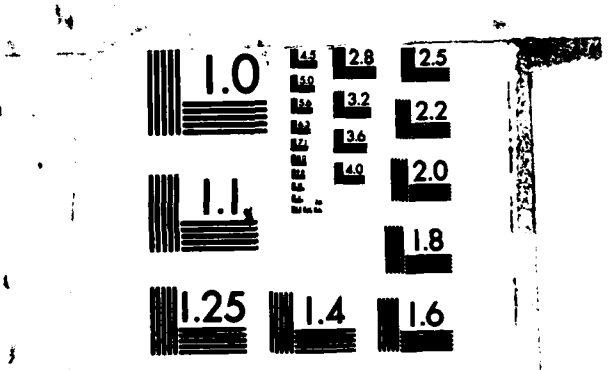
Item	Upper Falls	Lower Falls	Combined
Installed capacity	21 MW	5.4 MW	28 MW
Number of units	2	1	2
Type of turbine	Vertical propeller (fixed blade)	Horizontal bulb Kaplan	Vertical Propeller (fixed blade)
Hydraulic capacity	6,200 cfs	3,100 cfs	5,500 cfs
Average net head	49 feet	22 feet	70 feet
Annual energy	74,880 MWh	18,900 MWh	83,710 MW
Annual plant factor	41%	40%	34%
Deperdable capacity	8.8 MW	2.3 MW	9.5 MW
Total investment cost	$23,860,000	$9,938,000	$37,311,000
Total annual cost	2,124,000	899,000	3,192,000
Total annual benefits	4,403,000	1,125,000	4,862,000
Net benefits	2,283,000	226,000	1,670,000
Production cost	28 mills/kWh	48 mills/kWh	38 mills/kWh
Benefit-cost ratio	2.1	1.2	1.5

(1) North Pacific Division Report - Appendix D - Exclusive of real estate and visual aesthetics costs

AD-A140 262 FEASIBILITY REPORT FOR HYDROPOWER ST ANTHONY FALLS LOCKS AND DAMS MISSISSIPPI RIVER MINNEAPOLIS MINNESOTA (U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT 2/6

UNCLASSIFIED FEB 84 F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CONCLUSIONS

The study results show that all three alternative sites are economically justified. The upper falls site, with approximately 21 MW of additional generation, produces the maximum benefit-to-cost ratio and maximum net benefits. The lower falls is economically justified but is not as economically attractive. Either plant could be built without affecting the economics of the other. The combined alternative would exclude the upper and lower plant developments.

The maximum net benefits would occur from the upper falls (5U) and lower falls (2L) options added together. The next best option, considering net benefits, would be to build only the upper falls unit (5U). The third best option is the combined alternative (8Ud). The lowest option is to construct the lower falls only (2L). On the basis of the above analysis, the maximum net benefits would be provided by the upper and lower falls sites (alternative 5U+2L).

ENVIRONMENTAL IMPACTS

The following section generally describes the environmental impacts investigated. A more complete discussion is found in the Environmental Assessment and Section 404(b)(1) evaluation at the end of this report.

NO ACTION ALTERNATIVE

The no action alternative would result generally in the continuation of the status quo. However, because of the excess generating capacity at the site, it would be likely that given the proper economic climate additional hydropower would be installed. Impacts would be approximately the same as projected in this report.

CONSTRUCTION IMPACTS

Installation of new generating facilities requires construction of cofferdams to permit dewatering of the construction area. The construction and removal of cofferdams would locally destroy benthic organisms and temporarily increase turbidity.

The upper (5U) and the lower (2L) dam alternative would be constructed with upstream and downstream cofferdams. Combined alternative 8U would require only an upstream cofferdam. Cofferdam construction impacts can be minimized with proper construction techniques.

At the upper dam, construction in the wasteway would make use of an existing structure in an area which has already been disturbed. Construction of an outlet channel would be required but long-term impacts of this feature should be beneficial because a riprap outlet channel is provided. The lower dam powerhouse addition has a similar sized outlet channel. Lower dam construction impacts and benefits would be about the same as for the upper site channel. The combined alternative would require open excavation of Main Street and would constitute a severe disruption to St. Anthony Main, Pillsbury Company, and other interests along Main Street. The cobblestone street would have to be restored to preserve the historic nature of this feature. In the early stages of study, the State Historic Preservation Officer expressed strong reservations regarding these impacts.

Noise and dust would be an impact of any construction technique. Noise could be minimized by selection of construction methods, proper maintenance of equipment mufflers, and sound screening. Control of dust during construction can also be achieved through proper construction techniques.

OPERATIONAL IMPACTS

Upper Falls Alternative

The addition of generating units to those already in place at the upper falls would result in an increased diversion of water away from St. Anthony Falls. This would result in increased entrainment of drifting larval fish although the effect is difficult to predict since mortality of fish passing over the falls is not known. The mortality of fish passing through the turbines may be no greater or possibly less than that of passage over the falls. The type of turbines to be installed is not known to cause substantial mortality.

Other impacts which are typical of hydroelectric turbines would not be expected. Dissolved oxygen depletion would not be expected to be a problem because oxygen levels are sufficient in the vicinity. Intake velocities, though higher than those used at steam electric plants, would be within the swimming speed of most large fish. No structures are planned which might funnel fish toward the intake. Since St. Anthony Falls is a historic barrier, no interference with upstream fish passage would occur.

The quality of tailwater fishery habitat is unknown because of the hazardous conditions there. It is not expected that detrimental impacts would occur because the flow would be only slightly displaced in the tailwater.

Without the establishment of a minimum or base flow, operation of the proposed hydro station would have an adverse effect on the St. Anthony Falls Historic District. The recommended plan takes into consideration the negative historic and aesthetic effects of diverting all water to the proposed hydro station by establishing a base flow level plus rustication of the spillway and horseshoe dam. A "No Adverse Effect

Determination" has been received from the State Historic Preservation Officer. The Advisory Council on Historic Preservation has concurred with this determination with conditions (see Exhibit section of the Environmental Assessment). These conditions have been made a part of the recommended plan, and they represent the St. Paul District's compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Operation of a maximum development hydro station could significantly reduce the frequency and duration of water flowing over the upper falls. Full hydro development may have an adverse effect if the water is entirely diverted to the new hydropower station. Consequently, the State Historic Preservation Officer and other local interests believe that "some" water must continue to flow over the upper falls two spillways (see Environmental Assessment, Exhibit section, 21 November 1983 letter). Therefore, a determination was made by the St. Paul District to provide a guaranteed base flow during the current 60 percent of time that the upper falls spillways would experience overflow without the add-on power project.

A flow of 700 cfs was determined to be a desirable visual effect that could be provided, over and above the current Northern States Power Company design usage of 3,300 cfs at the upper falls. This flow, combined with roughed-up horseshoe and Hennepin roll dam spillways, could preserve visual aesthetics during low flow periods. (This flow should be reconfirmed during subsequent design studies using modeling techniques.) The 700 cfs flow would result in approximately 0.3-foot depth of flow over the 1,400-foot long horseshoe spillway and about 0.7-foot depth of flow over the 430-foot long Hennepin roll dam.

The above base flow, plus structural modification of the horseshoe and main spillway to provide the appearance of "more flow", is incorporated as a part of the 5U portion of the recommended plan to lessen any

visual adverse impact of add-on hydropower flow diversion. The base flow must be provided to make the plan implementable from the local viewpoint.

Lower Falls Alternative

The addition of hydropower to that already existing at the lower falls would divert water that now flows through the dam tainter gates to the added powerhouse section. Expected operation effects would be basically unchanged from present conditions. There are no overflow spillways at the lower falls site.

The effects of the lower falls alternative on historic resources would consist of modifications to the lower dam powerhouse. While not within the St. Anthony Falls Historic District, this structure is considered by the State Historic Preservation Officer to be eligible for the National Register of Historic Places on the basis of architectural and historic criteria. The St. Paul District has prepared a "Determination of Eligibility" and has submitted it to the National Register. Future design of the lower falls powerhouse will be closely coordinated with the State Historic Preservation Officer and the Advisory Council to insure that the historic character of the structure is not compromised.

Combined Falls Alternative

This alternative would divert flow completely away from the pool below Upper St. Anthony Falls to the possible detriment of the tailwater fish habitat. Other effects on fisheries and dissolved oxygen would not be expected to be more pronounced than with the combination of the upper and lower falls alternative.

The combined alternative (8Ud) would require a 1,200 cfs release over the upper falls spillways to provide the existing lower falls NSP plant

with prior water right allotments. (Lower NSP plant capacity is 4,500 cfs versus upper NSP plant capacity of 3,300 cfs.) Area interests would possibly be more receptive to this operational scheme from the visual aesthetics viewpoint. (See Department of Energy letter recommendation, 17 November 1983, Environmental Assessment, Exhibit section).

The major impacts from this alternative come from construction of the channel connecting the intake of the penstock with the new powerhouse and from construction of the new powerhouse adjacent to the lower dam hydro station. Impacts of the latter were discussed in the previous section and would be substantially similar for this alternative.

Construction of the channel would have an adverse impact on portions of the Pillsbury A Mill (a significant resource within the St. Anthony Falls Historic District) and on other mills located along Main Street. This channel would crosscut intakes, vaults, tailraces, and other components of these mills. In addition, Main Street, which is surfaced as originally constructed, would be adversely impacted.

SOCIAL IMPACTS

Social impacts resulting from construction activity, noise, and dust would be most severe in residential areas adjoining the project area. Social controversy could arise through selection of dredged material sites and inequitable distribution of project costs and benefits.

The city of Minneapolis and area developers have gone on record favoring a flow of water over the upper falls, for aesthetic purposes, during 10 months of the year. In fact, the upper falls spillways are currently dry about 40 percent of the time due to existing flow diversions for hydro by Northern States Power Company. A project, 5U+2L plan with full development, would reduce the spillway overflow

from 60 percent of the time at present to 20 percent of the time with full development. However, providing a base flow of 700 cfs and modifying the horseshoe and lower roll dam in the 5U+2L plan would offset the visual impact of full hydro development.

With the combined plan 8Ud, there would be a considerable impact during the estimated 2-year construction period due to the Main Street construction. This could have a severe effect on the existing St. Anthony Main development which is patterned after the San Francisco Wharf development concept, with restaurants and shops. On the other hand, the combined plan in operation would be almost entirely underground, except for the intake structure near the old Main Street station. Also, the combined plan would require the release of 1,200 cfs over the upper falls spillways to meet the first priority needs of the NSP lower falls plant, described earlier.

RECREATION IMPACTS

The diversion of flow through a proposed power plant rather than over the upper falls could have a minimal adverse impact on recreational user experience in the various adjacent recreation areas. The impressive power of nature, as manifested in the upper falls during some flow conditions, will be decreased under the proposed project conditions. This is an inherent trade-off of using flows (over the spillway) for added hydropower generation. Generally, the decrease in flows over the upper falls will not involve lengthy periods of time, and the number of viewers who would not see these flows over the falls is not substantial. Therefore, this decline in the duration and magnitude of "roaring whitewater" is not considered significant.

This sensory loss could result in a slight decrease in visitor experience for those visitors who would have experienced the impressive power of nature. Existing visual resources are adequately maintained

in the proposed plan and would therefore not be a significant adverse factor to future recreational development or use. The proposed 5U+2L plan could offer increased interpretive potential if a hydropower interpretation facility were incorporated as part of the final detailed plans. The net long-term implications of the proposed project on recreation are considered to be neutral. In the short-term, the proposed project would be somewhat disruptive to the present recreational activities along Main Street. This is due to construction activities which are estimated to take 2 years.

The combined plan 8Ud would have effects on recreation similar to those of the 5U+2L plan. The aesthetics of the upper falls would be preserved by this plan also, with a 1,200 cfs release over the upper falls spillways to meet the design capacity of the existing NSP lower plant, which is 1,200 cfs greater than the design capacity of the existing upper plant. The plan would be disruptive to the present recreational activities along Main Street during the 2-year construction period.

IMPACTS UPON CULTURAL RESOURCES

A number of impacts to historic and archeological resources would result from construction of the proposed hydropower development at St. Anthony Falls.

Alternative 5U is within the St. Anthony Falls Historic District, a National Register of Historic Places property. The major impacts are visual impacts to the District and proposed modifications to the horseshoe dam and spillway. The potential for archeological sites at the upper falls was eliminated by the construction of wasteways 1 and 2.

At the lower dam (alternative 2L) major impacts are related to the lower dam hydro station, a potentially eligible National Register property. Here the existing powerhouse would be altered by the addition of the proposed powerhouse. It is likely that construction in this area destroyed what prehistoric archeological potential existed; however, there is a potential for extant historic archeological remains at this location.

As with alternatives 5U and 2L, the combined plan (alternative 8Ud) has visual impacts from the addition of the powerhouse and intake structures. Also, major adverse effects would result from the construction of the Main Street channel where features from the Pillsbury A Mill and other mills would be destroyed. The original surfaces of Main Street would also be disturbed, and archeological resources at the lower hydrostation would be impacted.

Identification and evaluation of cultural impacts has been coordinated with the National Park Service, the Minnesota State Archeologist, the Minnesota State Historic Preservation Officer, and the Advisory Council on Historic Preservation. A more detailed discussion of cultural impacts can be found in the environmental assessment.

CONTRIBUTION OF PLANS TO NATIONAL OBJECTIVES

GENERAL

The selected plan must satisfy planning objectives and show a positive contribution to national economic development, consistent with protecting the environment.

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

The (5U+2L) plan best meets these requirements, with maximum annual net benefits of $1,597,900 and with less adverse environmental effects than

plan 8Ud, for example (see previous environmental summary and the environmental assessment following this report). Developing only the upper site (alternative 5U) would have somewhat less environmental effects because only one construction site would be involved. However, annual benefits are $98,900 less than for the 5U+2L option.

The following three tables support the above conclusions.

Estimate of Annual Charges ($1,000)[1]

Features	Upper Falls	Lower Falls	Total
Construction first cost (NPD-Oct 82)	$16,999	$ 6,978	
Construction first cost (NPD-Oct 83)	17,262	7,078	
Construction first cost (NCS-Oct 83)	17,837[2]	7,078	
Contingencies	3,180	1,216	
Subtotal	21,017	8,294	
Inflation adjustment	-1,357	-413	
Subtotal	19,660	7,881	
Engineering and design, supervision and administration	2,359	946	
Subtotal	22,019	8,827	
Interest during construction	3,015	1,281	
Total NED investment cost	25,034	10,108	$35,142
Real estate	92	104	196
Contingencies	18	21	39
Disposal area	63	87	150
Total NED investment cost including real estate	25,207	10,320	35,527
Interest and amortization of investment cost[3]	2,049	839	2,888
Annual operation, maintenance, and replacement	266	118	384
Total annual charges	2,315	957	3,272

(1) See the technical appendix, sections 5 and 6, for detailed explanation of items.
(2) Upper falls construction first cost modified to include grooved concrete overlays for the horseshoe and lower roll dam spillways, to preserve aesthetics. Added first cost of $575,000.
(3) 8-1/8 percent and 100-year life (I and A factor = 0.08128).

St. Anthony Falls Benefit-Cost Summary

Item	Alternative for added power: Upper falls (5U)	Lower falls (2L)	(5U+2L)	Combined (8Ud)
Plant Data				
Installed capacity, MW	21	5.4	26.4	28
Average annual energy, MWh	65,120(1)	18,900	84,020	83,710
Average annual plant factor (percent)	35	40	(See	34
Quantity and type of turbine	2 vertical propeller	1 horizontal bulb Kaplan		2 vertical propeller
Runner diameter (meters)	3.35	3.35	upper	3.0
River flow, cfs @ design head	6,200	3,100		5,500
Net design head (feet)	49	22		70
Design head power output, kW	21,000	5,400		28,000
Dependable capacity, MW	8.8	2.3	and	9.5
Benefits(2)				
Capacity benefit(3)	$ 1,769,700	$ 462,500	lower	$ 1,910,500
Energy benefit (4)	2,044,300	593,400		2,628,500
Energy benefits forgone (aesthetics)	-306,000		falls)	
Total annual benefits	3,814,000	1,055,900	4,869,900	4,539,000
Costs(2)				
First cost	$22,019,000	$8,827,000	30,846,000	$33,603,000
Interest during construction (3 years at 8-1/8 percent)	3,015,000	1,281,000	4,296,000	4,386,000
Investment subtotal	25,034,000	10,108,000	35,142,000	37,989,000
Real estate	92,000	104,000	196,000	303,000
Contingencies	18,000	21,000	39,000	61,000
Disposal area	63,000	87,000	150,000	150,000
Total NED investment cost	25,207,000	10,320,000	35,527,000	38,503,000
Annual cost:				
Amortization and interest	2,049,000	839,000	2,888,000	3,129,000
Operation and maintenance and replacement	266,000	118,000	384,000	257,000
Total annual costs	2,315,000	957,000	3,272,000	3,386,000
Benefit-to-cost ratio	1.65	1.10	1.49	1.34
Annual net benefits	1,499,000	98,900	1,597,900	1,153,000
Millage rate, mills/kWh	36	51	39	40

(1) 74,880 minus 9,760 MWh's for aesthetics.
(2) 8-1/8 percent and 100-year life (I and A factor = 0.08128).
(3) October 1983 value = $201.10/kW-year.
(4) October 1983 value = $31.40/MWh.

(Rev. 3/84)

Alternative Effects on Planning Objectives

Planning objective	No Federal action	Upper falls (5U)	Lower falls (2L)	Combined (8Ud)
o Increase national economic efficiency by full utilization of renewable resource	No	Yes	Yes	Yes
o Contribute to maximum reduction of nonrenewable fossil fuels	No	Yes	Yes	Yes
o Minimize site specific environmental effects of added hydropower development	Yes	Yes	Yes	No

(1) 100-year project life, 8 1/8 percent interest, and October 1983 prices.

ENVIRONMENTAL QUALITY (EQ) PLAN

The plan that has the least effect on the environment is also the 5U+2L plan as evidenced by comments made in the 25 March 1983 Fish and Wildlife Planning Aid letter (Environmental Assessment, Exhibit section). This decision is reinforced further with the aid of the following system of accounts table.

The basic 5U plan, as well as all other hydro plans evaluated for the upper falls, diverts water through turbines and, consequently, leaves less water over the existing horseshoe and roll dam spillways. The total diversion of low flows during any portion of the current overflow periods was subsequently termed detrimental to the mystique and visual aesthetics of the falls by the city of Minneapolis and area developers who have plans to restore economic life and historical character to the downtown riverfront area of Minneapolis adjacent to the falls. Consequently, the modified 5U upper falls plan was developed that provides a base flow which would have the appearance of 1,500 to 2,100 cfs at the roll dam and 1,000 to 1,400 cfs at the horseshoe dam. This is accomplished with a base flow of 700 cfs and a structural modification to the horseshoe dam and main upper falls spillway (lower roll dam).

System of Accounts - Alternative Plans for Added Power[1]

Account	No Federal action	Upper falls (5U)	Lower falls (2L)	Combined (8Ud)
National Economic Development		----------NED Plan----------		
Annual NED benefits	0	$3,814,000	$1,055,900	$4,539,000
Annual NED costs	0	2,315,000	957,000	3,386,000
Net NED benefits	0	1,499,000	98,900	1,153,000
Benefit-to-cost ratio	0	1.65	1.10	1.34
Installed capacity (MW)	0	21	5.4	28
AAE (MWh)	0	65,120	18,900	83,710
Plant factor %	0	35	40	34
Environmental Quality				
Air quality	No change	Temporary disturbance during construction	Temporary disturbance during construction	Temporary disturbance during construction
Water quality	No change	Minor effects on turbidity during construction	Minor effects on turbidity during construction	o Minor effects on turbidity during construction o Less aeration of intermediate pool
Aquatic resources	No change	No adverse impact	No adverse impact	No adverse impact
Endangered species	No change	No impact	No impact	No impact
Archeological and historic resources	No change	o In historic district o Minor impact	No impact	o In historic district o Substantial impact on Main Street during construction
Recreational resources	No change	Minor changed visual effects 700 cfs minimum base flow with grooved horseshoe and main spillway	No impact	Minor changed visual effects 1,200 cfs minimum base flow to provide lower falls plant flow
Regional Economic Development				
Desirable community growth	No change	No impact	No impact	No impact
Local government finance				
Tax revenues	No change	No impact	No impact	No impact
Property values	No change	No impact	No impact	No impact
Other Social Effects				
Displacement of people	No change. Minor controversy due to differing positions on water use	No change. Minor controversy due to differing positions on water use	None	No change. Minor controversy due to differing positions on water use
Community cohesion			No change	
Public facilities	No change	Beneficial	Beneficial	Beneficial
Public services	No change	Beneficial	Beneficial	Beneficial
Average households served[2]	No change	10,900	3,000	14,000
Barrels of oil saved annually[3]	0	111,000	32,000	142,000

(1) 100-year project life, 8-1/8 percent interest, and October 1983 prices.
(2) An average household may use 6,000 kWh per year of electricity.
(3) 1.7 barrels saved per MWh.

THE RECOMMENDED PLAN

The recommended plan is alternative 5U (upper falls) plus 2L (lower falls). This option provides the maximum net benefit and the least impact on the environment. The plan for the upper site is shown on plates 5, 6, 14, and 15, and for the lower site on plates 7, 8, and 15. Existing and proposed electrical transmission line locations are shown on plate 9.

The 5U alternative adds a 21 MW plant to the existing 12.4 MW upper falls site. The plant would be located in the presently unused wasteway No. 2, which parallels the southwest side of the University of Minnesota Hydraulic Laboratory. Two vertical axis, fixed blade propeller units would generate 65,120 MWh average annual energy from the new plant. The final 5U alternative also includes a grooved concrete overlay on the 1,400-foot long horseshoe and 430-foot main roll dam spillways. The grooved overlays in combination with a 700 cfs base flow release over the spillways, whenever the proposed 21.0 MW plant is operating, will provide desired visual aesthetics.

The 2L alternative adds a 5.4 MW plant to the existing 8.0 MW lower falls site. The plant would be located along the east side of the existing plant, on the left bank of the Mississippi River. One horizontal axis Kaplan bulb unit would generate 18,900 MWh of average annual energy from the new plant addition.

A convenient summary of the recommended plan turbine and related details is shown on the following tabulation for the upper and lower sites.

St. Anthony Falls Recommended Plan - Turbine and Related Details[1]

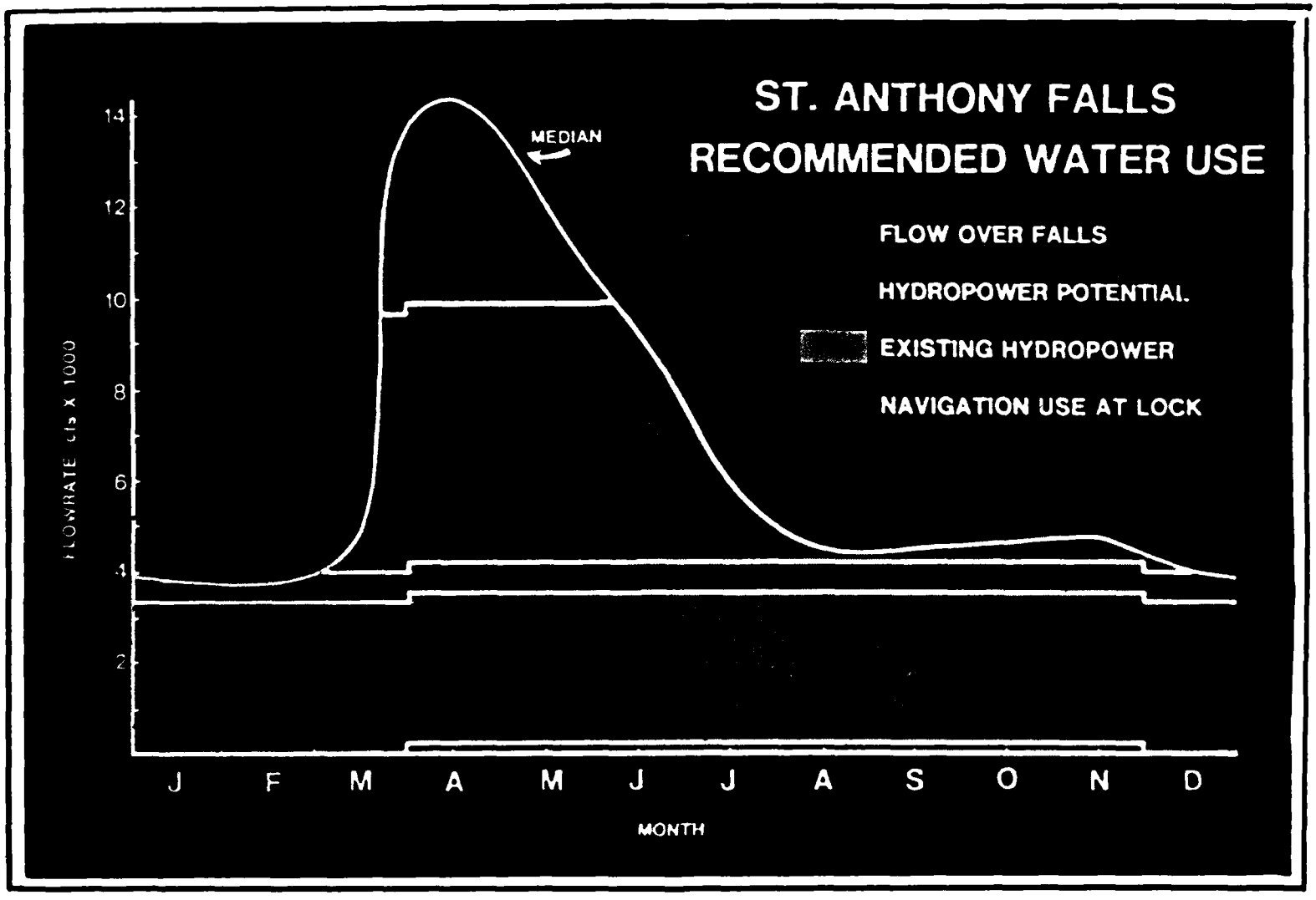
Item	Upper site	Lower site
Number of units	2 - 10.5 MW	1 - 5.4 MW
Type of turbine	Vertical propeller	Bulb-Kaplan
Shaft	Vertical	Horizontal
Runner type	Fixed propeller	Kaplan
Number of blades	5	4
Blade to blade clearance	(3)	(3)
Runner diameter	132 inches	132 inches
Runner to case distance	(3)	(3)
Mixed or axial flow	Axial	Axial
Wicket gates (number)	Yes ((3))	Yes ((3))
Normal gate opening	Full	Full
Operation (percent of full capacity - frequency curve)	(Figure 3-1)[4]	(Figure 3-2)
Turbine setting (relative to tail water)	11 feet[2]	14 feet[2]
Runner RPM	163.64	116.0
Mode of operation	Shut down turbines one at a time (see 6.07)	
Trash rack size/spacing	(3)	(3)
Monthly hydrographs	(Appendix B, Monthly Power Curves from the technical appendix)	

(1) In some instances, data will be found on the indicated page references of North Pacific Division's Technical Report (the technical appendix).
(2) Distance from propeller center line to minimum tailwater.
(3) Not available until detailed design stage.
(4) First 700 cfs flow above 3,300 cfs line will be allocated for visual aesthetics.

SITE DEVELOPMENT OPTIMIZATION

The study was conducted on the basis of adapting the existing plants for additional hydropower generation and was limited to assessing an increment of available flow beyond that now used by the existing plants. This increment of higher flow was used to determine the size and capability of added generating units at each site. Each site was optimized by preparing a series of annual project costs and comparing them with corresponding annual benefits.

The work by the North Pacific Division optimized the proposed development at the Upper and Lower St. Anthony Falls sites for maximum hydro development. However, the optimized plan was not implementable due to strong local objections in the area of visual aesthetics and historic considerations. The recommended plan was therefore modified to include a 700 cfs flow release for aesthetics and rustication of the two upper falls spillways. The recommended plan, from a Federal perspective, is therefore the optimum site plan and is shown graphically on the following figure.


ST. ANTHONY FALLS
RECOMMENDED WATER USE
FLOW OVER FALLS
HYDROPOWER POTENTIAL
EXISTING HYDROPOWER
NAVIGATION USE AT LOCK
MEDIAN
FLOWRATE cfs X 1000
14
12
10
8
6
4
2
J
F
M
A
M
J
J
A
S
O
N
D
MONTH

STANDARD PROJECT FLOOD CONSIDERATIONS

The recommended plan for the Upper and Lower St. Anthony Falls sites has no added adverse effect on the standard project flood heights. The wasteway site is currently blocked with concrete. Flood flows pass through the existing power plant, over the horseshoe dam and lower roll dam, and through the main lock. At the lower site, flood flows pass through the existing plant, the tainter gates, the auxiliary lock, and tne navigation lock. The added power features would not decrease the present flow capacity at either the upper or lower site and would, in fact, provide added flow capability that could be utilized during floods. A grooved overlay to preserve the horseshoe and lower roll dam flow aesthetics will be modeled to insure present flow capability.

PUBLIC SAFETY CONSIDERATIONS

The recommended plan would pose no added safety hazards to the public.

VISUAL HISTORIC CONSIDERATIONS

During coordination with the State Historic Preservation Officer and the Advisory Council on Historic Preservation, and as a result of public involvement, it became apparent that maximizing hydropower benefits by diverting all available water to the proposed hydro station was unacceptable. While the aesthetic and historic environments are interrelated, the flow levels required for each are different. It is the opinion of the Minnesota State Historic Preservation Officer that "to again utilize water impounded by the existing dam is consistent with the structures' original purposes and the district's history, and therefore does not constitute an adverse effect" (letter of 21 November 1983).

The severe shortage of water for operating the mills at St. Anthony Falls in the late 1800's was documented by Lucile M. Kane in

The Waterfall that Built a City (1966, Minnesota Historical Society). The water shortage problem was corrected in part by the Federal Government's interest in maintaining navigation on the Mississippi River. The construction of the headwaters reservoirs in the 1880's greatly benefited the mills at St. Anthony Falls. During the 3 months of low water, the reservoirs contributed about a foot of water at St. Paul (Kane, p. 159). The benefits of the headwaters system were so obvious to the milling interests at St. Anthony Falls that between 1900 and 1910 John S. Pillsbury, president of the St. Anthony Company, donated to the Federal Government 2,000 acres of land for flowage at Gull Lake (Kane, p.159).

The period of the late 1800's and early 1900's, with its battles over who was to use not only the natural flow of the river at St. Anthony Falls but also the added flow from the headwaters reservoirs, is only a segment of the history of St. Anthony Falls which is represented by its nomination to the National Register of Historic Places. Viewing the falls within a dynamic historical process, the Minnesota State Historic Preservation Officer concluded that a *no flow condition* would be "inconsistent with the other major association of the falls as a natural waterfalls" (letter of 21 November 1983). From this perspective, diverting all water to hydroelectric generation would constitute an adverse effect. Both the view of the falls from the historic perspective as a workhorse of the milling era and the view from the more aesthetic perspective of the falls as a precursor to the scenic beauty of the natural falls are correct. However, each brings to mind a flow level different than the other. In an effort to balance these views, the Minnesota State Historic Preservation Officer concluded that "diverting water from the spillway to generate additional hydroelectric power will have no adverse effect, so long as some flow over the spillway is maintained" (letter of 21 November 1983).

The St. Paul District has incorporated a number of features into the recommended plan (discussed in the following Aesthetic Considerations Section) which attempt to deal with the interrelated historic and aesthetic attributes of St. Anthony Falls. Since the requirements for aesthetic base flows are greater than the requirements for the historic milling period base flows, the recommended plan focuses on the greater flow requirements.

An additional feature which is significant to the historic and aesthetic attributes of the St. Anthony Falls Historic District and the potentially eligible lower dam hydro station is the exterior design of the proposed hydro stations (alternatives 5U and 2L). Future planning and design of these hydro stations will require close coordination with the Minnesota State Historic Preservation Officer, the Minneapolis Heritage Preservation Commission, and the Advisory Council on Historic Preservation to ensure that the structures' design will not detract from the historic characteristics of the St. Anthony Falls Historic District.

AESTHETIC CONSIDERATIONS

Visual resource analysis is largely a qualitative and somewhat subjective analysis because aesthetics lie in the eyes of the beholder. Definition of an acceptable visual appearance at Upper St. Anthony Falls is also complicated by a number of compounding factors which are noteworthy. First, an acceptable appearance is needed at both the horseshoe spillway and the concrete roll dam which make up the falls. Second, structural changes to the surfaces of the spillways can significantly enhance the appearance of water flowing over these features. This engineering technique, known as rustication, can make a relatively small flow of falling water appear to be a much larger flow. Third, aesthetics of the falls are seen in different ways by different groups (e.g., as a public amenity by the general public and the City Park Board, as a cornerstone for future riverfront development by

developers and local government, as a significant historic feature to be preserved by the Historic District and the State Historic Preservation Officer, etc.). Each group sees the upper falls as significant, and seeks to provide some form of protection and guidance as to future development of these features. Yet, because each group has a different prime motivation, the perception of what is acceptable and/or desirable for each group differs to some extent.

Because of these complexities, there was a need to address in this feasibility level report the acceptable aesthetic appearance to be maintained at the upper falls. To accomplish this, a range of base flow alternatives was compared to the character of the upper falls as viewed from the St. Anthony Falls lock visitor platform without the project. This approach allowed the use of quantitative data about existing use and flows as a proxy to evaluate potential visual implications of alternative plans. These quantitative evaluations, plus the coordination effort following the September 1983 draft report, helped to identify a reasonable set of visual quality measures. These measures could be combined and implemented to maintain the visual resources of the upper falls while maintaining the feasibility and effectiveness of hydropower generation.

Both the horseshoe falls and the concrete roll dam would be rusticated(1) to make flows look greater, thereby optimizing hydropower benefits. It was determined that an appearance of 1,000 cfs to 1,400 cfs of flow over the existing horseshoe falls and an appearance of 1,500 cfs(2) to 2,100 cfs over the existing roll dam might be possible with a 700 cfs flow and structural modification. To accomplish these appearances, a combination of base flow and an optimized rustication design for each structure would need to be engineered. These rustication designs could be developed only through physical model studies which are not appropriately accomplished in a feasibility study. Therefore, the specific design of rustication features for the

(1) Rustication refers to structurally changing surfaces to enhance flow appearance.
(2) This is the base flow prescribed in the Mills District Plan, January 1983.

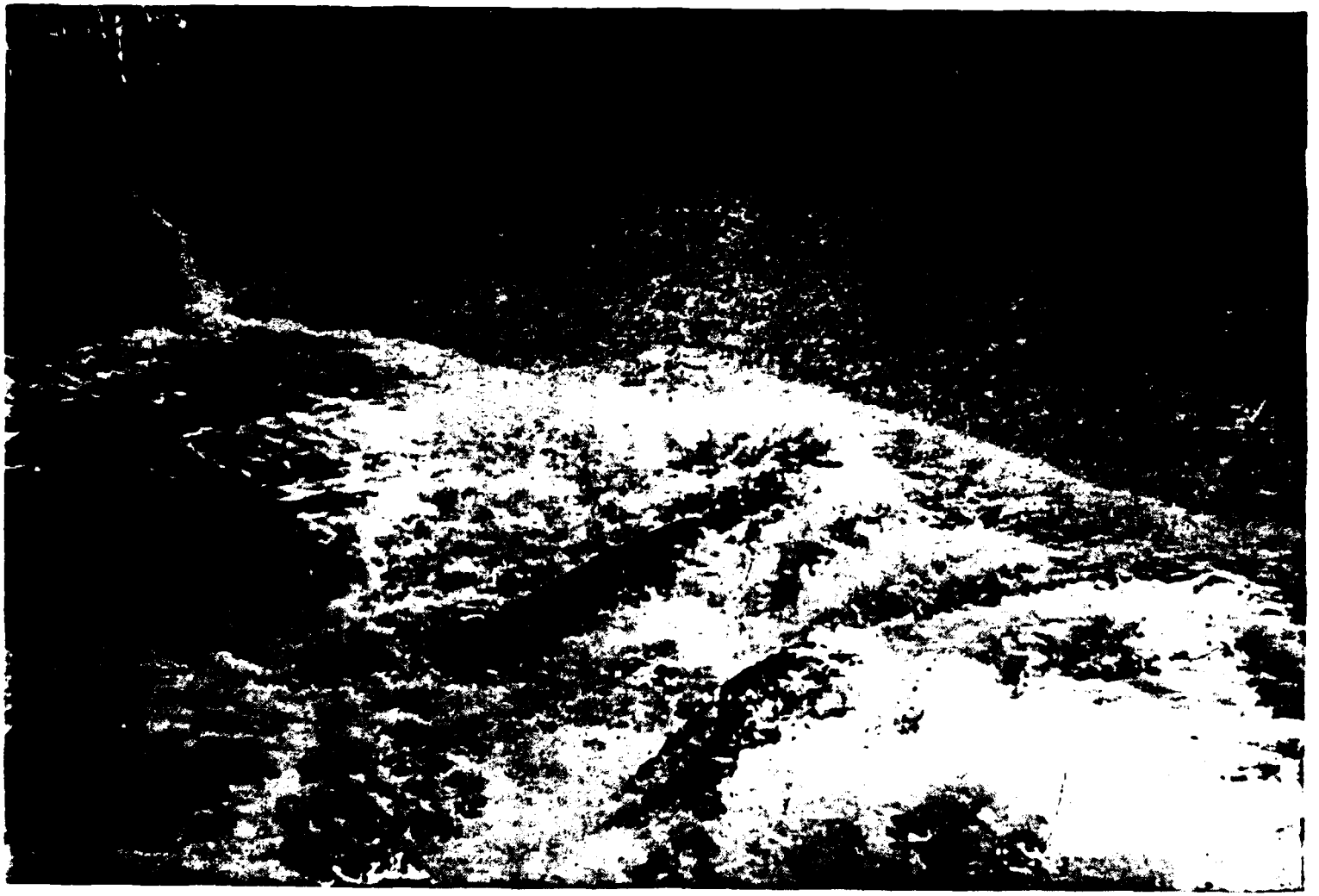
horseshoe and roll dam will need to be conducted in future detailed planning studies.

Given experience with other existing rustication projects, a base flow of approximately 700 cfs was identified as the flow which could be made to give the appearance of 1,500 to 2,100 cfs over the existing roll dam and 1,000 to 1,400 cfs over the existing horseshoe. Therefore, there is little or no visual impact associated with the recommended plan. The falls would still be dry approximately 40 percent of the time during the period of record, under both existing and recommended project conditions. The recommended plan would not improve on the current non-overflow periods for the falls. Other visual aspects of this project relate to how the added transmission lines and hydro stations are constructed. The recommended plan includes provisions to bury all transmission lines. The design of the powerhouse will be coordinated with the appropriate historic review agencies. Therefore, no adverse impacts upon existing conditions will result from these activities.

An example of the visual effect of a small amount of water flowing over the falls or spillway is shown on the following two photographs of an existing structure in northern Minnesota. Horizontal grooves or corrugations are cast into a concrete overlay covering the face of the dam which causes a small amount of overflow to appear much more significant.



Prairie Portage Dam Showing Grooved Spillway



Prairie Portage Dam With 0.3- to 0.5-Foot Depth Overflow

ENVIRONMENTAL CONSIDERATIONS

Environmental features incorporated or considered in the recommended plan include the following items which were recommended in the 25 March 1983 Fish and Wildlife Planning Aid letter. The Planning Aid letter, the detailed Corps response, and the October 24, 1983, Fish and Wildlife Coordination Act Report are included in their entirety in the Environmental Assessment, Exhibit section.

- o The recommended power facilities will be operated witnin the existing constraints, and no added storage and release of flows are proposed over existing conditions.

- o Trash racks are provided to minimize entrainment losses. Installation of screens to prevent passage of fish would not be a cost effective way to handle turbine flows without clogging. The Fish and Wildlife Service recommended no lighting in the turbine entrance approach area to minimize attracting fish. However, lighting is needed to allow cleaning of trash racks and for safety reasons. These lights can be kept to a minimum and their use limited to critical times.

- o The Fish and Wildlife Service recommended that approach velocities be designed to be 0.5 foot per second or less to allow fish to escape from in front of the intake. This is not engineeringly feasible, and velocities are expected to be 2 to 3 feet per second or more.

- o The Fish and Wildlife Planning Aid letter recommends horizontal-axis Kaplan turbines that have adjustable blades to minimize fish mortality. However, horizontal-axis Kaplans would not achieve the project purpose at the upper site. It was determined that the upper site would best utilize two vertical axis propeller (fixed blade) turbines because of the relatively stable 49 feet of head.

The lower falls, with approximately 22 feet of design head, will have a single horizontal axis bulb Kaplan unit (variable pitch blades). The variable pitch blades are desirable in this location because the head differential is more variable. The proposed upper and lower falls units will be operated at maximum efficiencies to minimize fish mortality as recommended by the Fish and Wildlife Service.

- Cavitation (negative pressure) will be minimized in the structure design as much as possible to reduce fish mortality.

- The Fish and Wildlife Service recommended that "large clearances (be) provided between the vanes of the runners and between runners and wicket gates." The recommended plan facilities will be equipped with wicket gates and runners with vane clearances as required by environmentally sound design practices.

- Turbine mortality estimates were made for the St. Anthony Falls sites by Corps environmental staff. These results are discussed in the accompanying environmental assessment and in the Planning Aid letter response contained in the Environmental Assessment, Exhibit section. The Corps estimates show that added turbine effect on fish mortality would be minimal. In addition, it appears that, if the proposed new units were operated in preference to the already installed units, adverse effects on fisheries at St. Anthony Falls could actually decrease.

- The recommended plan will use existing transmission lines and crossings in the project area as much as possible. However, new lines are required from the upper site 21.0 MW plant to the old Main Street plant switch yard and from the 5.4 MW plant to a nearby transmission line (see plate 9). The new lines will be buried.

- o Construction impacts will be minimized. No dredging will be required. Excavation will take place within cofferdams at the project site. Excavated material will be trucked or barged to a suitable landfill.

- o The recommended plan retains the same amount of flow passing through the intermediate pool (as opposed to the combined plan, which would bypass new plant flows around the intermediate pool).

- o The recommended plan includes a base flow of 700 cfs and modification of the horseshoe and main (lower roll) dam to preserve the visual aesthetics of the upper falls area.

The Fish and Wildlife Service 25 March 1983 Planning Aid Letter also suggested that consideration be given to including the following measures in project design: (1) large riprap in the powerhouse tailrace areas to provide habitat for fish and benthic organisms, (2) a supply of fresh water to be added to the backwater areas immediately below the old Main Street hydro plant, and (3) additional public boat access and facilities for shoreline and pier fishing from lock and dam 1 to St. Anthony Falls.

The first measure is easily complied with as riprap bank protection will be used for scour protection in the tailrace areas. The second measure can likely be met through small releases via an existing 5-foot sluiceway that parallels the north side of the existing plant. Discussions with Northern States Power Company officials indicate that this is a good possibility.

Further consideration of added public access for boat launching and shoreline fishing in the immediate Upper and Lower St. Anthony Falls area is out of the question because of the high banks and the relative inaccessibility and congestion of the area. Recreational boating in the vicinity of the Upper and Lower St. Anthony Falls sites should be

discouraged because of the dangerous current situations and possibility of being drawn over the upper falls roll dam or through the Lower St. Anthony Falls gates. The 50-acre intermediate pool which is controlled by the Lower St. Anthony Falls dam is obviously too small for recreational boating.

Similar high banks exist in the lock and dam 1 to St. Anthony Falls reach of the river. Although this part of the river is not as congested commercially or subject to dangerous current situations as the St. Anthony Falls area, the city of Minneapolis is not encouraging added boat launching or improved fishing access in this area.

REAL ESTATE REQUIREMENTS

The location of the proposed new hydro units in wasteway No. 2 of the Upper St. Anthony Falls site and adjacent to the existing lower hydro plant (Lower St. Anthony Falls) is on Northern States Power Company property. The recommended plan for the upper and lower falls sites would require acquisition of 3.8 acres. Acquisition would be the responsibility of the Federal Government. Of the total acreage, approximately 3.2 acres would be acquired in fee for the powerhouses and 0.6 acre in temporary work area easement. It is estimated that approximately 3 ownerships would be affected. The estimated cost of acquiring the necessary right-of-way is as follows:

3.2 acres fee	$189,000
0.6 acre temporary work area	3,000
Contingencies	38,000
Total	230,000

The recommended plan would also require a disposal site. An existing site referred to as the Port of Minneapolis Upper Harbor Site would be used. It has been estimated for planning purposes only that the acquisition of a temporary easement on a 5-acre disposal site is

required to store the 137,400 cubic yards of excess material for a period of 2 years. The material will be used by private contractors, free of charge, and will all be removed from the site within the 2-year period. The temporary easement would cost approximately $150,000.

Access to both power sites would be provided across lands currently owned by Northern States Power Company. Access is from the left, or east bank, for both upper and lower sites. Both sites are readily accessible by land on the east and from the Mississippi River on the west. Construction and operation access agreements would be negotiated with Northern States Power Company.

There could be some limited materials disposal at each power site and this would be in conformance with design plans and specifications. However, most materials disposal would take place at a location upstream of the Upper St. Anthony Falls power site, as identified and discussed in a later section titled "Potential Disposal Areas." Site access is also discussed further under the Civil Features section for Upper and Lower St. Anthony Falls.

SENSITIVITY ANALYSIS

The North Pacific Division did a sensitivity analysis on the recommended plan using different interest rates and a different project life (see the technical appendix, section 6). They found that project economics were affected insignificantly by changing from a 100-year to 50-year project life. The effect on the project benefit-cost ratio would be negligible. However, changing the interest rate to 14 percent, for example, would reduce the benefit-cost ratio by about one-third.

The following table of recommended plan costs and benefits was prepared using a 100-year period of economic life, with several interest rates, and an October 1983 cost level. The costs and benefits in this table

are recommended plan costs, including all real estate and aesthetic measure costs. (Real estate and aesthetic costs are not included in the North Pacific Division (technical appendix) cost estimates.)

Comparison: Interest Rates and Periods of Economic Analysis
(Recommended Plan, October 1983 prices)

Site	Interest rate	Annual costs[1] (1,000)	Annual benefits[2] (1,000)	Net benefits (1,000)	Benefit-cost ratio
Upper Falls (21.0 MW)	8 1/8	2,315	3,814	1,499	1.65
	14	4,280	5,101	821	1.19
Lower Falls (5.4 MW)	8 1/8	957	1,056	99	1.10
	14	1,750	1,390	-360	0.74

(1) Costs for 8-1/8 percent and 100-year life.
(2) Benefits for 8-1/8 percent are from the table on page 90.

HYDRAULIC POWER AND ENERGY ANALYSIS

AVERAGE ANNUAL ENERGY

The power potential at each site was determined using the North Pacific Division's Power Duration Plot Program (DURAPLOT). This computer program analyzes daily average flow, forebay and tailwater data, and constraints associated with various sized power installations. The program produces annual and monthly flow-duration curves and corresponding power duration curves. All data are based on daily flows and are for flow and generating head ranges of specific turbine generator sizes. The available power potential was that which would be available over and above that which is presently generated by the existing facilities.

Several sizes of installations were investigated for each of the three sites (upper, lower, and combined). Also, different combinations of generator inputs were studied. The number of units selected at each

site was primarily a function of the existing power plant's capability and with an eye to future project operation. Net benefits were computed for various plant sizes weighing costs versus benefits. The 21.0 MW upper and 5.4 MW lower units provide the maximum net benefits for those particular sites. The average annual energy expected from each site is as follows:

Site	Added capacity (MW)	Added annual energy (MWh)
Upper (5U)	21.0	65,120(1)
Lower (2L)	5.4	18,900

(1) 74,880 minus 9,760 MWh's for aesthetics.

DEPENDABLE CAPACITY

The dependable capacity is defined as the amount of capacity available in a period of time (usually a critical month, from the standpoint of load and hydrologic availability). Dependable capacity is frequently less than the installed capacity and reflects hydrologic availability. For this study, hydrologic availability is defined as the plant factor at which the plant is projected to operate during the highest electric demand period of the year, which is the July-August time period for electric utilities in the vicinity of the site.

Dependable capacity = Installed capacity x Hydrologic availability

The dependable capacity of the relocated plant sizes for Upper and Lower St. Anthony Falls sites is:

Site	Capacity (MW)	Hydrologic availability	Dependable(1) capacity (MW)
Upper (5U)	21.0	42 percent	8.8
Lower (2L)	5.4	41 percent	2.3

(1) July-August.

It should be noted that not all electric utilities calculate dependable capacity as indicated above. In the case of NSP, the present hydropower licensee, plant output under median stream flow conditions applies, as discussed in NSP's 10 November 1983 letter in the Environmental Assessment, Exhibit section.

MONTHLY POWER GENERATION

As stated previously, the DURAPLOT program produces monthly power duration curves. These curves are available in appendix B of the North Pacific Division Report, which is the technical appendix of this report.

The St. Anthony Falls site operates in both a peak winter (December-January-February) system and a peak summer (July-August) system. The summer load for July and August is the more critical of the two.

GEOLOGICAL - TECHNICAL

GEOLOGY

St. Anthony Falls constitutes an extremely important geologic feature which was a major factor in both the topographic development of the Mississippi River valley in Minneapolis and the early settlement of the city. An understanding of the recent geologic history of the falls is, therefore, a prerequisite to an appreciation of the physical conditions at the site.

Late in the Pleistocene Epoch the falls were located near the mouth of the Minnesota River, and the river valley above the falls was a shallow feature bordered by gentle drift terraces similar to the valley upstream of the present falls. Resistant Platteville limestone overlying easily eroded St. Peter sandstone formed the falls. Water cascading over the falls continuously eroded the sandstone and undermined the limestone, allowing it to collapse. Due to this

process, the falls retreated upstream and left behind the deep, narrow gorge that now exists between the falls and the Minnesota River.

By the time Father Hennepin described the falls in 1680 they had migrated to a point 1,600 feet downstream of their present location, and by 1868 the falls had progressed upstream nearly to where they are now. This rapid recession between 1680 and 1868 was due to the thinning of the limestone cap and the development of the falls for hydropower. Although development of hydropower provided for the early industrial growth of the city, it robbed the falls of water during the winter and accelerated deterioration of the thin limestone cap due to freezing and thawing of the exposed rock. This factor, coupled with the natural thinning of the cap rock which extends only 1,200 feet upstream from the falls, threatened extinction of the falls and prompted aggressive action to stabilize them in 1874. Without this action, the falls would probably have deteriorated to a series of rapids.

Glacial drift mantles the valley walls and rests on the eroded surface of the Platteville Formation. The Platteville is a thin bedded, moderately hard limestone. Up to 25 feet of the formation is present on the sides of the valley, but only 13 feet remains at the crest of the falls. The rock is competent foundation material that can be excavated to close tolerance. It is extremely durable where covered but breaks down on bedding planes and joints where exposed to severe weathering. It should be left exposed only where some deterioration can be tolerated.

The bedrock dips downstream toward the center of a regional structural basin. Downstream of the falls, the dip is much less than upstream where the base of the Platteville rises above river level in a distance of 1,200 feet. The steep dip upstream accounts for the rapid thinning and eventual absence of the cap rock.

The Glennwood Formation, which consists of 2 feet of soft shale and up to 3 feet of shaly sandstone, underlies the Platteville. It is generally impervious, has low strength, and weathers rapidly.

The St. Peter Formation underlies the Glennwood with a contact elevation between 761 and 764 at the falls and 758 at the lower lock and dam. It consists of 160 feet of fine-grained sandstone that is extremely friable for about 100 feet below its upper contact. The lower 60 feet of the formation is moderately to well cemented. On the positive side, the sandstone offers good bearing capacity, is easily excavated, and is a good tunneling medium. On the negative side, however, it is highly sensitive to erosion and piping by running water. Protection from running water during and after construction is, therefore, an important design consideration. Cambrian and Precambrian rocks underlie the St. Peter but are below the influence of the work considered and are not discussed.

Immediately upstream of the falls, the clean, jointed surface of the limestone cap rock is visible during low flows, but the depth of scour into bedrock and thickness of alluvial fill within project limits below the falls are not well defined. Based on limited boring data from exploration for the St. Anthony Falls Locks and Dams, maximum scour is estimated to be to elevation 704. Alluvial fill is estimated to be less than 20 feet thick and to be composed of sand and gravel with coarse limestone debris left during the recession of the falls. Dumped fill and debris resulting from the long history of use and development of the area should be expected at almost any site downstream from the falls.

Available foundation information is displayed on plates 6 and 11.

FOUNDATIONS

The proposed structures will be founded on sandstone of the St. Peter Formation. The sandstone above elevation 665 is fine-grained, very poorly cemented, and easily eroded. Below elevation 665 the sandstone is moderately well cemented, interbedded with siltstone, and frequently contains water under artesian pressure. All foundations, as proposed, will be in the upper friable portion of the sandstone. Careful control of water during construction and protection of the sandstone from running water after construction are, therefore, important design considerations. The sandstone is sufficiently friable to allow removal by machine excavation but exhibits more than adequate strength and bearing capacity to allow economical foundation design for the proposed features.

Some of the upstream work may be founded on the Platteville and Glennwood Formations. The Platteville is a thin bedded, moderately hard limestone characterized by a high frequency of bedding planes and vertical joints. Excavation in this formation will require blasting. The underlying Glennwood Formation consists of 2 feet of soft shale and up to 3 feet of shaly sandstone which can be removed by machine excavation. Neither formation presents any significant or unusual foundation problem.

Natural alluvium consisting of sand and gravel with large limestone blocks is expected in the discharge channel for the upstream powerhouse and the excavation for the downstream powerhouse. In addition, dumped fill ranging from sand to limestone rubble will be encountered in the excavation for the downstream powerhouse.

MECHANICAL AND ELECTRICAL FEATURES

GENERAL

The following is a general discussion of the mechanical and electrical requirements for hydropower additions at St. Anthony Falls. Individual discussion is presented for each of the upper and lower dam areas for clearer presentation. More detailed information on the proposed hydro additions at the Upper and Lower St. Anthony Falls sites is contained in section 4 of the North Pacific Division technical report (see the technical appendix).

UPPER ST. ANTHONY FALLS (HENNEPIN ISLAND)

Existing Mechanical Features

The existing plant is owned and operated by Northern States Power Company. The powerhouse contains five units with a total of 12.4 MW capacity. The turbine units are horizontal and were rebuilt in 1955 using new runners, shafts, and flow control gates. The turbines are rated at 3,200 hp at 240 rpm with a 48-foot head. A new unit was added in 1955 and is a vertical Kaplan with a rating of 3,500 hp at 277 rpm with a 48-foot head. The unit is automatically controlled and uses a steel draft tube liner and 13-foot diameter steel penstock.

Added Turbines

Two additional 10.5 MW vertical propeller units would be installed in the abandoned wasteway No. 2 on the west side of the St. Anthony Falls Hydraulic Laboratory and west of the existing upper falls powerhouse. Each added turbine would discharge approximately 3,100 cfs at a design head of 49 feet. The estimated runner diameters are 132 inches, and the synchronous speed is 163.64 rpm. Each new unit is rated at 14,375 hp at design head.

Turbine Controls

The added turbines would be controlled by oil actuated mechanical driven units that control the turbine wicket gates. Overall gate position would be limited to prevent operation of the turbine in an undesirable range. Various governor systems would be investigated during the detailed design stage.

Turbine Selection

Several different types of turbines were considered in this study. The vertical propeller (fixed blade) turbine was selected from those units studied. All possible turbine units would be studied further if additional detailed design studies are undertaken.

Existing Electrical Features

The present installation at the Hennepin Island hydro plant consists of five older generator units for a total of 12.4 MW site capacity. Four of the units are rated 2.75 MVA, 0.9 power factor, 240 rpm, 13.8 kV, 3-phase, 60 cycle. The remaining unit, installed in 1955, is a vertical generator with a direct connected exciter. This unit is rated 3.125 MVA, 0.8 power factor, 277 rpm, 13.8 kV, 3-phase, 60 cycle. The plant has been automated to vary output in order to maintain pool level throughout the year. Equipment in this plant is well maintained and should continue to perform adequately for many years.

Added Generators and Breakers

The added turbine generators would be a synchronous type, rated 11.67 MVA, 0.9 PF, 3-phase 60 HZ 13.8 kV. The generators would have a 75°C rise with Class B insulation system and no overload provision. A disconnect clutch would not be needed, since each unit is capable of

full runaway speed. Metal-clad breakers rated 500 MVA would be furnished in a control switchboard, which would contain complete protective relays metering and start-up/loading controls.

Excitation System

The excitation system for each unit would be the standard manufacturer's type. This can be either a bus-fed power potential, static excitation, or direct connected brushless exciter.

Connection to Load

A 3-phase 115 kV underground transmission line would tie the new upper falls plant to the transmission system, located at the existing NSP switchyard. The transformers inside the powerhouse would be sized as follows.

	Size	Voltage	
Upper	17.51/23.34 MVA	13.8/115 kV	OA/FA Class/Delta ground wye

Bridge Crane

The upper falls powerhouse would be equipped with a bridge crane due to the limited access for repairs at this site. The 50-ton crane would have a hook speed of 5 feet per minute, trolley speed of 50 feet per minute, and bridge speed of 100 feet per minute.

LOWER ST. ANTHONY FALLS (LOWER DAM)

Existing Mechanical Features

The existing plant is owned and operated by Northern States Power Company and consists of 10 outdoor-type generators driven by Leffel turbines with wicket gate control. The units were installed about 1952

in the old powerhouse. These are fixed-blade units operating at 225 rpm with an output of approximately 1,000 hp. An outside gantry crane is provided for maintenance of the units and bulkhead placement. A trash racking unit is provided for trash removal from the intake screen. The plant is fully automated from within.

Added Turbine

A single additional 5.4 MW, horizontal Kaplan (adjustable blade) bulb turbine would be installed in a separate building adjoining the northeast (landward) side of the existing powerhouse. The turbine would discharge 3,100 cfs at the rated 7,525 hp and 22 feet of net head. The estimated runner diameter is 132 inches, and the synchronous speed is 116.1 rpm.

Turbine Controls

The added turbine would be controlled by an oil actuated mechanical driven unit that controls the turbine wicket gates. Overall gate position would be limited to prevent operation of the turbine in an undesirable range. Various governor systems would be investigated during the detailed design stage.

Turbine Selection

Several different types of turbines were considered in this study. The horizontal Kaplan (adjustable blade) bulb turbine was selected from those units studied. All possible turbine units would be studied further if additional detailed design studies are undertaken.

Existing Electrical Features

This installation has 10 vertical turbine-generator units installed outdoors upstream of the old powerhouse superstructure. The total site

capacity is 8.25 MVA. All of the generators were manufactured by Electric Machinery, Inc. They are of the weather protected synchronous design with directly connected exciters. Each unit is rated 825 kVA (800 kW at 0.97 PF), 4.16 kV, 3-phase, 60 cycle, 225 rpm. The generator circuit breaker, controls, and protective relays were manufactured by Westinghouse Electric Incorporated.

The switch gear is located inside the old powerhouse. The turbine-generator units and circuit breakers were installed in 1951 as part of a site upgrade. Presently, the plant is automated remotely from within. The automatic controls were built by Autocon, a division of Honeywell, Incorporated.

Power generated by the plant is routed to the Main Street substation at 4.16 kV where it is converted by transformers to the system distribution voltage. The equipment installed at this site is of a modern efficient design.

Maintenance of generators installed outdoors in Minnesota is difficult during the winter. However, the plant is adequately maintained and should provide continued reliable operation.

Added Generator and Breaker

The added turbine generator would be a synchronous type, rated 6.04 MVA, 0.9 PF, 3-phase 60 HZ 13.8 kV. The generator would have a 75° C rise with Class B insulation system and no overload provision. A disconnect clutch would not be needed, since each unit is capable of full runaway speed. A metal-clad breaker rated 500 MVA would be furnished in a control switchboard, which would contain complete protective relays metering and start-up/loading controls.

Excitation System

The excitation system for the new unit would be the standard manufacturer's type. This can be either a bus-fed power potential, static excitation, or direct connected brushless exciter.

Connection to Load

A 3-phase 115 kV underground transmission line would tie the new lower falls plant to the transmission system, located at the existing NSP switchyard. The transformers inside the powernouse would be sized as follows.

	Size	Voltage	
Lower	4.53-6.04 MVA	13.8/115 kV	OA/FA Class/Delta ground wye

Mobile Crane

The lower falls powerhouse would require the use of a 50-ton mobile crane.

CIVIL FEATURES - UPPER FALLS

This section describes civil features pertaining to installation of additional power generating units at the Upper St. anthony Falls site. Civil features include the powerhouse, intake and exit channels, permanent access, and site work. Descriptions of construction impacts on existing structures and cofferdamming are also included.

The alternative selected for more detailed study at Upper St. Anthony Falls places a two-turbine powerhouse in the downstream end of wasteway No. 2 (see plate 4).

POWERHOUSE

The powerhouse would be located in the abandoned wasteway adjacent to the University of Minnesota Hydraulic Laboratory. It would have the power generating units and primary electrical equipment. The upstream wall of the powerhouse and the upstream channel walls would be constructed to elevation 805.0 to prevent overtopping of the powerhouse during flooding of the Mississippi River. Flow to the turbines would be regulated by individual slide gates located just upstream of the turbines. Trash racks with small openings to protect the turbines from damage during operation would be installed upstream of the turbines. Bulkhead slots would be provided on the upstream and downstream edges of the powerhouse so that individual turbines could be dewatered for maintenance. The powerhouse would be made of reinforced concrete and would receive architectural treatment so that it would blend visually with the surroundings. Additional powerhouse information is presented in the North Pacific Division report (the technical appendix to this report).

A preliminary stability analysis was performed on the structure and the results of the analysis indicate that Corps of Engineers stability criteria can be obtained without additional work.

Approximately 34,250 cubic yards of rock and rubble would need to be excavated to construct the powerhouse. The construction contractor would be responsible for disposal of the excavated material. A disposal area would be located for the contractor if needed.

CHANNELS

The upstream portion of wasteway No. 2 would be modified for use as the intake channel for the power generating units. The abandoned existing control structure would be removed. The existing wasteway walls would

need to be removed as they do not have enough structural strength to be raised. New, higher channel walls made of reinforced concrete would replace the existing walls. The channel walls would have an exterior design compatible with the St. Anthony Falls Historic District. The floor of the existing wasteway channel would be lowered to accommodate the increased flows. A 6-inch layer of concrete would be placed over the limestone on the floor of the intake channel to provide a smooth flow surface. To minimize the rock excavation required for the intake channel, a drop structure would be constructed immediately upstream of the powerhouse. The drop structure would have reinforced concrete walls and a reinforced concrete floor. The thickness of the floor would increase to 12 inches over the sandstone portion of the drop structure. A control joint utilizing a shear key would be installed between the powerhouse and the drop structure to minimize temperature effects.

The location of the powerhouse would minimize the length of the discharge channel. A concrete surface would be placed over the sandstone on the channel bottom and side slopes. The concrete surfacing would extend until the channel bottom elevation matched the existing ground elevation.

Excavation requirements would include approximately 3,940 cubic yards of rock for the upstream channel, approximately 5,530 cubic yards of rock for the drop structure, and an estimated 13,255 cubic yards of rock, rubble, and dirt for the discharge channel. Disposal of the excavated material would be the responsibility of the construction contractor. A disposal area would be provided for the contractor, if needed.

The analysis to determine erosion protection requirements considered average inlet and outlet velocities, the possibility of flow concentration, and the possibility of a local increase in shear stress

at channel transitions such as elevation changes in the approach channels tc the turbines.

ACCESS

Access to the powerhouse would be from the Hydraulic Laboratory parking lot. The access is limited to personnel and items that can be transported in a small truck because of size limitations at the intake control structure for the existing powerhouse and at the ramp between the Hydraulic Laboratory building and the intake channel wall. Extremely heavy or bulky items used in the construction or maintenance of the powerhouse could be transported by raft or barge along the Mississippi River.

SITE WORK

The location of the powerhouse in the wasteway would minimize the site work needed. Site work at the upper falls powerhouse would consist primarily of the restoration of the Hydraulic Laboratory parking lot. Trees and snrubs could also be planted on the riverward berm of the intake channel.

CONSTRUCTION IMPACT ON EXISTING STRUCTURES

Wasteways Nos. 1 and 2 are no longer used to discharge water. Wasteway No. 1 has been closed with an earth cofferdam at the upstream end of the wasteway, and wasteway No. 2 has been closed with a concrete cofferdam at the upstream end of that wasteway. Installation of the powerhouse at the downstream end of wasteway No. 2 would permanently close the wasteways but, since the powerhouse would increase the present flow capacity, it is doubtful that the wasteways would be needed.

Permanent access to the powerhouse would be through the Hydraulic Laboratory parking lot. Use of this access would probably reduce the already limited parking space at the laboratory. Compensatory parking could be provided at the existing NSP site. During construction of the new powerhouse, it is probable that Hydraulic Laboratory personnel could experience some access inconvenience because of the greatly increased use of the present access across the NSP hydropower control structure.

Excavation for the new powerhouse and channels should not significantly affect the existing Hydraulic Laboratory building as both structures would be founded on rock. Instrumentation would be placed on the foundation of the laboratory building to detect small foundation movements. The instruments would be mounted during construction of the powerhouse and used to avoid or minimize any potential damage to the Hydraulic Laboratory building.

COFFERDAMS

The upstream cofferdam would be a single stage earth cofferdam extending across the upstream mouth of wasteway No. 2. Material used for the cofferdam would be a standard clay core with either a rock or sheet pile upstream face to protect against erosion, if necessary. The downstream cofferdam would be a single stage earth cofferdam extending across the downstream end of the wasteways. The center line of the cofferdam would be approximately 40 feet into the Lower St. Anthony Falls pool. A combination of sheet pile cells and earth would be used to build the downstream cofferdam. The sheet pile cells would be filled with sand, and the downstream face of the earth portion of the downstream cofferdam would be protected from erosion by rock or sheet pile, if necessary. The top elevation of both cofferdams would be 4 feet above normal pool levels to protect against overtopping during flooding of the Mississippi River. Both cofferdams would be completely

removed after completion of the powerhouse. Approximately 7,510 cubic yards of earth would be used to construct the upstream cofferdam, and six 33-foot diameter sheet pile cells plus an estimated 10,240 cubic yards of earth would be used to construct the downstream cofferdam.

Dewatering of the site would be accomplished by sump pumps because the sandstone foundation makes deep well dewatering impractical.

CIVIL FEATURES - LOWER FALLS

This section describes civil features pertaining to installation of an additional power generating unit at the Lower St. Anthony Falls site. Civil features include the powerhouse, intake and exit channels, permanent access, and site work. Descriptions of construction impacts on existing structures and cofferdamming are also included.

The alternative selected for more detailed study at Lower St. Anthony Falls locates a one turbine powerhouse immediately to the land side of the existing NSP powerhouse (see plate 4).

POWERHOUSE

The powerhouse would be located immediately to the landward side of the existing NSP powerhouse. Flow to the turbines would be regulated by a slide gate installed just upstream of the turbine. Trash racks with small openings to protect the turbine from damage during operation would be installed upstream of the turbine. Bulkhead slots would be provided on the upstream and downstream edges of the powerhouse so that the turbine could be dewatered for maintenance. The powerhouse would be made of reinforced concrete. Some form of architectural or landscape design may be required for this structure, even though it would be located below the existing ground surface. This would ensure compatibility between the proposed powerhouse and the existing

structure. Additional powerhouse information is presented in the North Pacific Division report, appendix D.

A preliminary stability analysis was performed on the structure and the results indicate that Corps of Engineers stability criteria can be obtained without additional work to the powerhouse foundation.

Approximately 35,420 cubic yards of dirt and rock would need to be excavated to construct the powerhouse. The construction contractor would be responsible for disposal of the excavated material. A disposal area would be provided for the contractor if needed.

CHANNELS

The intake and discharge channels for the existing powerhouse would be widened to accommodate the additional turbine. The intake and discharge channel invert elevations for the new turbine would be lower than the existing channel invert elevations for the existing power generating units. The channel bottoms are founded on sandstone, allowing a sloping transition to be built between the existing and proposed channel bottoms. A 12-inch thick layer of concrete would be used to cover the face of the transition slope and line the channel bottom. The concrete would provide the necessary erosion protection. The existing limestone retaining wall on the land side of the existing channels would be removed during excavation for widening of the channels. A new reinforced concrete tieback retaining wall would be installed on the land side of the widened intake and discharge channels as part of the powerhouse construction.

Excavation requirements would include approximately 16,960 cubic yards of dirt and rock for the upstream channel and an estimated 26,330 cubic yards of dirt and rock for the discharge channel. Disposal of the

excavated material is the responsibility of the construction contractor. A disposal area would be provided for the contractor if needed.

The analysis to determine erosion protection requirements considered average inlet and outlet velocities, the possibility of flow concentration, and the possibility of a local increase in shear stress at channel transitions such as elevation changes in the approach channel to the turbine.

ACCESS

The existing access to the powerhouse site is adequate even for large and bulky items. Large and/or bulky items could also be transported by barge or raft along the Mississippi River.

SITE WORK

Site work at the lower falls site would consist of access road relocation, bypass spillway relocation, and restoration of the site to its original condition after construction is completed. The existing access road would have to be relocated to accommodate widening of the existing intake channel. A small retaining wall would be required to retain the existing railroad slope in order to provide the space necessary for the access road relocation. The location of the new powerhouse would require removal and replacement of the existing bypass spillway. The existing bypass spillway is approximately 2 feet deep and 5 feet wide. Excavation for construction of the new powerhouse would affect the existing access road and parking lot. The access road, parking lot, and ground surface would need to be restored to their original condition after construction.

CONSTRUCTION IMPACT ON EXISTING STRUCTURES

A portion of the unused, abandoned powerhouse does not have a full foundation, and it would normally have to be removed during excavation for construction of the new additional powerhouse. Because of the potential historic significance of the existing structure, future planning and design of the proposed hydro station will consider in greater detail the preservation and/or mitigation of the existing powerhouse.

Excavation for the new additional powerhouse and channel widening should not significantly affect the existing NSP powerhouse as both structures would be founded on rock. Instrumentation would be placed on the foundation of the NSP powerhouse to detect small foundation movements. The instruments would be monitored during construction of the new powerhouse and used to avoid or minimize any potential damage to the NSP powerhouse.

Construction of the additional unit would temporarily disrupt normal operation of the powerhouse as access to the existing powerhouse would be across the construction site for the new powerhouse.

COFFERDAMS

The upstream cofferdam would be a single stage, sheet pile cell cofferdam extending between the existing retaining wall and the upstream, land side corner of the existing NSP powerhouse. Five sheet pile cells, 33 feet in diameter and filled with sand, would constitute the upstream cofferdam. The sheet pile cells would be located to minimize interference with the existing turbines during the construction period.

The downstream cofferdam would be a single stage earth cofferdam extending from the downstream, land side corner of the abandoned powerhouse, along the land side of the existing discharge channel, and connecting with the existing riverbank at the downstream end of the existing discharge channel. Material for the cofferdam would be a standard clay core with either a rock or sheet pile downstream face to protect against erosion should existing river velocities require protection. Approximately 1,000 cubic yards of earth would be used to construct the downstream cofferdam.

The top elevation of the upstream and downstream cofferdams would be 4 feet above normal pool elevation to protect against overtopping during flooding of the Mississippi River. Both cofferdams would be completely removed after completion of the new powerhouse.

Dewatering would be accomplished by sump pump because it is the most practical method of dewatering a sandstone foundation.

MATERIALS DISPOSAL

Material removed from the construction site would be disposed of in a landfill or other upland site. Excess material would be removed from below the cofferdams and transported by barge or truck to selected disposal areas as there are no disposal sites for the material in the immediate project site vicinity. It is the responsibility of the St. Paul District to identify likely disposal areas during this phase of study.

The excavated material would consist of the following approximate types and quantities by site.

Type of material	Amount (cubic yards) Upper dam	Lower dam	Total
Earth fill	2,100	63,000	65,100
Rock	37,700	17,000	54,700
Rubble	17,200	-	17,200
Concrete	200	200	400
Grand Total			137,400

(Rev. 3/84)

MATERIAL FOR COFFERDAMS

Cofferdams would consist of both sheet piling and clean fill material as indicated in the detailed cost estimate. The fill material would be clean, well-graded borrow material from an approved commercial source. After the principal construction work is complete, the cofferdam material would be removed and disposed of in an approved upground location.

POTENTIAL DISPOSAL AREA

A 14-acre dredged material disposal area, currently used by the Corps of Engineers, is located about 2-1/2 miles upstream of the upper dam. The site, known as the Port of Minneapolis-Upper Harbor location, is on the right bank of the Mississippi River, starting about 1,400 feet upstream of the Lowry Avenue Bridge. The Lowry Avenue Bridge is located at river mile 856.45, and the upper dam is at river mile 854.1.

The Port of Minneapolis site is owned by the city of Minneapolis, but is leased to the Packer Terminal Company. The company operates a barge terminal just upstream of the site. The city of Minneapolis is encouraging disposal of dredged material at this location, and the material is then reused by private contractors.

Material excavated from the two St. Anthony Falls sites could be barged to this site within the unit costs shown in the project construction cost estimates. Disposal of excavated material at this site, which is above the ordinary high watermark, would be coordinated with the State of Minnesota.

VALUE OF PLAN

MARKETABILITY

There is no Federal power marketing agency establisned to market power to the Great Lakes area. The reason is that, with one exception, there are no Federal power dams constructed in this area for which the Secretary of Energy has to exercise general power marketing authority. That exception is the St. Marys Falls Canal site on the St. Marys River in Michigan. The Corps of Engineers markets power output from this site.

The increased cost of fuel and renewed interest in hydropower in the 1970's prompted the Department of Energy to set up an ad hoc team to conduct a special power marketing study for the Great Lakes area. The ad hoc team published draft reports in January and August 1981 summarizing area power marketing potential.

The draft reports concluded that approximately 2,600 MW hydroelectric capacity and about 11 million MWh of average annual energy could be obtained from dams now operated by the Corps of Engineers in a nine-State area. The nine States are: Illinois, Indiana, Michigan, Ohio, and Wisconsin, with parts of Iowa, Minnesota, Pennsylvania, and West Virginia.

The study concluded that preference customers in the Great Lakes area currently use about 10,000 MW of generating capacity, or about four times the 2,600 MW hydroelectric potential of Federal dams. These preference customers for federally generated energy are municipalities and nonprofit cooperative utilities, as specified by law. Preference customers also have over 1,000 MW of oil-burning diesel electric generation, and Great Lakes area utilities burn over 40 million barrels of oil each year to generate electricity.

The study also concluded that the hydroelectric potential at the Federal dams in the Great Lakes area is readily marketable and, if fully developed, would reduce the Nation's dependence on foreign oil--possibly by 20 million barrels of oil annually.

The Department of Energy, in a letter dated 17 November 1983, notified tne St. Paul District that energy from both the upper and lower falls proposed developments could be marketed to repay all power production costs.

INSTITUTIONAL ANALYSIS

KEY INSTITUTIONS

Many interests and agencies would have input to proposed hydropower development at the St. Anthony Falls sites. However, several key institutions would have a major impact on any proposed hydropower development at St. Anthony Falls. They are identified and discussed in the following paragraphs.

- o Northern States Power Company (NSP) - The existing hydroelectric facilities at Upper and Lower St. Anthony Falls are owned and operated by the Northern States Power Company. NSP is an investor-owned utility company as opposed to a municipality, or a cooperative type utility. Northern States Power Company would not be a "preference customer" under the Federal Power Act which gives preference to utilities and cooperatives for purchasing federally developed power.

- o Federal Energy Regulatory Commission (FERC) - The Federal Energy Regulatory Commission replaced the Federal Power Administration (FPA) and regulates all non-Federal power development. The FERC issues preliminary permits and licenses for power development to

non-Federal agencies. In contrast, the Corps of Engineers develops power by virtue of authorization and direction of Congress and follows the established Federal Principles and Guidelines for report preparation and public involvement.

In the case of the existing hydropower development at St. Anthony Falls, the FERC has issued a license which governs operation of the project until 31 December of the year 2000. The FERC project license is numbered 2056. When the license expires in the year 2000, the licensee (NSP) must reapply for a new license. According to the Federal Power Act, when the existing license is up for renewal, municipalities may also apply for tne right to generate power at the site, and they have priority over investor-owned utilities.

o Mid-Continent Area Power Pool (MAPP) - The MAPP organization recently assumed the responsibilities of the Mid-Continent Area Reliability Council Agreement (MARCA) Region. The MAPP/MARCA region is currently one of nine electric reliability council regions in the United States. These regions were formed in 1968 by the electric utility industry to promote the reliability and adequacy of bulk electric power supply in North America.

The current MAPP region covers 400,000 square miles of the United States and involves 7 States, with respect to electric reliability planning and operating activities. The States involved are: the western half of Wisconsin; all of Minnesota, Iowa, Nebraska, and North Dakota; eastern Montana; and most of South Dakota. Two Canadian Provinces of Manitoba are associate members of MAPP.

o Department of Energy (DOE) Power Marketing Organizations - The Department of Energy has the authority to market power produced at Federal facilities. This authority is contained in section 5 of

the Flood Control Act of 1944. Currently, the DOE has five power marketing authorities in the continental United States.

No Federal power dams have been constructed in the Great Lakes area where the St. Anthony Falls sites are located, so no marketing administration has been established by DOE for this area. However, DOE did establish a DOE ad hoc work group which prepared a power marketing study for the Great Lakes area in January 1981. The DOE could possibly market federally produced power at St. Anthony Falls through the nearby Western Area Power Administration (WAPA).

- o State Historic Preservation Office - The State Historic Preservation Office is responsible for preserving and protecting the historic values of the State. The St. Anthony Falls historic district is recorded on the National Register. Opportunities exist to develop the additional hydropower potential of the falls without adversely impacting on the historic district except possibly for some minor inconveniences during construction.

- o City of Minneapolis - The St. Anthony Falls sites (upper and lower) are located within Minneapolis, Minnesota. The city has a special interest in restoring and expanding on the historic character of the area. An existing development on the east bank adjoins the upper falls site (St. Anthony Main) and is built in similar fashion to the commercial establishment located on the San Francisco, California, wharf area. The city also proposes to develop several similar areas along the west bank of the Mississippi River in this area (Heritage Landing and the Mills District Plan). The proposed hydropower development would not interfere with these developments.

- o U.S. Fish and Wildlife Service (USFWS) - The USFWS is an agency of the Department of the Interior, which is charged with safeguarding the Nation's wildlife, including migrating fish and wildlife

resources and endangered species. The St. Anthony Falls area, located in downtown Minneapolis, supports a limited fishery. The falls have been a natural barrier to upstream fish passage over the years and the existing or proposed hydropower facilities will not change that. The Fish and Wildlife Service is concerned over any further reductions in residential fish populations and supports efforts to maintain viable tailwater and backwater fisheries in the area.

The USFWS provides both planning assistance to the Corps in these proposed developments and a supplemental report for the study, outlining desirable fish and wildlife preservation and enhancement features.

- o Minnesota Department of Natural Resources (MDNR) - The Minnesota Department of Natural Resources has the same interests as the USFWS, but at the State level. The MDNR is also charged with the responsibility for issuing permits for water use and water withdrawals within the State and for monitoring actual use.

- o Environmental Protection Agency (EPA) - The Federal Environmental Protection Agency has the responsibility of protecting the Nation's land, air, and water quality. Generally, a hydropower proposal has little or no impact on water or air quality, except for some minor impacts during the construction phase.

- o Minnesota Pollution Control Agency (MPCA) - The MPCA has the same responsibilities as the Federal EPA except that responsibilities are confined to State inland or boundary waters.

COORDINATION WITH INSTITUTIONS

Coordination was conducted with the aforementioned agencies, as well as other interests, through meetings, telephone calls, letters, and public notices. This coordination will continue throughout the remaining study phases and during the proposed preparation of plans and specifications and construction stages.

PLAN IMPLEMENTATION

The plan, as developed and presented herein, envisions the added power potential of the Upper and Lower St. Anthony Falls being developed solely by the Federal Government, with no involvement by the existing licensee, Northern States Power Company. Under this plan, the Federal Government would acquire the necessary lands, access, and disposal areas for constructing two new powerhouses and connecting transmission lines.

The Corps of Engineers would construct the power facilities, if authorized by Congress, under the recommended plan. Once the project was constructed, the Department of Energy would market the added power, giving first preference to municipalities and cooperatives as discussed earlier in the report.

The proposed new power plant, operated by the Federal Government, would operate side-by-side with the existing non-Federal Northern States Power Company plant. The new plant would tie in to Northern States Power Company's transmission and distribution facilities as indicated earlier. This plan is implementable, assuming that Northern States Power Company chooses not to develop the added power first. Northern States Power Company has indicated an interest in developing the added power at Upper St. Anthony Falls at the 18 October 1983 public meeting and in its 10 November 1983 letter. However, NSP personnel indicate

that they would need to make additional studies before they would make a final decision on the upper falls site. NSP indicates that the lower site is not economically feasible to develop from their viewpoint.

There is no indication, either from NSP or from other sources, that there would be any operating difficulties with the proposed Federal project side-by-side with the existing NSP plant at the upper falls.

SUMMARY OF COORDINATION, PUBLIC REVIEW AND COMMENTS

Comments were solicited from agencies and other groups after completion of the September 1981 reconnaissance study. Comments generally expressed concern for the possible environmental effects and for possible unrecorded archeological sites that might be disturbed with the addition of hydropower at Mississippi River locks and dams.

Natural resource and environmental protection agencies generally opposed any plans that would include intentional use of storage to provide peaking power (that is, to fluctuate river pools in any manner to facilitate increased hourly power production during high daily power demand periods). This concern was directed primarily to Mississippi River power sites located downstream of St. Paul, Minnesota, and the St. Anthony Falls area.

Added letters of comment were solicited from the same agencies and general public during the formulation process. The selection of a preliminary plan was provided to the public for comment with a public notice dated 13 May 1982.

Subsequent 1982 meetings were held with Northern States Power Company, State and Federal regulatory agencies, Ford Motor Company, and North Pacific Division, Corps of Engineers. These meetings were for coordination and to aid in preparing an environmental assessment. No

comments were received from the city of Minneapolis on the 13 May 1982 public notice and the District was not aware of a "flow aesthetics issue" involving the upper falls until later in 1983.

The first indication of a possible interest conflict occurred when the St. Paul District received a copy of the city's Mills District plan for review and comment. District comments on the Mills District plan were provided to the city in May and again in June 1983. However, the spillway flow aesthetics issue did not surface until the St. Paul District requested a special meeting with the city in August 1983. A strong expression of concern against losing the aesthetics of water presently flowing over the upper falls man-made spillways became evident in subsequent 1 September and 18 October meetings with the city and the general public. Concern for preserving "flow over the falls" as opposed to diverting flow through turbines came from the city and from area developers who plan to renovate the old milling and other downtown districts (see Environmental Assessment, Exhibit section).

The 18 October 1983 public meeting and September 1983 draft feasibility report generated considerable adverse reaction to the maximum hydropower development plan presented. A number of information meetings were subsequently conducted with several Minneapolis civic groups. In addition, two workshops were held with downtown developers, Minneapolis city government, and others, on 3 and 10 November 1983, in an attempt to resolve the conflict. At these workshops, possible measures were identified that might be used to preserve the aesthetics or appearance of water flow over the existing Upper St. Anthony Falls spillways. There was no significant adverse reaction to the lower falls proposal.

The inputs from the 3 and 10 November 1983 workshops were used to develop the final recommended plan which was presented to the Mayor of Minneapolis and the city council at a 10 February 1984 meeting and to the general public at a 14 February 1984 information workshop.

OTHER REQUIREMENTS

To comply with the National Environmental Policy Act, the Corps of Engineers is required to prepare an environmental assessment or environmental impact statement for the development of hydropower projects. An environmental assessment has been prepared in compliance with the National Environmental Policy Act and is a part of this document.

In addition, a 404 (b)(1) evaluation has been prepared to comply with provisions of the Clean Water Act, as amended. This analysis of the fill placement in water is required under section 404 (r) of the Act for projects submitted to Congress for authorization. If interests other than the Corps of Engineers decide to develop hydropower at the site, they will have to apply for the appropriate State and Federal permits.

Section 106 of the National Historic Preservation Act of 1966, as amended, requires all Federal agencies to assess project impacts upon National Register of Historic Places properties in consultation with the State Historic Preservation Officer and to request the comments of the Advisory Council on Historic Preservation in accordance with implementing regulation 36 CFR Part 800. The Section 106 review process has been completed and the comments of the Advisory Council are incorporated into the Environmental Assessment, Exhibit section.

WATER RIGHTS

No detailed study of the existing water rights at St. Anthony Falls was made for this study. However, an analysis of these rights seems warranted and should be an integral part of future detailed design studies, if the proposed Federal hydropower development plan is authorized.

It is a documented fact that Northern States Power Company purchased the majority of early milling and hydropower interests at the upper and lower falls sites. NSP currently pays designated sums each year to holding companies for these rights. It is also documented that these interests in 1909, for example, were capable of utilizing 41 MW of capacity at the upper falls (11,500 cfs) with their installed equipment. This compares with the 12.4 MW NSP existing capacity (3,300 cfs) and the Federal add-on capacity of 21.0 MW (6,200 cfs) for a total of 33.4 MW (9,500 cfs) at the upper falls today (reference "Creativity, Conflict, and Controversy" by Raymond H. Merritt, 1977).

Currently, NSP maintains that the "flat-out" capacity of its upper and lower falls plants can utilize 3,800 and 5,500 cfs capacity, respectively. However, the efficient design of these units or installed capacity amounts to only 3,300 and 4,500 cfs, respectively. This is another aspect of the proposed site development that would have to be addressed more thoroughly in more detailed studies.

According to Mr. Raymond Merritt's research, the 1880 to 1912 construction of the six Mississippi River Headwaters Reservoirs provided 40 percent more flow capacity on the Mississippi River at the Twin Cities of Minneapolis and St. Paul during August and September and 50 percent more flow capacity in October and November.

The recently completed Mississippi River Headwaters study (1982) developed an HEC-5 flow model that could be used with an existing Federal Energy Regulatory Commission hydropower model for the Upper Mississippi River basin. These two models could allow calculation of the amount of flow and hydro capacity that now results at St. Anthony Falls due to the operation of the six Mississippi River Headwaters Reservoirs. In effect, it is possible that the city of Minneapolis and/or area developers who claim rights to upper falls spillway flows for aesthetic purposes should, in fact, be assessed a charge for maintaining these flows over the upper falls spillways at the expense of developable power forgone (the developable power forgone, being directly related to the increased river flows that result from upstream Mississippi River Headwaters Reservoir releases).

The Federal Energy Regulatory Commission (formerly Federal Power Commission) has already been involved in litigation with power companies operating on the Mississippi River downstream of the six Mississippi River Headwaters Reservoirs. The litigation involved a FERC determination that the power companies should pay for the benefits received from the increased river flows produced by the reservoirs. The initial litigation was settled out of court with the power companies agreeing to pay a partial assessment of these benefits.

DESIGN PHASE ANALYSIS

The intent of this and other feasibility studies undertaken by the Corps is to determine whether a proposed project is, in fact, feasible to develop. The analysis done in this report indicates that there is strong economic justification for the development of hydropower at the site. There are, however, a number of considerations, not appropriate for a feasibility study, which must be addressed in subsequent design studies (the next step in the Corps planning process) if it is determined that the Federal Government should develop the hydropower

potential at the site. In addition, normal Corps procedures will result in further analysis of items already addressed in this feasibility study.

Briefly, items of further analysis would include detailed examination of existing water rights; detailed study of aesthetic flows and means for those flows to be realized; further analysis of available flows; additional analysis of optimum turbine size based on water rights, aesthetics, and flows; consideration of architectural design of powerhouses consistent with historic attributes; and archeological survey at the lower dam hydro station.

With regard to the implementation strategy discussed in another section, optimization of hydropower generation and aesthetics may justify establishing operating agreements with Northern States Power Company. These agreements could allow the more efficient turbines proposed for the upper and lower falls to use the first available flows (following navigation). The existing upper and lower falls turbines of NSP could then be brought on line when additional flows were adequate to operate these older, less efficient units. This option could take full advantage of electrical generation potential and give maximum flexibility to realizing aesthetic needs.

Regarding aesthetic needs, maximum benefits for electrical generation and aesthetics may be achieved by daily (eg., afternoon and evening hours during the week and daylight hours on weekends) and seasonal (reduced aesthetic needs in winter) scheduling of aesthetic flows. The analysis of these needs and turbine optimization are most appropriate for design phase studies.

The authority of the Corps to examine the potential for hydropower and subsequent development is limited. However, Corps guidance and Public Law 91-190 state that one objective, which will be an integral part of

project formulation, is to coordinate and implement measures which lead to aesthetically sensitive projects. The intent of such measures is not to "gold plate" but simply to harmonize basic construction projects with the landscape. The amount of project funds to be allocated to such measures depends on the severity of visual impacts which would result from the basic project. However, historically a ceiling of 3 to 5 percent of total project implementation funds has been recognized as appropriate for civil works projects. An additional 1 percent of total project costs can be used for implementation of historic considerations associated with a project (in accordance with Public Law 93-291). The proposed plan sensitively incorporates visual quality measures and historic measures within these recognized funding levels.

The measures which have been incorporated into the plan to address aesthetic concerns were identified through public workshops on 3 and 10 November 1983. The workshops resulted in identification of additional measures that would have an enhancement effect but are not appropriate for the Corps of Engineers to implement given the limited scope of the hydropower authorization and guidance described above. The Corps does realize, however, that many of those proposals are worthy of further study and possible implementation by others.

If additional study (at the design level) is authorized, the St. Paul District intends to work closely with Federal, State, and local interests to assure cooperative planning of hydropower and related local development. This cooperative planning is absolutely necessary if the national objective to develop hydropower, mandated by Congress, is to be compatible with existing water rights, preservation of the historic district, and proposed associated development by the city.

CONCLUSIONS

The feasibility study confirms that additional hydropower development at both Upper and Lower St. Anthony Falls is technically possible and economically feasible and would not cause significant environmental damage. Two economically "most-feasible" plans were arrived at through formulation of approximately 17 different options or alternatives involving the upper and lower sites. Alternative 5U (wasteway No. 2) combined with 2L (new units landward of existing plant) appears to be the best singular approach.

OTHER IMPLEMENTATION STRATEGIES

The existing licensee, Northern States Power Company, has the priority, and first right, to develop the added power potential at the Upper and Lower St. Anthony Falls sites. The Federal Government also has an interest in the two sites because of the navigational servitude and the existing upper and lower lock systems. Consequently, development of the added power potential could conceivably be accomplished by either party, or under a joint arrangement. Other implementation strategies would then be as follows:

1. Northern States Power Company could proceed to develop the added power potential on its own, with no further Federal involvement. The entire financing arrangement would be handled exclusively by the utility company, and no added Federal cost or congressional authorization would be required.

2. NSP and the Federal Government could enter into a joint arrangement to develop St. Anthony Falls added power potential. This arrangement would allow the Federal Government to develop the added power in consultation with,

and with concurrence of, NSP. At the completion of the project, the facilities would be turned over to NSP for operation and control. All accrued Federal design and construction costs would be reimbursed by NSP under some previously negotiated arrangement.

a. Several key considerations would have to be resolved with this strategy. A joint venture of this nature must be authorized by Congress and, according to present administration policy, would require 100 percent up-front financing commitments.

b. Northern States Power Company has advised the District that it has never entered into a joint venture of this nature.

c. Northern States Power Company is not a preference customer and would normally not be given a chance to share in a Federal power development project. Municipalities and cooperatively owned utilities are given preference under the law in the marketing of Federal power.

3. NSP could decide to develop the added power potential at the Upper St. Anthony Falls site and not at the lower site. This arrangement could allow the Federal Government or other private interests to develop the lower site potential. Under these circumstances, NSP would likely be asked to sign an agreement waiving further interest in the added power development at the lower site.

RECOMMENDATION

Based on this report, I have concluded the following:

- o That the Nation has a continuing need for the development of power sources, in particular, hydroelectric power sources.

- o That additional power can be developed at Upper and Lower St. Anthony Falls Dams in a manner that is engineeringly sound, economically feasible, environmentally acceptable, and compatible with navigation and other public uses of the Upper Mississippi River.

- o That a base flow is needed over the upper falls to maintain aesthetic, historic, and associated community development benefits.

- o In the event that the existing licensee, Northern States Power Company, or another non-Federal entity does not apply to FERC for rights to develop the additional hydropower, it would be in the public interest for the Federal Government to do so.

In consideration of the above, I recommend that the addition of run-of-the-river hydroelectric facilities at the Upper and Lower St. Anthony Falls project, Mississippi River, be authorized for implementation generally in accordance with the proposed plan, with such modifications as in the discretion of the Chief of Engineers may be advisable, including an appropriate number and size of units, and in accordance with cost recovery, cost sharing, and financing arrangements satisfactory to the President and Congress. The total first cost of the project, based on October 1983 price levels, is estimated at $35,527,000, with interest, amortization, annual operation and maintenance, and replacement costs presently estimated at $3,272,000.

I further recommend that, in accordance with the Administration's policy of support for development by a qualified non-Federal interest, the authorization of this project for Federal construction be without prejudice to completion of action on a permit issued or license application under consideration by the Federal Energy Regulatory Commission at the time of authorization.

Edward G. Rapp

EDWARD G. RAPP
Colonel, Corps of Engineers
District Engineer

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL MINNESOTA 55101

REPLY TO
ATTENTION OF:

Planning Division
Environmental Resources Branch

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the St. Paul District, Corps of Engineers has assessed the environmental impacts of the following project.

ST. ANTHONY FALLS HYDROPOWER
MISSISSIPPI RIVER, MINNEAPOLIS
HENNEPIN COUNTY, MINNESOTA

The intent of the project is to provide additional hydroelectric generating capability at St. Anthony Falls. There are two operational plants and one abandoned generating plant in the vicinity. The proposed action calls for the installment of two vertical shaft propeller turbines at the upper falls location (50-foot head) and a horizontal, adjustable blade bulb turbine at the lower falls location. A description of the proposed action may be found in section 1.00 of the environmental assessment.

The finding of no significant impact is based on the following factors: pool fluctuations would not exceed existing levels; terrestrial habitat would not change; aquatic habitat impacts would be minimal and be offset by the placement of riprap in tailraces; dissolved oxygen depletion would not be significant; tailwater flows would not be altered appreciably; turbine mortality of larval fish would not be appreciable; visual resources would be maintained; and the design of the powerhouse and channels would be consistent with the historic character of the St. Anthony Falls Historic District. See section 5.00 of the assessment for a discussion of impacts.

The environmental review process indicates the proposed action does not constitute a major Federal action significantly affecting the human environment. Therefore, an environmental impact statement will not be prepared.

24 February 1984
Date

Edward G. Rapp
Colonel, Corps of Engineers
District Engineer

ENVIRONMENTAL ASSESSMENT
ST. ANTHONY FALLS HYDROPOWER
MINNEAPOLIS, MINNESOTA

St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

February 1984

ENVIRONMENTAL ASSESSMENT
ST. ANTHONY FALLS HYDROPOWER
MINNEAPOLIS, MINNESOTA

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ENVIRONMENTAL ASSESSMENT
ST. ANTHONY FALLS HYDROPOWER
MINNEAPOLIS, MINNESOTA

1.00 SUMMARY

Major Findings and Conclusions

1.01 This study was conducted to determine the feasibility of adding hydropower near two existing hydropower plants. Various alternatives and combinations of alternatives were evaluated to best utilize the 50- and 25-foot head differentials at the sites. The feasibility of renovating two existing and one decommissioned plant was also evaluated. The alternatives which would best satisfy the planning objectives were the placement of two vertical axis, propeller turbines in a wasteway at the upper site and a bulb turbine (adjustable blade, propeller) at the lower site. These were selected as the proposed plan.

1.02 An environmental review of the proposed action has been conducted. Because this review indicated that the project would not have a significant effect on the environment, an environmental impact statement will not be prepared.

Relationship to Environmental Requirements

1.03 The selected plan has been considered in relationship to, and for compliance with, a number of Federal, State, and local laws and policies (table EA-1), including the Fish and Wildlife Coordination Act of 1958; the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969; the Clean Water Act of 1977; Executive Orders 11988 and 11990; the Endangered

Table 1 - Relationship of plan to environmental protection statutes and other environmental requirements.

Federal statutes:	
Archeological and Historic Preservation Act, as amended, 16 U.S.C. 467 et seq.	FC(1)
Clean Air Act, as amended, 42 U.S.C. 7401, et seq.	FC
Clean Water Act, as amended (Federal Water Pollution Control Act) 33 U.S.C. 1251 et seq.	FC
Coastal Zone Management Act, 16 U.S.C. 1451, et seq.	NA(2)
Endangered Species Act, as amended, 16 U.S.C. 1531 et seq.	FC
Estuary Protection Act, 16 U.S.C. 1221, et seq.	NA
Federal Water Project Recreation Act, as amended, U.S.C. 661 et seq.	FC
Fish and Wildlife Coordination Act, as amended, U.S.C. 661 et seq.	FC
Land and Water Conservation Fund Act, as amended, 16 U.S.C. 4601-4601-11 et seq.	FC
Marine Protection Research and Sanctuaries Act, 22 U.S.C. 1401 et seq.	NA
National Historic Preservation Act, as amended, 16 U.S.C. 470 a, et seq.	FC
Rivers and Harbors Act, 33 U.S.C. 401 et seq.	FC
Watershed Protection and Flood Preservation Act, 16 U.S.C. 1001, et seq.	NA
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq.	NA
Executive Orders, memoranda, etc.	
Floodplain Management (E.O. 11988)	FC
Protection of Wetlands (E.O. 11990)	FC
Environmental Effects of Major Federal Actions (E.O. 12114)	NA
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 30 Aug 76)	FC
State and local policies	
Minnesota State Water Quality Standards	FC
Land use plans	
None	
Required Federal entitlements	
None	

(1) FC - Full compliance.
(2) NA - Not applicable.

Species Act of 1973, as amended; the Land and Water Conservation Act of 1965, as amended; and the Reservoir Salvage Act, as amended by Public Law 93-291.

2.00 NEED FOR AND OBJECTIVES OF ACTION

2.01 The installation of run-of-the-river hydropower at St. Anthony Falls is proposed to fully utilize the generation potential of the site. The study was authorized by a resolution of the House Committee on Public Works dated 11 December 1969.

3.00 ALTERNATIVES

3.01 Three alternatives were considered in detail. These were selected from a preliminary list of 17 structural alternatives, a peaking alternative, and a no action alternative. In general, alternatives were evaluated for adding hydropower to the upper falls pool, the lower falls pool, a combination of the two, one plant for both pools, renovation of existing plants, and restoration of a decommissioned plant. Fourteen of the plans were eliminated from further study early in the study after review of economic, engineering, institutional, and environmental factors. Detailed descriptions are presented in the main report.

3.02 Northern States Power Company proposed that additional "peaking" be evaluated as a means of providing more valuable power. A preliminary analysis indicated that raising the upper pool and allowing it to fluctuate more widely than at present would be detrimental to aquatic habitat, potentially cause erosion of terrestrial habitat, and interfere with commercial navigation. For these reasons, this option was eliminated from further study.

Upper Falls

3.03 Installation of additional hydropower at the upper falls would consist of two, vertical shaft, fixed blade, propeller turbines developing 21.0 megawatts (MW) and producing approximately 74 million kilowatt-hours (kWh) annually. These units would be installed in the abandoned wasteway No. 2 adjacent to the St. Anthony Falls Hydraulic Laboratory. These units would require a total of 6,200 cfs for generation (plates 5 and 6). A flow of 700 cfs would be reserved to flow over the horseshoe and roll dams at times when flow would have been available without additional hydropower development. The faces of the dams would be roughened to provide the appearance of 1,500 to 2,100 cfs.

Lower Falls

3.04 Additional hydropower at the lower falls site would consist of a single bulb turbine with a horizontal Kaplan (adjustable blade) runner. This unit would develop 5.4 MW that would produce 18.9 million kWh annually. It would be located immediately adjacent to (landward of) the existing lower falls plant and utilize 3,100 cfs of flow (plates 7 and 8).

Combined Falls

3.05 This alternative would consist of two units comprising 28 MW and 83.7 million kWh annually. They would utilize the generating heads of both the upper and lower pools. The units would be vertical axis, propeller turbines which would utilize a penstock buried under an existing street (Main Street) for most of its length and then traverse the bluff to the turbine site. These units would use a total of 5,500 cfs which would not be routed through the lower pool. However, 1,200 cfs would be required for use by existing

units at the Lower Falls Dam. This flow would flow over St. Anthony Falls whenever sufficient flow would be available (predevelopment levels).

No Action Plan

3.06 There is hydroelectric generating potential at St. Anthony Falls which is not presently utilized. There is also installed generating capacity and the associated electrical distribution system. It is likely that, with sufficient economic incentive, there would be interest in installing additional hydropower. The current license holder, Northern States Power Company, has investigated the possibility of adding power and may apply for an amended license to develop that power. The current license expires in the year 2000 at which time others may choose to apply for a license.

4.00 AFFECTED ENVIRONMENT

Cultural Resource Setting

4.01 Historically, St. Anthony Falls has been a focal point for human habitation. The late 1800's saw St. Anthony Falls as a milling district which was to make Minnesota the leading flour producing State in the Nation until 1930. With the milling boom came the extreme interest in the development of hydroelectric power. In September 1882, the Nation's first hydroelectric plant began operating at the falls. The flour milling period had been preceded by sawmills which predominated in the vicinity of St. Anthony Falls in the early 1800's. Prior to 1680 when Father Louis Hennepin gave Europeans their first view of the falls, many different Indian groups used the falls. The Sioux, occupying the area around St. Anthony Falls or Minirara ("Curling Waters"), as they called it,

when Europeans first entered the Americas, regarded it as sacred, offering prayers and sacrifices to appease the spirit within it.

Environmental Setting

4.02 The St. Anthony Falls locks and dams are located in downtown Minneapolis, Minnesota. These structures form and provide access to the most upstream navigation pool of the 9-foot channel portion of the Mississippi River. The lower lock and dam is located at mile 853.3 (above the Ohio River) and forms the lower pool. The upper lock is located at St. Anthony Falls (mile 853.7) and forms the upper pool which contains the head of navigation at mile 857.6 (Soo Line bridge). The upper dam is privately owned.

4.03 Above St. Anthony Falls, the Mississippi River meanders between banks 15 to 25 feet high through a broad, shallow, glacial outwash valley. At St. Anthony Falls it descends 75 feet in two steps and then flows 8 miles to Fort Snelling through a gorge 100 feet deep scoured by these falls as they receded upstream. At lock and dam 1, the river drops another 38 feet. Below lock and dam 1, the Mississippi River is joined by Minnehaha Creek and the Minnesota River.

4.04 Since the early 19th century, man has significantly affected the area around St. Anthony Falls and alterations of the aquatic and terrestrial resources have occurred since then. Today, the St. Anthony Falls area is surrounded by urban developments including commercial and light industrial buildings, railroads, and highways. Very little terrestrial habitat remains in a natural state.

4.05 Vegetation is confined primarily to landscaping and parks. Small mammals and birds may be found in these areas.

Aquatic Resources

4.06 The development of the area around St. Antnony Falls for urban and industrial purposes resulted in lock and dam construction, cnanges in pool levels and flows, dredging, barge traffic, and combined sewer overflows. Because of this, habitat for aquatic life has been reduced. Tne oxygenation of water by the dams and recent efforts to improve water quality somewnat offset these habitat losses.

4.07 St. Anthony Falls has presented a barrier to the dispersal of fish species for the last 10,000 years. Therefore, the fish community, and tne clams which depend on tne fisn for upstream movement of their larval stages, have been less diverse above the falls. The installation of locks has made upstream movement possible but only to the Coon Rapids Dam about 9 miles upstream.

4.08 Fish populations are limited in the pool because of the lack of shallow water habitat, tne pools' small size, and occasional short periods of poor water quality. Fishing is popular in the area due to the proximity of the urban area, but the Minnesota Health Department advises that fish consumption be limited because of high levels of mercury and polychlorinated biphenyls. Specifically, no more than 1 meal per month should be eaten of carp or bigmouth buffalo taken from pool 1, below the falls. Only half that amount should be eaten by young children and pregnant or nursing women.

Terrestrial Resources

4.09 Because of the urban and industrial development, habitat for terrestrial fauna is limited. Trees and shrubs are found primarily in parks and landscape plantings and provide some habitat for the more common species of birds. Habitat for small furbearers is

provided by the wooded bluffs along pool 1. Waterfowl occasionally utilize areas of the upper pool outside the main channel.

Water Quality

4.10 Water quality is now considered generally good through the area. Aeration provided by the dams helps to maintain quality. Short-term declines occur during periods of heavy precipitation where storm and sanitary sewers are combined and, necessarily, overflow into the river when their capacity is exceeded.

Aesthetic Resources

4.11 The Upper St. Antnony Falls, which is identified as the horseshoe and main concrete roll dam, is a significant visual resource which provides an identity and point of interest for the study area. The considerable river flows which pass over the upper falls during the summer recreation season and the significant vertical drop which characterize the Upper St. Anthony Falls create an impressive visual and sensual resource. When these facts are combined with viewer access from a large market population (i.e., the Twin Cities of Minnesota) and a number of potential and existing vantage points from which to view the falls, the significance of the upper falls to tne human environment becomes evident. The importance of maintaining this existing quality visual resource has been stressed as being critical to future regional riverfront and public park developments now planned for the area. These conditions have resulted in the need to incorporate structural and base flow measures into the recommended plan.

Endangered and Threatened Species

4.12 Species on the Federal list of Endangered and Threatened Species could occur in the project area. The bald eagle (Haliaeetus leucocephalus) and the Arctic peregrine falcon (Falco peregrinus) may migrate through the project area or be present in a transient status in the spring and fall. The Mississippi River supports endangered mussels in some locations but there are none in the project area because of poor water quality. No State endangered or threatened species are in the project area.

National Register of Historic Places

4.13 In accordance with the National Historic Preservation Act of 1966, as amended, the National Register of Historic Places was consulted. As of January 1, 1984, one district, the St. Anthony Falls Historic District (see plate 1), was listed on the National Register. Of special significance to the District are the Falls of St. Anthony, a number of mills, businesses, the Ard Godfrey House, the Stone Arch and Third Avenue bridges, the Pillsbury Library, Our Lady of Lourdes Church, the Lucy Wilder Morris Park, and Nicollet Island. In addition to the Historic District, the following properties within the District have been listed on the National Register: the Pillsbury A Mill and the Washburn A Mill Complex.

4.14 The lower dam hydro station, just downstream of the St. Anthony Falls Historic District, has been submitted by the St. Paul District to the National Register of Historic Places for a determination of eligibility. It is the opinion of the Minnesota State Historic Preservation Officer (SHPO) that this structure is eligible for the National Register, and it is an integral part of the Historic District, though not yet formally included.

5.00 ENVIRONMENTAL EFFECTS

5.01 The following is a description of the effects of the proposed action. In compliance with Section 404 of the Clean Water Act, a 404(b)(1) evaluation has been prepared; it is attached.

Cultural Resources Impacts

5.02 The impacts to cultural resources can be divided into five categories of effect: impacts concerning base flow; building design; structural modifications to the spillway and horseshoe dams; impacts to the lower dam hydro station; and impacts to unrecorded archeological resources. Each category will be discussed as it relates to the four alternatives under consideration.

5.03 No Action Alternative: The no action alternative would not affect any of the individual historic sites or structures within the historic district or the district itself. Under a no action alternative, the unused and deteriorating lower hydro station is likely to be removed.

5.04 Combined Falls Alternative: This alternative would have an adverse effect upon the Pillsbury A Mill and other milling operations along Main Street. According to the Minnesota SHPO (see letter of 23 November 1982, Exhibit Section B), construction of the channel along Main Street could destroy intakes, vaults, tailraces, and other mill components. In addition, it would have an adverse effect on portions of Main Street which remain as originally surfaced. Design of the intake structure and downstream powerhouse would have an adverse visual impact upon the St. Anthony Falls Historic District and the lower dam hydro station, if architectural design considerations were not incorporated to avoid detracting from the historic characteristics of these National Register properties.

It is also possible that, during construction of this alternative, historic archeological resources could be impacted. As noted above, cultural features associated with milling are located along Main Street. The construction of the lower powerhouse would also affect archeological resources, especially those associated with the construction of the existing lower dam hydro station.

5.05 Upper St. Anthony Falls Alternative: The removal of wasteway No. 2 and portions of wasteway No. 1 and the construction of a new power plant and guidewalls will affect the historic and aesthetic character of the St. Anthony Falls Historic District. This project is located on Hennepin Island, in the historic district, and is flanked by 16 historic sites which are included in the district, including the falls itself. The powerhouse and guidewalls will be constructed to an elevation of 805.0 msl and will protrude well above the existing elevation at the lower end of the wasteways. As long as the historic significance and aesthetic character of the historic district, as well as historic structures and sites, are considered and provided for during later planning stages, adverse impacts can be avoided. Such provisions will include architectural designs which are compatible with the historic character of the area.

5.06 Because construction of the power plant would be within wasteways 1 and 2, it is unlikely that any unrecorded archeological resources still exist at this location. Construction of the wasteways would have destroyed all evidence of prehistoric use of the area.

5.07 Lower Dam Alternative: The lower dam hydro station is not located within the St. Anthony Falls Historic District; however, the Minnesota SHPO has stated that the structure is an integral part of the Historic District, and it is eligible for inclusion on the

National Register as a significant resource in itself. The St. Paul District has requested a determination of eligibility from the National Register on the lower dam hydro station.

5.08 Construction of the new powerhouse adjacent to this structure could result in adverse impacts to this structure. However, during project design, architectural considerations will be incorporated in the new structure to avoid detracting from the visual historic and architectural attributes of the existing structure.

5.09 Unrecorded archeological sites, especially historic, may be impacted by construction of the new powerhouse.

5.10 Sites for the disposal or borrow of material will require a cultural resources review once they have been selected.

5.11 Low Flow Considerations: Each of the proposed alternatives, except the no action alternative, includes special provisions for maintaining low flow over the horseshoe dam and the spillway. The modifications to the recommended plan have been discussed in the "Aesthetic Considerations" section and the "Visual Historic Considerations" section of the main report. Briefly, the revised plan calls for modifications to the horseshoe dam and spillway. Combined with a base flow of 700 cfs, there would be an apparent flow of 1,000 to 1,400 cfs over the horseshoe and 1,500 to 2,100 cfs over the spillway. Both the modifications to the dams and the base flow have been coordinated with the Minnesota SHPO and the Advisory Council on Historic Preservation; a determination of no adverse effect has been received from both agencies on the low flow aspects of the recommended plan. The Advisory Council's comments included a number of conditions which have been incorporated into the report as part of the recommended plan. Acceptance of these conditions

represents the St. Paul District's compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

Aesthetic Resources

5.12 The proposed plan incorporates a base flow during the summer season (April through November), includes rustication measures at both the horseshoe and roll dam, and buries all outgoing transmission lines. These visual quality measures have been incorporated to maintain the visual resources of the upper falls. The impressive power of nature, as manifested in the upper falls during high flow conditions, will be decreased under the proposed project conditions. This is an inherent trade-off of using flows for added hydropower generation. Generally, the decrease in flows over the upper falls will not involve lengthy periods of time and the number of viewers who would not see high flows over the falls is not substantial. Therefore, this decline in the duration and magnitude of "roaring whitewater" is not considered significant.

Endangered and Threatened Species

5.13 The project would have no effect on threatened or endangered species because the only species which would be in the project area would be migratory birds. The immediate project vicinity would not provide roosting sites or critical habitat for the peregrine falcon or bald eagle. No new transmission lines would be required which might provide a collision hazard; all new lines would be buried.

Natural Resources Impacts

5.14 The diverting action would provide additional electrical power by directing flow which would otherwise pass over the roll dam which covers St. Anthony Falls and the gated dam at the lower falls. The

potential effects of hydropower can be divided into operational and construction effects. Each will be discussed in the following paragraphs.

Operational Impacts

5.15 Operational impacts could include any or all of the following: entrainment, impingement, prevention of upstream movement, alteration of tailwater flow patterns, and depletion of dissolved oxygen. Operation of a hydroelectric plant in a "peaking" mode would cause water level fluctuations both above and below the plant, which could have serious effects on fish habitat.

5.16 The use of pool level fluctuation to provide peaking power was rejected in the initial stages of this study because of its potential for detrimental impacts. Only a 1-foot (upper) or 0.4 foot (lower) fluctuation would be allowed. These fluctuations are allowed by the current generating licenses and are also required to accommodate use of water for lockages.

5.17 St. Anthony Falls was a barrier to upstream fish movement until the construction of a navigation lock. Additional hydropower would not prevent fish from reaching the locks, the only avenue of upstream movement, because no velocity barriers would be created.

5.18 The reduction of dissolved oxygen resulting from the passage of water through the hydro plant rather than over the falls is not expected to be detrimental. The dissolved oxygen standard was met 99 percent of the time at stations above and below St. Anthony Falls (MWCC, 1982) so there is no oxygen deficit. In addition, the flow over the roughened falls and turbulent flow in riprap lined tailraces should provide sufficient oxygenation to maintain existing oxygen levels.

5.19 Adding hydropower would cause a greater amount of diversion of flow from St. Anthony Falls and the lower dam than presently occurs. It is not known specifically how these areas are used by fish since tailwater conditions are too hazardous to sample. The combined falls plan would deprive the tailwater area of St. Anthony Falls of some flow to the possible detriment of fish habitat. The upper and lower plans would not remove flow but only relocate it a short distance to an area already receiving the flow of the existing power plants. These diversions would be a significant portion of the flow only during low flow periods. Fish utilization at the base of the falls and lower dam would likely be minimal at that time. Thus, the alteration of tailwater flow patterns would not be expected to have significant effects on the fishery.

5.20 Impingement is the trapping of fish against intake screens of the power plants. The screens, which prevent the passage of large pieces of debris, such as logs, would also trap large fish if velocities prevented the fish from escaping from the intake area. Projecting structures around the intake could funnel fish toward the screens. To minimize impingement, no such projections would be placed in the intake areas. In addition, intake velocities in the immediate intake area would be held to 2 to 3 feet per second, a speed that most large fish can successfully swim against, at least for short distances. The large volume of water required for hydropower generation prevents the achievement of low (0.5 foot per second) velocities utilized for the intakes of steam generating plants. Since intake velocities would be reasonably low, no impacts from impingement are anticipated.

5.21 Entrainment is a process by which aquatic organisms are drawn into and pass through mechanical equipment along with the water which contained them. The potential for entrainment of larval fish which would be drifting and unable to avoid the intakes of the new

hydropower facilities was an area of concern. The main concern was tne effect of the mortality of those organisms on downstream fish populations. An analysis of the potential amount of entrainment was conducted using an entrainment study (Heberling et al. 1981) done for the Riverside plant, a steam generating station 3 miles upstream of the falls. The study included an estimate of the total amount of drift passing the plant. To estimate the fish reaching the falls, tne total drift was reduced by 10 percent to account for tne entrainment of the Riverside plant and tne Minneapolis water supply. In addition, species which are not normally found in the impounded reach below the falls were not analyzed because it is unlikely that habitat conditions would be suitable for them below the falls. It was assumed that the remaining fish were evenly distributed in the water; thus, the percentage of fish that would pass tnrough tne proposed turbines would be equal to the percentage of the total flow that would pass through tne turbines. Mortality of entrained fish was assumed to be 100 percent. It was also assumed that the new turbines would be utilized first because of their greater efficiency. If additional hydropower was developed by other than the current license holder, then the turbines would not have first priority for flow. Their use would be limited by flow availability and impacts of additional power would be less than described below.

5.22 A metnod proposed by Horst (1975) was used to calculate the number of adults which would be equivalent to the larval fish that were entrained. This was accomplished by multiplying the total fish entrained per week by the larval to adult survival factor. These factors were 0.00001 to 0.00007 for game fish (except rock bass, 0.007) and up to 0.7 for nongame species. The results (table EA-2) suggested that, in terms of yield to the sport fishery, the impact would be negligible. Much larger numbers of some nongame species might be affected but their small size means that the loss of biomass would probably not be detrimental to the fishery.

Table EA-2 - Equivalent Adult Fish Entrained: New Hydro First Priority

Species	April 17	April 24	May 1	May 8	May 15	May 22	May 29	June 5	June 12	June 19	June 26	July 2	Total entrained	Total drift	Percent of total
Cyprinidae	-	-	-	-	5,409	-	32,701	32,396	53,972	54,960	10,948	21,667	212,053	862,595	24.6
Cyprinus carpio	-	-	-	-	2.5	8	25	25	25	11	3	-	100	146	68.5
Catostomidae	-	-	-	1,741	374	1,628	754	13,274	4,011	-	-	129	21,911	27,933	78.4
Ictalurus punctatus	-	-	-	-	-	-	-	-	1	5	3	14	23	50	46.0
Micropterus dolomieui	-	-	-	-	-	-	9	23	17	-	-	-	49	64	76.6
Micropterus sp.	-	-	-	-	-	-	-	-	6	-	-	-	6	9	67.8
Pomoxis nigromaculatus	-	-	-	-	-	-	-	5	5	-	-	-	10	14	71.4
Pomoxis sp.	-	-	-	-	-	-	2	-	5	5	-	-	12	18	67.8
Lepomis machrochirus	-	-	-	-	-	-	-	-	-	2	1	1	4	13	30.8
Ambloplites rupestris	-	-	-	-	-	-	-	585	581	599	30	-	1,795	2,391	74.9
Percidate	-	-	1,269	468	67	101	32	67	128	-	-	-	2,132	3,177	67.1
Stizostedion vitreum	-	-	16	-	-	-	-	-	-	-	-	-	16	26	61.5

Evaluating the impact of the loss of larval fish to the fishery of downstream pools is difficult because detailed information on the fishery is lacking. Some creel census data are available but are somewhat biased toward fish that can be caught by bank fishermen. The Minnesota Department of Natural Resources suggested that the published survival rates tended to underestimate the equivalent adult fish which might be affected. While this may be true, having more accurate survival rates would not improve the ability to assess the potential impacts because the accuracy of the ichthyoplankton data is limited by the methods used to collect it, and data on the composition of the fishery are lacking. Finally, based on studies of turbine passage (Bell, 1981; Turbak et al, 1981), it is felt that fish mortality in the new turbines would be substantially lower than the 100 percent which was assumed. The relatively small number of blades, large-diameter runners, and low heads would be likely to contribute to a high rate of survival of entrained fish, especially considering that four of the existing turbines at the upper falls have two Francis (multi-bladed) runners per unit it may be posssible to reduce the existing mortality of entrained fish by employing the proposed turbines in lieu of the existing units, or passage over the falls, during low flow periods.

5.23 Bulb turbines, of the type to be installed at the lower falls, have not been extensively tested. However, based on their configuration, they would be expected to cause no greater mortality than the more common version of the propeller turbine.

5.24 The analysis was based on entrainment at the upper falls. The combined falls would entrain less than the upper falls and would utilize the same type of turbines so effects would be similar.

Terrestrial Resources

5.25 Both the upper and lower units would be placed in disturbed areas either currently or previously used as spillways or sluiceways. The two wasteways at the upper falls have been abandoned. The short wasteway and a small amount of the long wasteway would be replaced by the structure. No terrestrial habitat would be lost. The combined unit would be routed under Main Street for most of its length but would then cross the bluff and descend to the river flats. A few trees and some understory vegetation and associated wildlife habitat would be removed for the penstock. The amount removed would not be a significant part of the vegetation in the vicinity.

Construction Impacts

5.26 The environmental effects of construction are usually short term and quite localized. Construction activities would have some minimal short-term impacts on recreational activities in the Main Street area. Dredging, usually an item of major concern, would not be required for this project. Cofferdams of clean sand, with clay cores, some behind sheet pile walls and some in sheet pile cells, would be used to isolate the construction sites and allow dry excavation of foundations, intakes, and tailraces. Exposed areas would be lined with riprap before cofferdams would be removed. Short-term increases in turbidity may occur when cofferdams are removed, particularly where sheet pile cells are not employed. Clean fill from an upland source would be used so no long-term effects would be expected. Excavated material would be disposed of at the "Port of Minneapolis" site which is presently used as a disposal area for maintenance dredging. Since this is an existing disposal area and the disposal material is reused, its use would not result in significant effects to the human and the natural environment. The Corps

would, however, coordinate with the Minnesota Pollution Control Agency before using the area since materials excavated for hydropower development would likely be different than those currently being placed in the disposal area.

5.27 Noise in the area would increase during the 2 years of construction. Shopping and residential areas would be screened by trees and distance. The opposite shore is industrial area, and the noise would not be a problem on that side. Use of construction equipment would result in a minor decrease in air quality. Engine exhaust would be vented into the river corridor and quickly dissipated.

Executive Orders 11988 and 11990

5.28 The proposed action was reviewed with regard to Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands). This review determined that the proposed action would have no significant impacts on wetlands or on the floodplain in the project area. No wetlands are located in the project area. The proposed project would not provide increased area or increased protection of the floodplain which might promote development.

5.29 The no action alternative would not affect any of the individual historic sites or structures within the historic district or the district itself. Neither would this alternative affect the lower dam hydro station.

6.00 PUBLIC INVOLVEMENT

6.01 Coordination with the public and with government agencies was maintained throughout the planning process. The draft report, including the environmental assessment and 404(b)(1) evaluation, was

sent to interested citizens and the following agencies for their review and comment:

U.S. Fish and Wildlife Service
U.S. Soil Conservation Service
U.S. Environmental Protection Agency
National Park Service
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
Minnesota Department of Energy, Planning and Development
State Historic Preservation Officer
State Archeologist
City of Minneapolis Planning Department
Riverfront Development Coordination Board
Advisory Council on Historic Preservation
Minneapolis Heritage Preservation Commission

6.02 Coordination has been conducted with the U.S. Fish and Wildlife Service and Minnesota Department of Natural Resources to resolve tne entrainment mortality question. A discussion is contained in a letter to the Fish and Wildlife Service dated June 6, 1983 (see exhibits).

6.03 Cultural resources coordination has been conducted with the National Park Service, the Minnesota State Archeologist, the Minnesota State Historic Preservation Officer, and the Advisory Council on Historic Preservation. The comments of the Advisory Council were sought in accordance with 36 CFR Part 800 for impacts to the St. Anthony Falls Historic District. The Advisory Council has also been made aware of the determination of eligibility submittal made by the St. Paul District for the lower dam hydro station.

Literature Cited

Bell, M.C. 1981. Updated Compendium on the Success of Passage of Small Fish Through Turbines. Contract DACW-68-76-C-0254, U.S. Army Corps of Engineers, North Pacific Division. 335 p.

Heberling, G.D., K.N. Mueller, and J.W. Weinhold. 1981. 1980 Riverside Generating Plant NPDES Section 316b Supplement. Northern States Power Company. 56 p.

Horst, T.J. 1975. The Assessment of Impact Due to Entrainment of Ichthyoplankton. pp. 107-118. In: S.B. Saila (ed.) Fisheries and Energy Production, A Symposium. Lexington Books, D.C. Heath and Co., Lexington, MA.

Rasmussen, J.L. (ed.) 1979. A Compendium of Fishery Information on the Upper Mississippi River. Second Edition. Upper Mississippi River Conservation Committee. 257 pp.

Turbak, S.C. 1981. Analysis of Environmental Issues Related to Small Scale Hydroelectric Development IV: Fish Mortality Resulting from Turbine Passage. Oak Ridge National Laboratory ORNL/TM-7521. 103 p.

ENVIRONMENTAL IMPACT ASSESSMENT MATRIX

MAGNITUDE OF PROBABLE IMPACT

NAME OF PARAMETER	INCREASING BENEFICIAL IMPACT ← SIGNIFICANT	SUBSTANTIAL	MINOR	NO APPRECIABLE EFFECT	INCREASING ADVERSE IMPACT → MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
1. Historical/Archaeological Values					X(1)		
2. Noise Levels					X		
3. Aesthetic Values					X(1)		
4. Recreational Opportunities				X			
5. Transportation				X			
6. Public Health & Safety				X			
7. Community Cohesion (Sense of Unity)				X			
8. Community Growth & Development			X				
9. Business and Home Relocations				X			
10. Existing/Potential Land Use				X			
11. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenues			X				
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment			X				
6. Business Activity			X				
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Flooding Effects				X			
10. Energy Needs and Resources			X				
C. NATURAL RESOURCE EFFECTS							
1. Air Quality					X		
2. Terrestrial Habitat				X			
3. Wetlands				X			
4. Aquatic Habitat				X			
5. Habitat Diversity and Interspersion				X			
6. Biological Productivity					X		
7. Surface Water Quality				X			
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			

NCS Form 81 (NCS 81 (TEST) & NCS 81-2(TEST) 13 Apr 78 Obsolete)
9 April 1979

(1) Minor impacts will occur only if the National Register of Historic Places significance of the project area is addressed as stated in the report.

404(b)(1) EVALUATION
ADDITIONAL HYDROPOWER, ST. ANTHONY FALLS, MISSISSIPPI RIVER, HENNEPIN COUNTY, MINNESOTA

I. PROJECT DESCRIPTION

A. Location - The proposed addition of hydropower is at St. Anthony Falls, on the Mississippi River, at downtown Minneapolis, Hennepin County, Minnesota (plate 1).

B. General Project Description - The recommended plan would provide additional hydropower through the installation of two vertical axis, fixed blade, propeller turbines in an abandoned wasteway adjacent to the intake canal of the Hennepin Island hydro plant. In addition, a single bulb turbine with a horizontal axis and adjustable blades would be installed adjacent to the existing generating station at Lower St. Anthony Falls. Cofferdams and sheet pile cells would be placed to allow dry excavation and construction. Riprap would be placed during project construction to protect tailraces and shorelines from erosion.

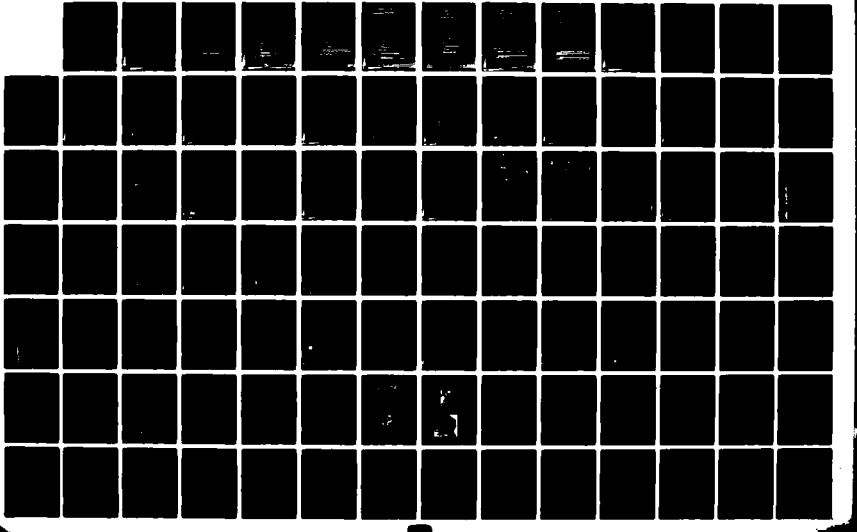
C. Authority and Purpose - This study was authorized by a resolution of the House Committee on Public Works dated 11 December 1969.

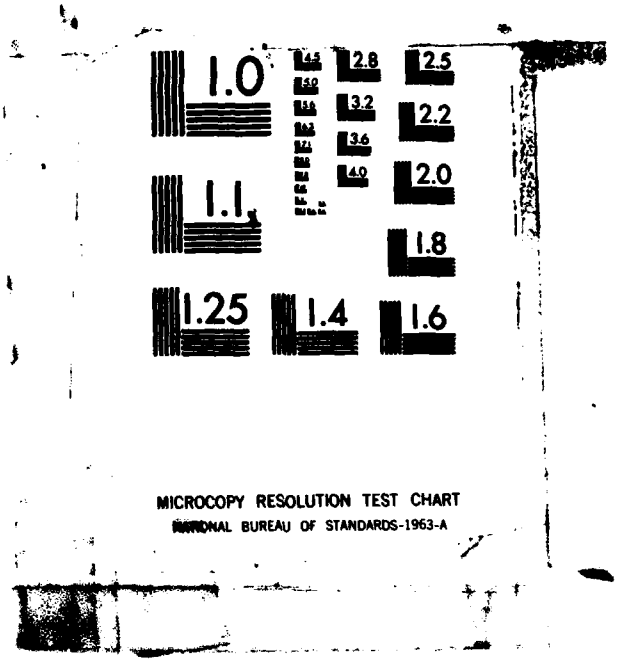
D. General Description of Dredged or Fill Material

1. General Characteristics of Material - Fine sand or clay would be placed for cofferdams, most if not all behind sheet pile. Fine sand would also be placed in 11 sheet pile cells. Riprap about 12 inches in diameter would be placed as well.

AD-A140 262 FEASIBILITY REPORT FOR HYDROPOWER ST ANTHONY FALLS LOCKS AND DAMS MISSISSIPPI RIVER MINNEAPOLIS MINNESOTA (U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT FEB 84 F/G 13/2 NL

UNCLASSIFIED




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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

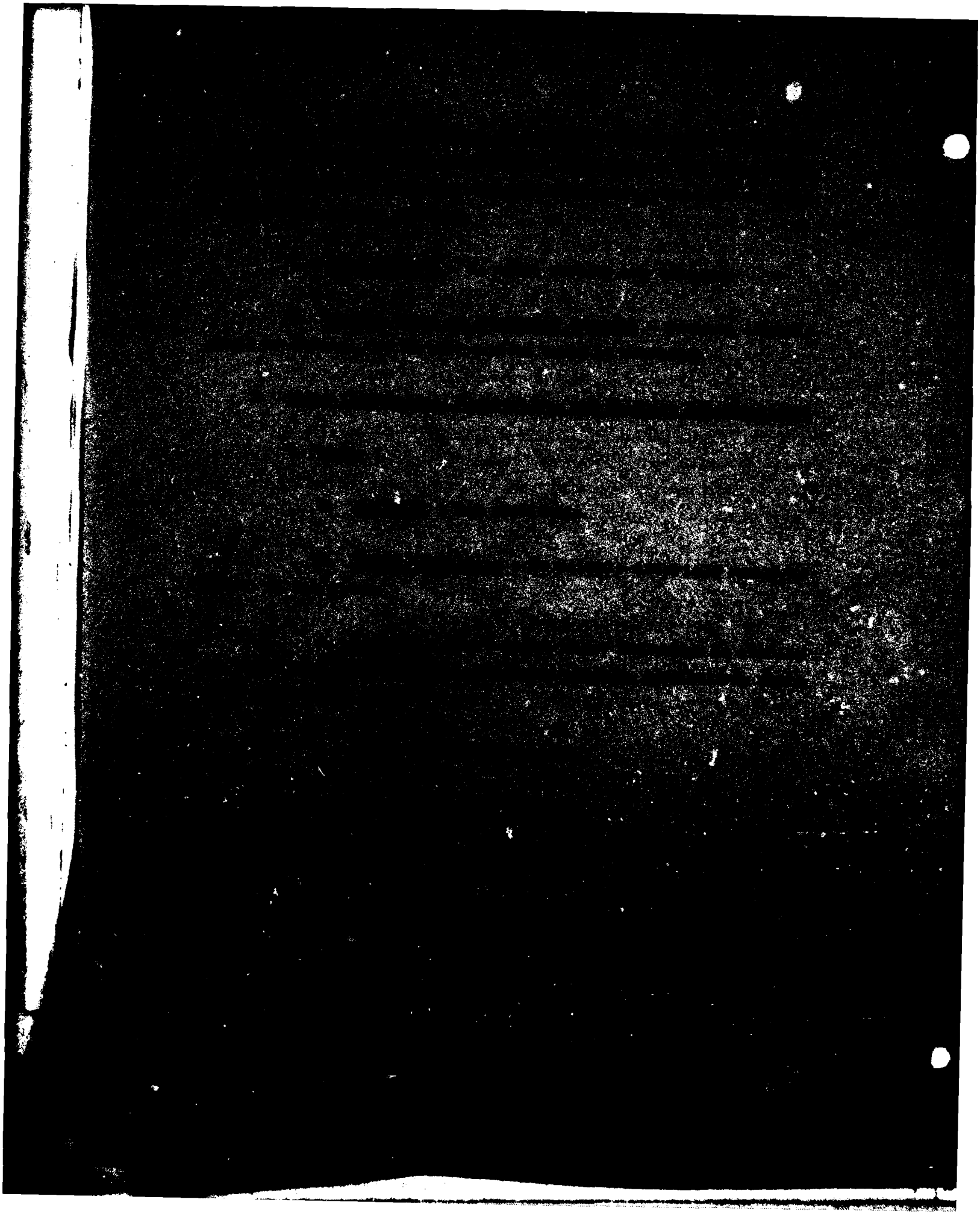
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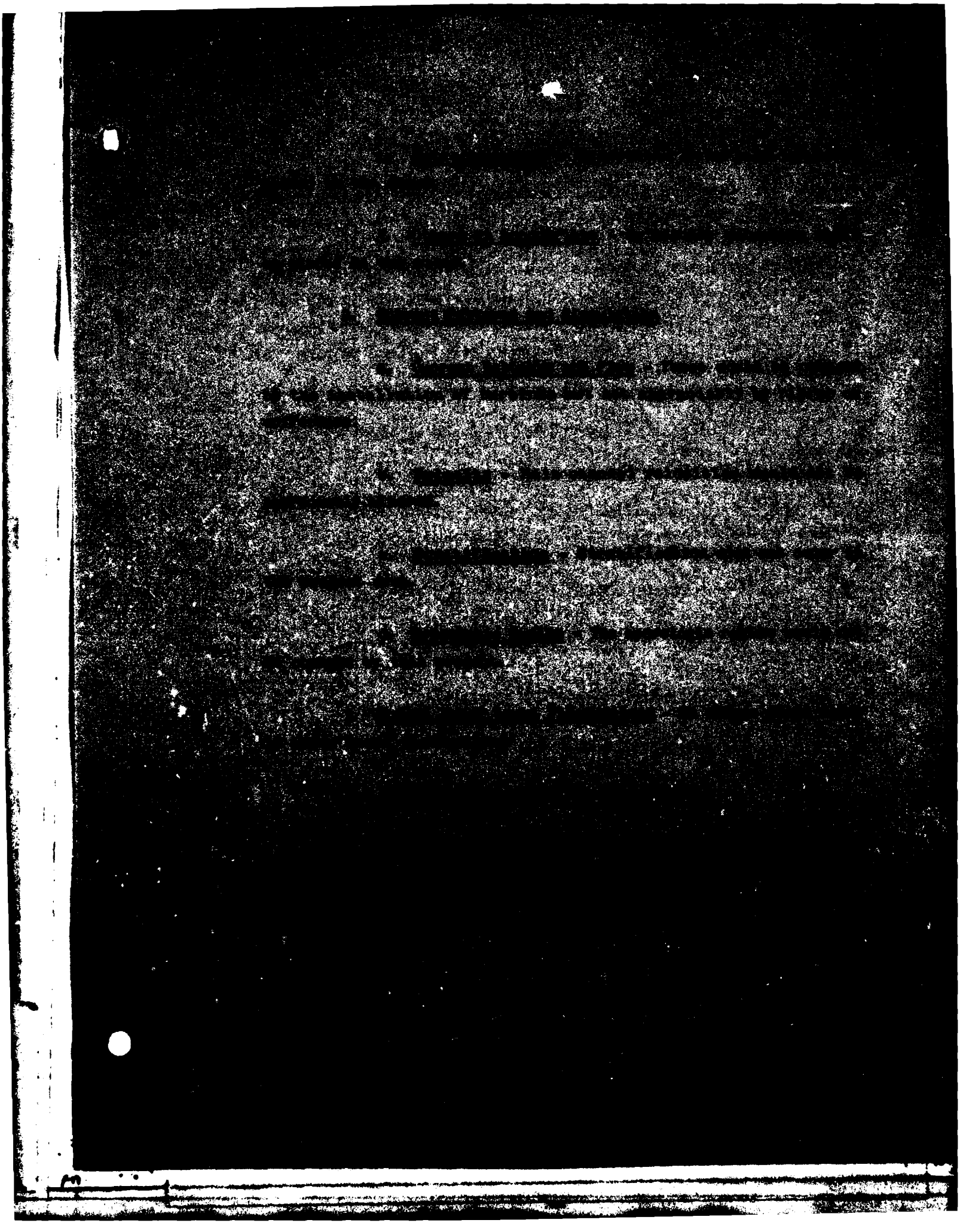
3. Sources of Materials - Sand, clay, and riprap would be obtained from local, established quarries. On-site materials would not be used.

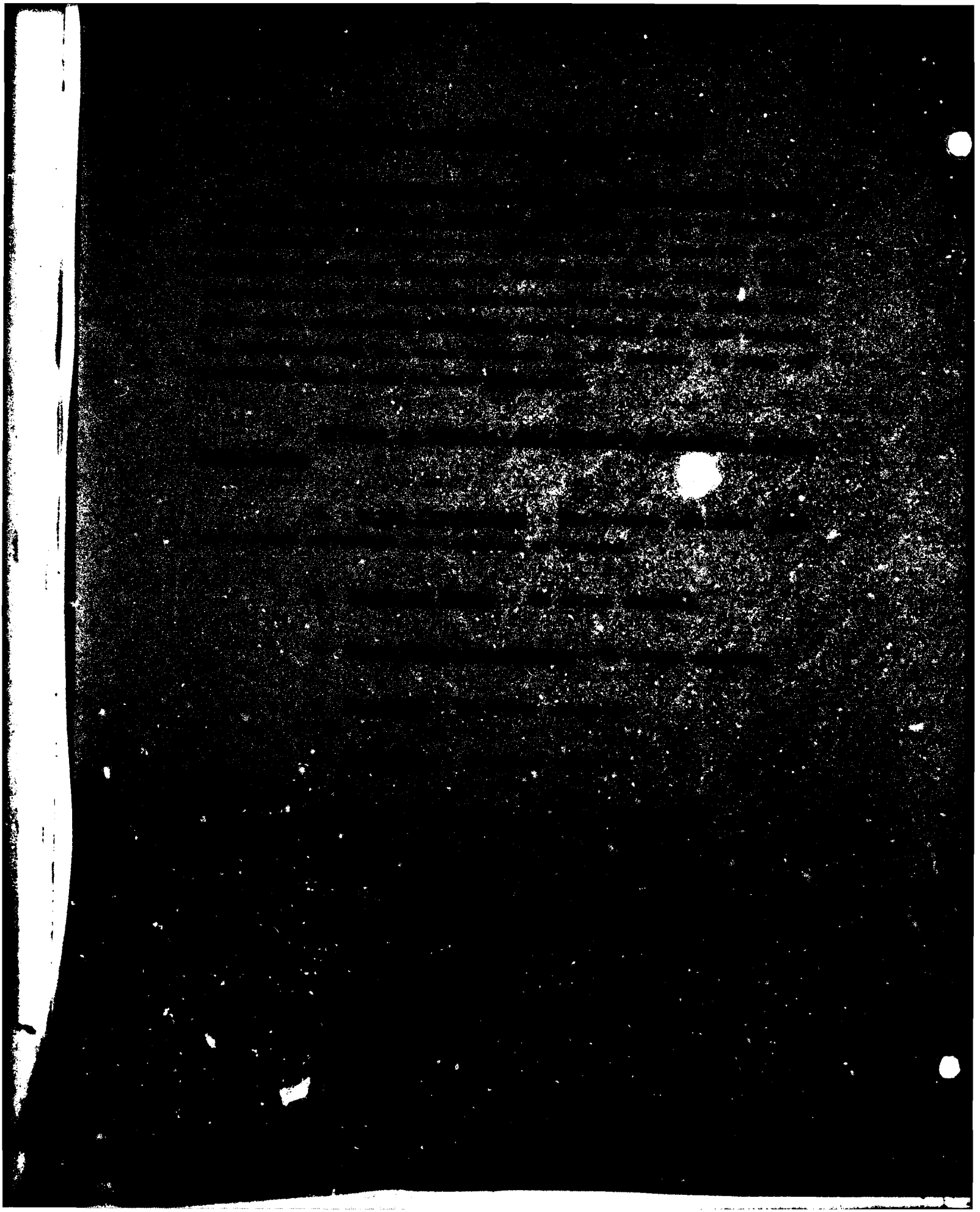
B. Description of Proposed Disposal Sites

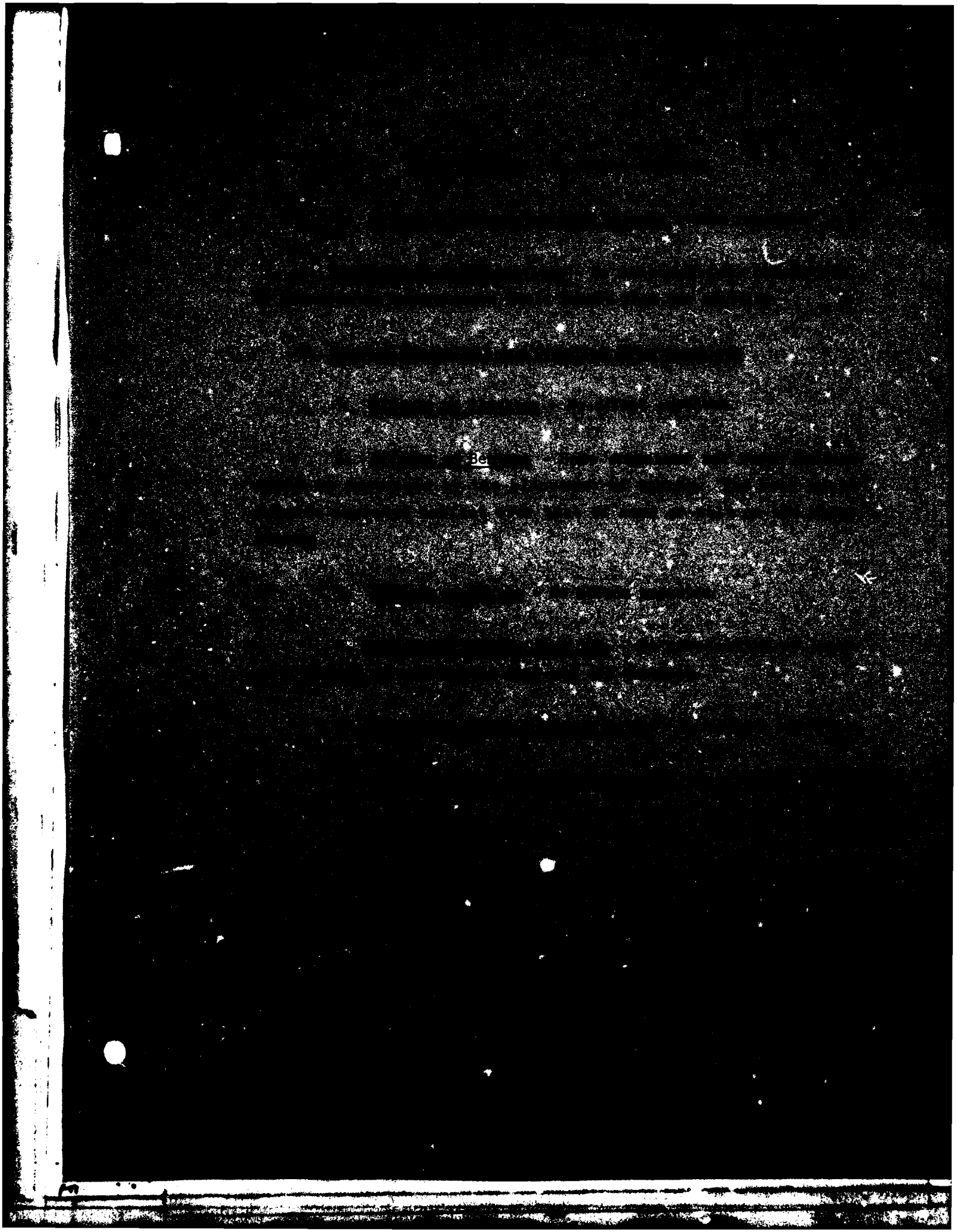
1. Location - Cofferdams would be placed to enclose the upper and lower ends of the proposed upper site as well as along the northeast side; the remainder of the side would be enclosed by a dike. At the lower site, the northeast side would be enclosed by a dike with five gates and the lower side by a cofferdam. Dikes would form part of the south entrance and would be placed to prevent material in other places (Photos 5 and 7).

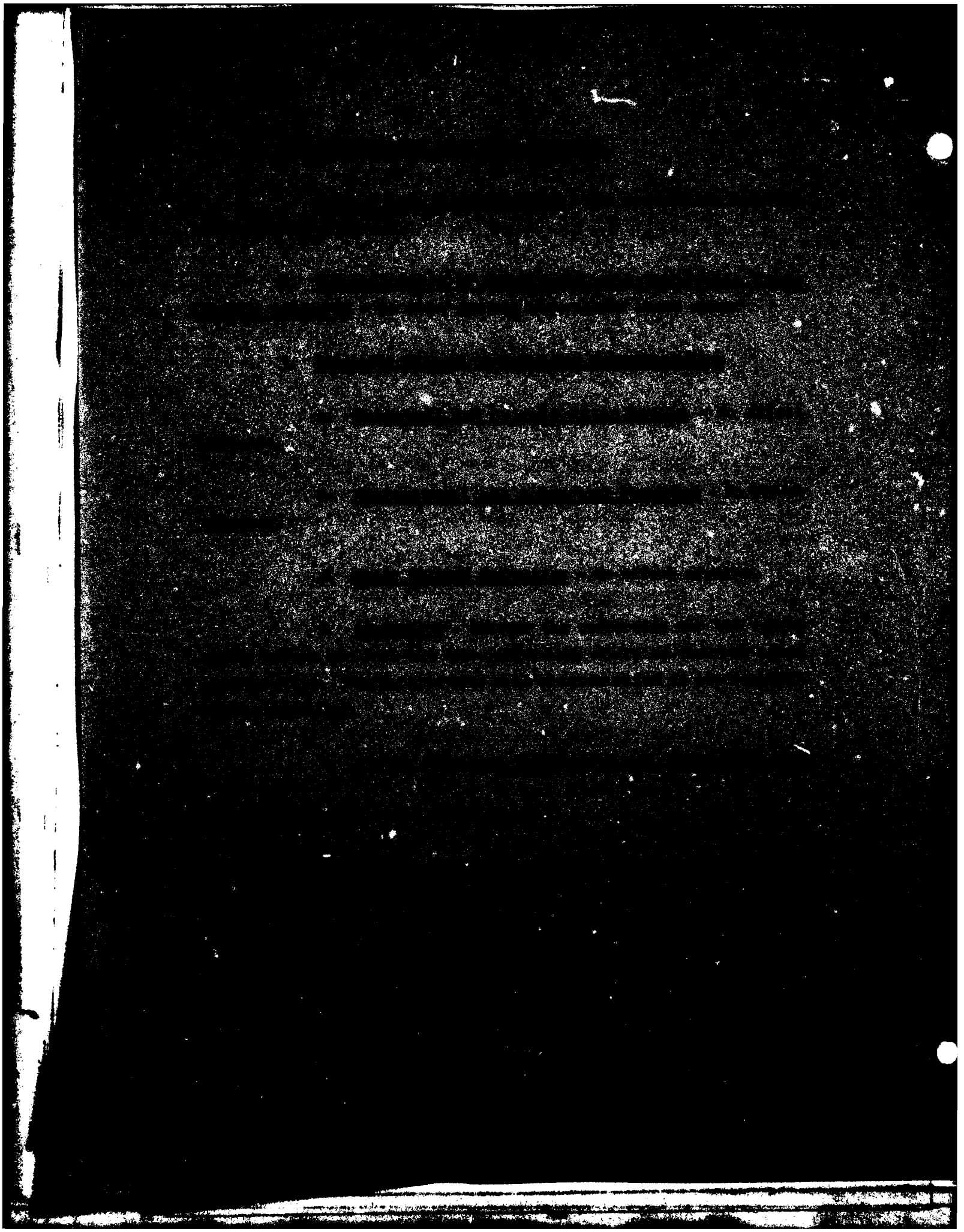
2. Size - Approximately 60,000 square feet would be affected by cofferdams. Of course, of such would ultimately be under approximately 11,000 square feet would be occupied by dikes.

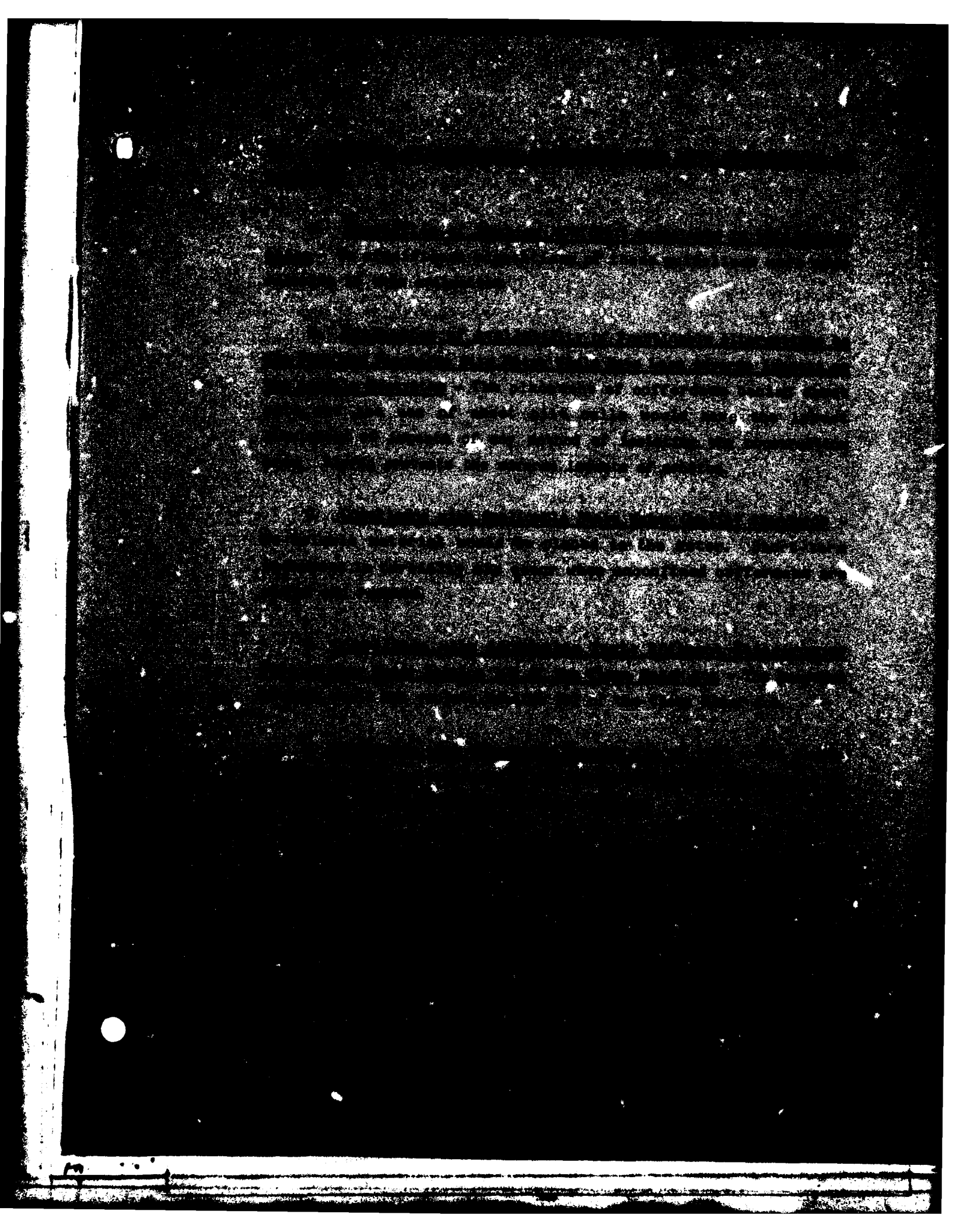












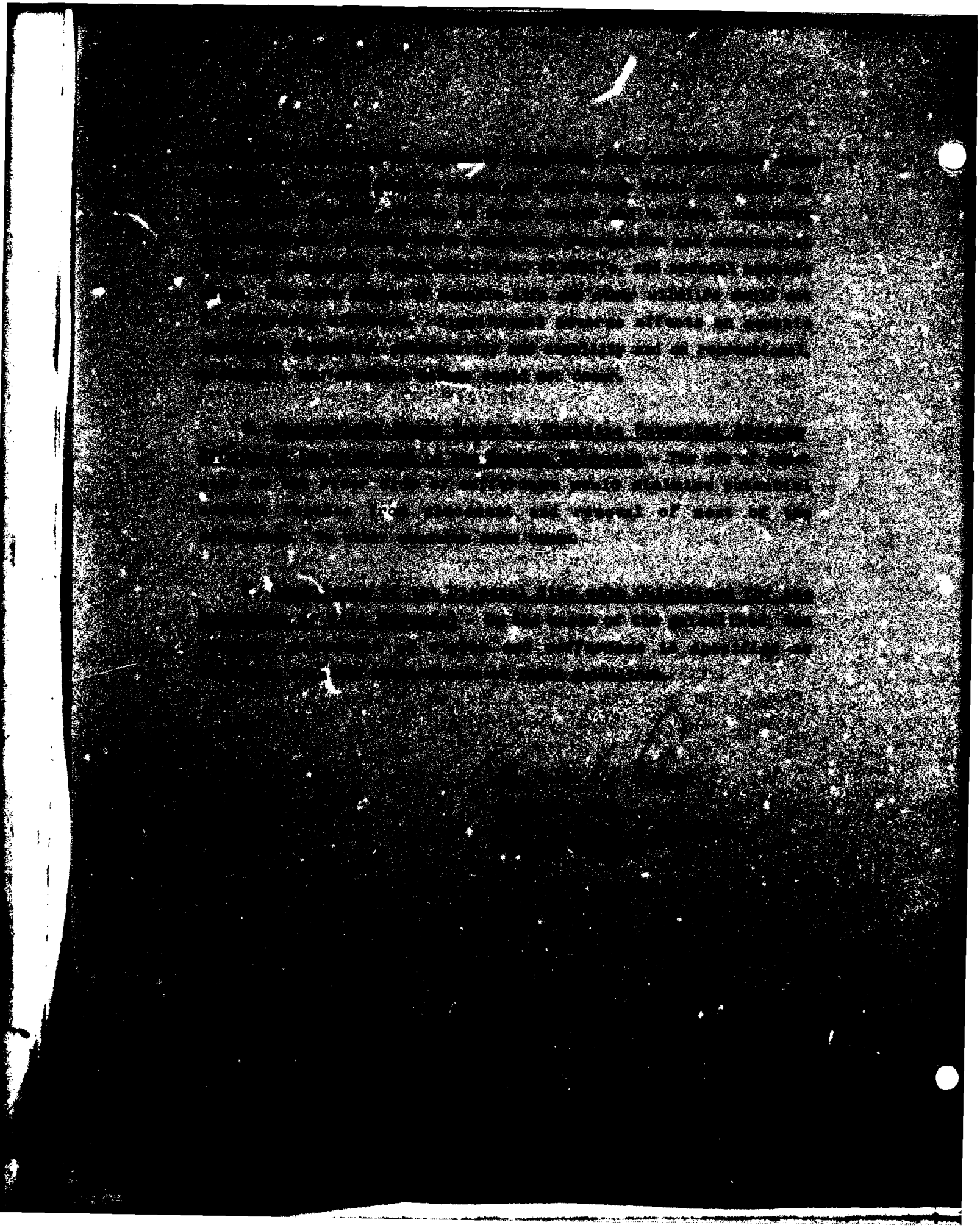


EXHIBIT A

COMMENTS AND RESPONSES

September 1983 Draft Report

and

October 1983 Public Meeting

ENVIRONMENTAL ASSESSMENT
ST. ANTHONY FALLS HYDROPOWER
MINNEAPOLIS, MINNESOTA

EXHIBIT A
COMMENTS AND RESPONSES

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ST·ANTHONY
MAIN

October 14, 1983

Colonel Edward G. Rapp
District Engineer
St. Paul District
U. S. Army Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

I am writing to convey the concerns of St. Anthony Main regarding the planned hydroelectric facility at the upper St. Anthony Falls. As you may know, St. Anthony Main is a retail, office, and housing complex immediately across Main Street from the old hydroelectric facility at the upper falls.

I have discussed the planned power facility at length with Carl Stephan. My concerns cover three areas: (a) the need to maintain the visual amenity of the falls during the spring, summer, and fall, (b) the visual eyesore that a new power facility, additional power lines, and transformers could create, and (c) the need to flush stagnant water from the tail races in Father Hennepin Bluffs Park.

A-1

First, we feel that the St. Anthony Falls are a very important historical and visual landmark. They represent the birthplace of Minneapolis and are now the focus of an urban renaissance. St. Anthony Main currently has 105,000 square feet of quality retail and office space, and the next phase of expansion will begin in April of 1984. This expansion will include 50,000 square feet of retail and a four-screen cinema. The Pracna restaurant and Winslow condominiums are also part of the complex. The river park system is an integral part of our marketing concept and our success. Other developments, such as Riverplace on our side of the river, and proposed projects on the west side, represent significant economic development along the river. There are a variety of planned recreational amenities that rely on the integrity of the falls. For example, the proposed trolley system, crossing the Mississippi on the Stone Arch Bridge, would feature the upper falls as a central attraction. As further development occurs, the upper falls will becoming an increasing important focus. The jobs, tax base, and contribution to the urban environment of the existing and proposed developments are important to the City and to us and should be the first priority when planning for the Mississippi. We feel that the impact on this economic activity by the proposed hydroelectric facility has not been adequately examined. It is our feeling that the falls must be a visual amenity from April through October. Currently the falls go dry during August and October in some years. This is due to the large amount of diverted water currently (which

1.

201 Main Street, SE · Minneapolis, Minnesota 55414 · Telephone 612/379-4540

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO ST. ANTHONY MAIN

October 14, 1983

1. National economic development generally receives first priority by the Corps as a Federal agency. However, urban development has been considered as well.

should be controlled). The proposed facility will make this aggravated situation even worse.

St. Anthony Main is also very concerned about the visual impact of a new power plant with the necessary additional transformer capacity and transmission lines. The existing substation and transmission lines already are not acceptable given the kinds of public uses that are now well established. They present a serious eyesore and impediment to utilization of the river, and should be eliminated in the long term. We will not accept further deterioration of our immediate river environment by additional electrical infrastructure. 2.

Finally, we would like to see the stagnant water in the tail races of Father Hennepin Bluffs Park be considered when planning new facilities. The run-off should be used to flush out these stagnant conditions. 3.

I understand the need to exploit hydroelectric energy opportunities, but this should not be done at the expense of other valuable economic and societal concerns. I hope you will carefully consider the concerns of St. Anthony Main in your future plans. 4.

Respectfully yours,

David J. Solomon
Real Estate Coordinator

DJS:jh

A-2

2. The new generators would be connected to existing substation facilities using buried transmission lines. Since no alteration of existing electrical systems is proposed, no changes could be made as part of this project.

3. Elimination of stagnation in the tailraces has been investigated and may be feasible, in conjunction with the proposed project, if only a limited amount of water is discharged. Aspects of this problem to be addressed in the next phase of study would include: replacement of deteriorated parts of the overflow spillway, ownership of the right of way and responsibility for operation (to avoid winter ice problems). Implementation of this feature does not depend on construction of the project.

4. Future planning, if authorized, will consider the suggested project design modifications suggested in this letter.

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

BOX . CENTENNIAL OFFICE BUILDING • ST. PAUL, MINNESOTA • 55155

DNR INFORMATION
(612) 296-6157

FILE NO _____

October 18, 1983

Colonel Edward G. Rapp
Commander, St. Paul District
U.S. Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

I am writing with respect to the St. Anthony Falls hydropower feasibility study which is the subject of a public meeting this evening.

While we have not received specific information on the Corps' findings, other than your notice dated October 3, 1983, it is our understanding that the upper dam exhibits the greater potential for additional hydropower development. The amount of time that water would not flow over this spillway would increase from about 40% to as much as 80% of a typical water year. The perceived detraction from the scenic resources of the area by virtue of this flow reduction has generated significant public concern. 1.

Several state environmental laws and rules would be applicable to such development. 6 MCAR § 3.038W.1. would require an Environmental Assessment Worksheet to be prepared with this Department being the Responsible Governmental Unit. One of the focal points of such a worksheet would be the impact on scenic resources consistent with Minn. Stat. Chapter 116B, the Minnesota Environmental Rights Law. § 105.482, Subd. 1, also indicates that hydropower redevelopment must be environmentally sound as well as economically feasible. 2.

The impact on scenic and other resources would also be considered in our processing of the required water resources permit application for appropriating state waters and changing the course, current, and cross-section of public waters pursuant to Minn. Stat. Chapter 105. 3.

AN EQUAL OPPORTUNITY EMPLOYER

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO MINNESOTA DEPARTMENT OF NATURAL RESOURCES

October 18, 1983

1. The proposed plan has been revised to reflect public concerns.

2. We have coordinated with your department to ensure that the proposed project would be environmentally sound.

3. Noted.

We will be happy to discuss state regulatory processes with you or your staff, upon request.

Sincerely,

DIVISION OF WATERS

Larry Schmidt
Director

LS:sk
cc: Mayor Donald Fraser
: Joseph Alexander
: Thomas Kalitowski
: A.N. Clapp, III
: Kent Lokkesmoe

1926F

MINNEAPOLIS COMMUNITY DEVELOPMENT AGENCY

331 SECOND AVENUE SOUTH, SUITE 600 MINNEAPOLIS, MINNESOTA 55401

JAMES R. HELTZER, EXECUTIVE DIRECTOR PHONE 612-348-2511

EQUAL EMPLOYMENT OPPORTUNITY

EQUAL HOUSING OPPORTUNITY

A-5

October 20, 1983

Colonel Edward G. Rapp
District Engineer
Department of Army
St. Paul District Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Attention: Planning; Plan Formulation

Dear Colonel Rapp:

At its October 19, 1983 meeting, the Board of Commissioners of the Minneapolis Community Development Agency voted to express to the U.S. Corps of Engineers the Board's strong concern over the proposed expansion of the hydroelectric power facilities at Saint Anthony Falls. The Board is appreciative of the financial and environmental benefits of using hydropower to generate electrical energy. However, the Board is seriously disturbed by the effect which the diversion of water from over the Falls will have on development of the riverfront. 1.

As the Agency responsible for several of the major redevelopment projects along the riverfront in Minneapolis, the MCDA is vitally aware of the significant and unique resource this area offers for the City and the entire region. The central riverfront is not only of historical, recreational, and aesthetic importance, but also contains the largest economic development potential outside of the Central Business District itself. 2.

Developments along the central riverfront which are currently proposed or under construction represent close to $1 billion in investment which will provide housing, jobs, taxes and economic activity. Historically, St. Anthony Falls is the reason for the founding and prospering of the City of Minneapolis, and today it is the aesthetic and symbolic centerpiece of a rebirth of the riverfront's vitality. The result of, in effect, shutting off the Falls is difficult to quantify, but it will undoubtedly have a significant negative impact on a unique historical and recreational resource and on a major economic development effort. 3.

The MCDA Board feels that the Environmental Assessment should be expanded to adequately consider the impact of the proposed water diversion on the economic development of the riverfront and that the Statement of No Significant Impact should be abandoned. The Corps of Engineers is also requested to reconsider the 4.

COMMISSIONERS STEPHEN H. HOOPE Chairman BARBARA ALLIVATO D. ELIZABETH ANDERSON LEONARD C. BIERMAS EDWARD DIRKSWAGER
MICHELE G. FOSTER RICHARD D. HALL RICHARD H. JEFFERSON STANLEY J. MURZYN RICHARD D. SCHNEIDER LYALL A. SCHWARZKOPF

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO MINNEAPOLIS COMMUNITY DEVELOPMENT AGENCY

October 20, 1983

1. Your comment is noted.

2. Your comment is noted.

3. The proposed project has been revised to reflect these concerns.

4. The revised plan incorporates a base flow over St. Anthony Falls to retain the visual aspects of water flow. The Corps has worked witn the City and others to propose a project which satisfies all their concerns.

wisdom of expanding the hydroelectric power facilities at Saint Anthony Falls or, at the least, to work with the City of Minneapolis, MCDA, Park Board, Heritage Preservation Commission and other interested parties to investigate ways to modify or mitigate the potential impact of the proposal. 4.(cont.)

Thank you for your consideration of the Board's concern relative to this matter.

Sincerely,

James R. Heltzer

James R. Heltzer
Executive Director

JRH:lae

U.S. Department of Transportation
Federal Highway Administration

Region 5
Minnesota Division

Suite 490, Metro Square Building
7th & Roberts Streets
St. Paul, Minnesota 55101

October 21, 1983

Mr. Edward G. Rapp
Colonel, Corps of Engineers
District Engineer
St. Paul District
1135 U.S. Post Office and Custom House
St. Paul, Minnesota, 55101

Attn: Planning
Plan Formulation

Dear Colonel Rapp:

Thank you for the opportunity to review the Draft Feasibility Report and Environmental Assessment for the proposed hydropower improvements at St. Anthony Falls Locks and Dams on the Mississippi River in Minneapolis.

The proposed hydropower project appears to have no significant impact on existing Federal-aid highway facilities. The project may impact a proposed Federally aided project along the west bank of the Mississippi River. This project, called West River Parkway from Franklyn to Plymouth, is being studied by the Minneapolis Park and Recreation Board. The Corps has been very helpful in assisting FHWA and the Park Board in the analysis and mitigation of the roadway impacts upon Corps' facilities along the river and upon existing river uses. 1.

The Corps' project may impact FHWA's opportunities to mitigate parkway impact to the St. Anthony Fall's Historic District. One mitigation being considered by the Minneapolis Park and Recreation Board and the State Historic Preservation Office is construction of a mill race through the Mill Area of the Historic District. Page 71 of the Environmental Assessment indicates that the hydropower project would lower river surface levels. While the parkway design has not progressed to the point where inlet and outlet elevations have been established for the mill race, it is fairly certain that the lower river level would make construction of the mill race unpracticable. 2.

At this point, we are not able to fully assess the significance of not being able to construct a mill race as mitigation to the parkway impact on the Mill Area. Certainly, an opportunity to partially recreate history would be lost along with the other social and recreational values of the mill race. However, the parkway would almost certainly be constructed with alternate riverfront social and recreational opportunities. 3.

It is our understanding that the Minneapolis Park and Recreation Board independently or through the Mayor's office is also responding to the Environ- 4.

A-7

ST. ANTHONY FALLS HYDROPOWER
CORPS RESPONSE TO U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
October 21, 1983

1. The Corps will continue to coordinate the proposed hydropower project activities with the proposed Great River Road Parkway along the west bank of the Mississippi River.

2. The proposed project would not lower river surface levels. However, at low flows, all available flow, except for a proposed base flow over the falls, would pass through the turbines. A mill race proposal for the Mill Area of the historic district presumably would require flow during 12 months of the year. This would require some commitment from NSP's water allocation which now causes the upper falls spillway to dry up about 40 percent of the time.

   The original mill race proposal would have required 1,000 cfs which would be incompatible with both existing and add-on hydropower. The Minneapolis Park Board, at the 14 February 1984 information meeting, indicated that a mill race plan could be developed with 25 to 50 cfs. It may be possible to negotiate a flow of this size without interference with the proposed hydropower project.

3. Your comment is noted.

4. Your comment is noted.

mental Assessment. Their comments may allow evaluation of the significance of the mill race in a broader context. Again, we appreciate the opportunity to comment on the Corps' proposed project. Any questions concerning these comments can be directed to Steve Bahler (725-5956) of this office.

Sincerely yours,

Roger Borg
Division Administrator

United States Department of the Interior

FISH AND WILDLIFE SERVICE
St. Paul Field Office, Ecological Services
570 Natural Building
333 Sibley Street
St. Paul, Minnesota 55101

IN REPLY REFER TO:

October 24, 1983

Colonel Edward G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

The U.S. Fish and Wildlife Service has reviewed the draft Feasibility Report, Environmental Assessment and Appendices for hydropower development on the Upper Mississippi River at Upper and Lower St. Anthony Falls in the Twin Cities, Minnesota.

The Service has been involved in this project since early 1981. On July 27, 1983, we submitted a draft Fish and Wildlife Coordination Act (FWCA) Report on the selected alternative for hydropower development at St. Anthony Falls. This report is contained in Appendix E of your above referenced documents. Recommendations contained in the draft FWCA Report were developed in an attempt to avoid, minimize or compensate for possible adverse project-related impacts to fish and wildlife resources in the St. Anthony Falls area. After reviewing the draft Feasibility Report and Environmental Assessment, we have no additional recommendations to offer. This letter and our July 27, 1983, report therefore constitute our final FWCA report for this project.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

We look forward to working with District personnel on other hydropower projects proposed for development on the Upper Mississippi River.

Sincerely,

Robert F. Walford
Field Office Supervisor

cc: MN DNR, St. Paul
MN PCA, Roseville
US EPA, Chicago

ST. ANTHONY FALLS HYDROPOWER
CORPS RESPONSE TO U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
October 24, 1983

Your comments are noted. The participation of the Fish and Wildlife Service in this study was particularly valuable.

minneapolis
city of lakes

24 October, 1983

Colonel Edward G. Rapp
District Engineer
Department of Army
St. Paul District Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, MN 55101

Attention: Planning; Plan Formulation

Dear Colonel Rapp:

The Minneapolis Heritage Preservation Commission wishes to voice its concern about the inadequacy of analysis in the St. Paul District Corps of Engineer's plan to increase the mill powers at the Falls of St. Anthony and the related Draft Feasibility Report and Environment Assessment.

The Findings of No Significant Impact states that the proposed plan "does not constitute a major Federal action significantly affecting the human environment." Yet the Summary (Section 1.05, *p. EA-4) notes that "the interest in St. Anthony Falls has increasingly* been redirected toward its historic and scenic value."

Integral to the historic and scenic value of the Falls of St. Anthony is the water coursing over the upper falls. The flow over the spillway is the only natural feature of the historic falls remaining in an otherwise man-made environment. As the most abrupt drop in the Mississippi River's entire 2,200 mile course, the Falls today are visually represented primarly by this flowing water.

Of paramount concern to the Minneapolis Heritage Preservation Commission is the significance of the falls within the St. Anthony Falls Historic District which is on the National Register of Historic Palces.

The Falls is the pivotal structure, infact the raison d' etre for all other structures within the historic district .

We do not feel that the Draft Feasibility Report absolves the St. Paul Corps of Engineers of its legal obligation, under Section 108, to protect cultural resources. We do not agree with the finding of "no significant impact." We feel that little thought has so far gone into alternative plans to increase the mill powers at the Falls while at the same time mitigateing the historic and visual impact of the Falls and the surrounding National Register District. 1.

HPC
Heritage Preservation Commission
210 City Hall Minneapolis Minnesota 55415 telephone:348-6538

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO HERITAGE PRESERVATION COMMISSION

October 24, 1983

1. The St. Paul District has fully coordinated this project with the Minnesota State Historic Preservation Officer and the Advisory Council on Historic Preservation, and our legal obligation, under Section 106, has been complied with. We believe that tne revised NED plan maximizes hydropower benefits while avoiding impacts which would adversely impact the St. Anthony Falls Historic District.

The Minneapolis Heritage Preservation Commission is not the first to recognize the historic significance of the Falls of St. Anthony. In the recent book The Waterfall that Built a City the author, Lucile M. Kane, documents the recognition of the Falls throughout the history of Minneapolis.

Ms. Kane states that, "Although the cataract's role was subordinated after 1880, it still mirrored facets of local state and national history. Here culminated the city's century-old desire for navigation, here the flour milling industry became pre-eminent in the United States, and here the nation's first hydroelectric central station was established .

The Minneapolis Journal declared in 1908 that the "Backbone of Minneapolis, next to her good character, is her great water power."

A team of local historians asserted in 1914 that to "the great cataract . . . the city owes it origins, its existence, and the principal elements which form its condition and character." The importance of the Falls of St. Anthony to the city was infact recognized by the city and a representation of the Falls appears in the center of the city's official seal.

In 1923 the executives of Pillsbury-Washburn and Northern States claimed that the falls "have been the most powerful instrument in the up-building of this city to its present position of primacy in the industrial world."

A-11

Even during the early 1960's when the Urban Renewal Program was leveling entire blocks of historic buildings, a report sponsored by the Minneapolis Downtown Council in 1961 asserted that the cataract could again be " a great landmark at the continent's heart."

For the above stated reasons the Minneapolis Heritage Preservation Commission, as a part of its October 19 Public Hearing, gave its unanimous support to Alderman Slater's proposed City Council Resolution. The Commission feels that Alderman Slater's resolution reflects the attitude of all its members and adopts the resolution as its own. 2.

Thank you for your consideration of the Minneapolis Heritage Preservation Commission's concerns about the increase in mill powers at the Falls of St. Anthony.

If you have any questions about the Commission's concerns, please feel free to contact the commission office.

Sincerely,

Charles D. Liddy Chairman
Minneapolis Heritage Preservation Commssion

CDL/jdm
:ENCLOSURE

2. Alderman Slater's resolutions have been addressed in our response to the November 2, 1983 letter from the city of Minneapolis.

RESOLUTION

of the

CITY OF MINNEAPOLIS

Referred to _____ Comm.

Date _____

ALDERMAN SLATER

By _____

Advising The U. S. Corps of Engineers of the inadequacy of analysis for additional proposed hydropower development at St. Anthony Falls

WHEREAS, the U. S. Corps of Engineers, in following a basically commendable national mandate to develop hydropower to the optimum energy potential on the nation's waterways, has completed a Draft Environmental Assessment and Feasibility Report on Upper and Lower St. Anthony Falls in Minneapolis; and

WHEREAS, those studies favor a project whose design to optimize cost benefit ratios, would increase the power generated at St. Anthony Falls from a total of 20.4 MW to 46.8 MW; and

WHEREAS, to generate such power, it would be necessary to so reduce the water available to St. Anthony Falls that a flow sufficient for a falls would be absent eight months per year, including our summer months; and

WHEREAS, it is the policy of the City of Minneapolis, as adopted in the Mills District Project Guidelines and Criteria, that an adequate flow of water over St. Anthony Falls should be maintained in all months, except December and January; and

WHEREAS, such flowage is considered an integral part of the amenities being carefully cultivated by City, Metropolitan, State and Federal programs to leverage local private investment; and

WHEREAS, the prospective private investment would total over 800 million dollars in over 6,000 future dwelling units, 1,000,000 square feet of specialty retailing, 600 hotel rooms and 1,400,000 square feet of special purpose office space in the St. Anthony Main, Riverplace, Mills District and Heritage Landing development areas surrounding the falls area; and

WHEREAS, the Feasibility Report for the project relates only to the aesthetics of the Falls with respect to recreation; and

WHEREAS, cessation of the Falls for a majority of the year is in opposition to the direction of the Minneapolis Heritage Preservation Commission's efforts in the St. Anthony Falls Historic District; and

WHEREAS, there has been no showing of additional electrical local power need to be met by the proposed action; and

WHEREAS, the economic feasibility of the proposed project is based on a cost of money which is unaccountably conservative; and

WHEREAS, the price received for electrical power generated is based on federal rather than local state forecasts;

WHEREAS, the U. S. Corps of Engineers has scheduled a public meeting to consider the adequacy of their analysis and the desirability of the projects that their studies indicate as being feasible;

NOW THEREFORE BE IT RESOLVED, BY THE CITY COUNCIL OF THE CITY OF MINNEAPOLIS: that it finds current project analysis of the U.S. Corps of Engineers inadequate in reflecting future preservation and development efforts in the Central Riverfront Area which will be adversely affected, should the current proposed action for additional hydropower at St. Anthony Falls occur; and

BE IT FURTHER RESOLVED THAT THE CORPS OF ENGINEERS:

1. Consult with City Staff and local developers to establish the variety and extent of existing and proposed development affected by the proposal.
2. Expand the Draft Environmental Assessment accordingly and withdraw the Statement of No Significant Impact.
3. Undertake an Environmental Impact Statement process, developing techniques to quantify and apply factors which reflect the extent of local action effected by the proposed water diversion.
4. In collaboration with local agencies, modify the alternatives analyzed, along with any mitigating measures to compare with a no build alternative.

BE IT FURTHER RESOLVED, that the U. S. Corps of Engineers be requested to facilitate local economic development, by resisting the diversion of waters from St. Anthony Falls.

RECORD OF COUNCIL VOTE

Alderman	Aye	Nay	N.V.	Abs.	Ovrd.	Sust.	Alderman	Aye	Nay	N.V.	Abs.	Ovrd.	Sust.
Dziedzic							Scanlon						
O'Brien							Howard						
Daugherty							Rockenstein						
White							Schulstad						
Slater							Hoyt						
Carlson							Pres. Remvik						
Keane													

X INDICATES VOTE — N.V. - Not Voting Abs. — Absent Ovrd. - Vote to Override Sust. - Vote to Sustain

PASSED _____ 19____

APPROVED

NOT APPROVED _____ 19____

VETOED

ATTEST _____
City Clerk

_____
President of Council

_____
Mayor

PEPIN, DAYTON, HERMAN, GRAHAM & GETTS
ATTORNEYS AT LAW
930 LUMBER EXCHANGE
TEN SOUTH FIFTH STREET MINNEAPOLIS MINNESOTA 55402 (612)339-7633

CHARLES B. DAYTON
RICHARD O. PEPIN, JR.
JOHN H. HERMAN
KATHLEEN R. GRAHAM
PHILIP W. GETTS
JAMES A. PAYNE
JOHN C. BUENZ
BRADLEY J. GILLAN
CAROLYN CHALMERS
NESTOR C. DUKE ADDICKS JR.
JONATHAN L. EISENBERG
MARYBETH DORN
ROSEMARY HANSEN

October 28, 1983

Colonel Edward G. Rapp
District Engineer
Department of the Army
St. Paul District Corps of Engineers
1135 U.S. Post Office and Customs
House
St. Paul, Minnesota 55101

Re: St. Anthony Falls Hydropower Proposal

Dear Colonel Rapp:

We represent the East Bank Riverfront Partners, a joint venture of the Boisclair Corporation, the Kajima Development Corporation, and the Dai Ichi Seimei America Corporation, and we submit this letter in comment on the draft feasibility report and environmental assessment for the St. Anthony Falls hydropower proposal. In summary, we do not believe that there has yet been an adequate analysis of the project and the ways in which it might affect the preservation and redevelopment efforts in the riverfront area. Accordingly, we concur with the City of Minneapolis that the draft environmental assessment and finding of no significant impact should be withdrawn, and that an environmental impact statement should be prepared which analyzes in detail the potential effects of the project on the historic character of the area and on the redevelopment efforts currently underway; which develops and studies alternatives that might have less adverse impacts on that area and on those efforts; and which explores a full range of mitigating measures for those impacts. 1.

Our interest in the Corps' proposal is substantial. For the past five years, the partnership has been actively involved in creating Riverplace, a major redevelopment in the east riverfront area. In this regard, it is now constructing 500 units of new housing and thousands of feet of commercial and office space. The total amount invested in this redevelopment is over $70 million. A primary focus of the effort has been in preserving and highlighting the historic and aesthetic character of the area. This focus is consistent with long-standing city plans for the entire central riverfront area, with the policies of the Minneapolis Heritage Preservation Commission, and with other 2.

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO EAST BANK RIVERFRONT PARTNERS

(Pepin, Dayton, Herman, Graham, and Getts, Attorneys at Law)

October 28, 1983

1. Our reanalysis of hydropower development is presented in this final feasibility report. We have taken into consideration the preservation and redevelopment of the St. Anthony Falls Historic District in our revised NED plan. The proposed provision of a base flow has avoided the need to prepare an environmental impact statement (EIS). Therefore, the Finding of No Significant Impact has not been withdrawn.

2. It is noted that your interest and involvement in the area is considerable.

developments occurring at St. Anthony Main and the Mills District and Heritage Landing.

Of the many historic and aesthetic features of the area, one which has been central to both the design and marketing of Riverplace has been St. Anthony Falls. The current proposal to eliminate the Falls for eight months of the year, including the summer months, would have not only a potentially devastating impact on the historic, aesthetic, and recreational qualities of the redevelopment area, but also an adverse economic effect on the redevelopment efforts themselves. The environmental assessment blandly and in passing mentions that the project would "affect" or would "detract" from the character of the area, but goes into no further detail, nor does it discuss at all the secondary socioeconomic effects of the project on development in the vicinity. 3.

We believe that a full impact statement on this project is necessary under both the regulations of the Council on Environmental Quality and the Corps' own regulations. The National Environmental Policy Act requires that an EIS be prepared on "every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment . . ." 42 U.S.C. §4332(2)(C). Here, your feasibility report recommends the adoption of authorizing legislation by the Congress and, for that reason alone, an EIS should be prepared. 4.

Similarly, it is clear that the project is a "major action" which "significantly affects" the environment. Under the CEQ regulations, the term "major reinforces but does not have a meaning independent of significantly . . ." 40 C.F.R. §1508.18. The criteria which the regulations provide for determining "significance," in turn, are met here. For example, "context" is important. For "site-specific actions," such as this one, "significance" depends on the project's effects on the "local" area, such as its effects on local historic, aesthetic, recreational, and economic resources. 40 C.F.R. §1508.27(a). Again, "intensity" is important in determining "significance." Factors to be considered in determining "intensity" include "impacts that may be both beneficial and adverse" (even if on balance the total effect of the project will be beneficial); "unique 5.

3. The environmental assessment has been modified to address the historic, aesthetic, and recreational aspects in greater detail. Further, we believe the revised plan would not affect redevelopment efforts. Secondary socioeconomic effects on development would not be expected if the visual appearance of water flow could be preserved.

4. As redesigned, the proposed project would not significantly affect the quality of the human environment and an EIS would not be required.

5. We are aware that both adverse and beneficial impacts would require an EIS if determined to be significant. For the revised NED plan, it has been determined that maintaining the existing appearance of the falls would mean that no significant impacts would result from implementation of additional hydropower.

characteristics of the geographic area such as proximity to historic resources . . .; "the degree to which the effects . . . are likely to be highly controversial"; "the degree to which the action may adversely affect districts, sites, . . . structures, or objects listed on or eligible for listing on the National Register . . ."; and "whether the action threatens a violation of . . . local law . . . imposed for the protection of the environment." 40 C.F.R. §§1508.27(b)(1), (3), (4), (8), and (10). All these criteria are met here: the project is likely to have numerous impacts, including beneficial ones; it is adjacent to and will have direct and adverse effects on historic resources; because of its location in the central riverfront area, it is likely to be highly controversial, as is already evident from the recent editorial in the Minneapolis Star and Tribune; and it threatens to be inconsistent with local land use plans and policies. For all these reasons, the Corps should conclude that the project will "significantly affect the environment" and prepare a full environmental impact statement. 5.

The Corps' own regulations also require an EIS. Like NEPA itself, the regulations state that an EIS "will be prepared to accompany a . . . legislative proposal to Congress recommended by . . . the Corps of Engineers," 33 C.F.R. §230.6(a), and they provide that an EIS will "normally" be required for "feasibility studies." Id., §230.6(b). Moreover, an EIS which examines impacts in detail and which develops alternatives and mitigation measures capable of avoiding and minimizing those impacts is the only method by which the Corps will be able to meet its "general environmental goals." Those goals include preserving "unique and important . . . aesthetic and cultural values"; restoring, maintaining, and enhancing the "man-made environment in terms of its variety, beauty, and other measures of quality"; and creating "new opportunities for the American people to use and enjoy their environment." 33 C.F.R. §§230.5(h)(1), (3) and (4). All these goals, of course, are precisely the goals of the redevelopment efforts which the proposal is likely to adversely affect. 6. 7.

We believe that an environmental impact statement should not only explore in detail the effects of the project on historic resources, Aluli v. Brown, 437 F. Supp. 602 (D. Hi. 1977), reversed on other grounds, 602 F.2d 876, but also its secondary socioeconomic impacts on development in the area. Monarch Chemical Works v. Exon, 466 F. Supp. 639 (D. Neb. 1979). Moreover, the EIS should heed the command 8. 9.

6. The Corps' own regulation (33 CFR 230.6(a)) states that: "A legislative EIS will be prepared to accompany a bill or legislative proposal to Congress recommended by or with significant cooperation and support of the Corps of Engineers (exclusive of appropriations) significantly affecting the quality of the human environment." Legislation by Congress on the proposed project would be for the purpose of appropriation, not law, and would not require a legislative environmental impact statement. The regulation (33 CFR 230.6) lists: ". . .types of Corps of Engineers' actions which normally require the preparation of an EIS, although in certain cases an environmental assessment may be adequate." Further, the next section of the regulation (33 CFR 230.7) is a list of actions normally requiring an environmental assessment but not necessarily an EIS. Paragraph a. (33 CFR 230.7(a) states: "Certain feasibility studies, such as some survey or continuing authorities studies with a limited range of planning objectives and plans, may be sufficiently analyzed and reviewed through the preparation and circulation of an EA together with the Finding of No Significant Impact (FONSI)." Since an investigation of the feasibility of developing additional hydropower has a single objective, it qualified under this provision.

7. Alternatives for location, equipment, and modes of operation of hydropower were examined early in the study process and alternatives with high potential for causing adverse impacts were rejected. The 8Ud alternative which would utilize the entire head for one plan and preserve flow (1,200 cfs) over St. Anthony Falls to serve the lower falls hydropower plant was rejected in large part to preserve the historic Main Street and its "unique and important. . . aesthetic and cultural values." Changes to the proposed plan, appearing in this report, were made to maintain the man-made environment.

of the CEQ regulations to "rigorously explore and objectively evaluate all reasonable alternatives," including alternatives which would divert water from St. Anthony Falls only at times of the day or year when such diversion is likely to have the least adverse impacts on aesthetic and recreational resources. It may well be possible to develop a hydropower proposal which is consistent with the redevelopment efforts and city plans for the riverfront area, and which adequately protects historic, aesthetic, and recreational resources. Your comments of a few days ago evidence some thoughts in this direction. Nevertheless, without an environmental impact statement which fully explores the impacts of the project, which develops new alternatives to the proposal, and which examines a full-range of mitigating measures, there is little likelihood that an acceptable plan will be produced. 9.(cont.)

We further hope you will reevaluate the course of action here and open up the decision-making process to interested area developers and the City. Rather than confrontation and litigation, we hope to cooperate with you in a full study to ensure that there are adequate responses to the aesthetic, historical, and economic impacts of the hydropower project. 10.

Sincerely yours,

PEPIN, DAYTON, HERMAN, GRAHAM & GETTS

John H. Herman

JHH/rj
cc: Frank Dunbar

8. It is recognized that secondary socioeconomic impacts could result if aesthetics were not addressed. However, it is believed that the measures which have been included in the project plan (base flow, rustication) would prevent these impacts from occurring.

9. All reasonable alternatives have been "rigorously explored and objectively evaluated." Some alternatives which are not feasible (reasonable) are rejected early, without rigorous evaluation, because it is immediately obvious that they cannot be implemented. This is true of alternatives which would include operation of plants at limited times or seasons. The electricity generated during limited periods would not provide sufficient revenue to finance construction of the generating plant. The Corps, in this report, has attempted to formulate a plan which meets the project objective and protects historic, aesthetic, and recreational resources. All feasible alternatives have been examined.

10. The project has been reevaluated and the decision process has been open and inclusive. The Corps believes that the concerns of developers, city government, and other individuals have been addressed and the project, as presently designed, should be satisfactory to all.

CITY OF SHAKOPEE

PUBLIC UTILITIES COMMISSION

1000 EAST FOURTH AVENUE
SHAKOPEE, MINNESOTA 55379
445-1988

October 28, 1983

Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, MN 55101

Attention: Edward G. Rapps, District Engineer

RE: St. Anthony Falls Hydropower
feasibility report

Gentlemen:

Please be advised that the City of Shakopee is in favor of the development of additional hydro facilities at the St. Anthony Falls site. If federal development is the option selected from the various ones listed in the conclusion of the draft feasibility report, we are interested in an allocation of energy from that project.

Of the alternates developed in the reconnaissance study, we feel that the most cost beneficial alternate should be pursued which appears to be alternative #8Ud.

Thank you for the opportunity to comment on the draft feasibility report.

Sincerely yours,

Louis Van Hout, Utilities Manager
SHAKOPEE PUBLIC UTILITIES COMMISSION

LVH/sa

The Heart of Progress Valley

A-17

ST. ANTHONY FALLS HYDROPOWER
CORPS RESPONSE TO CITY OF SHAKOPEE, PUBLIC UTILITIES COMMISSION
October 28, 1983

1. Your interest is noted.

Minnesota
Environmental Quality Board
100 Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101
Phone 296-1424

October 28, 1983

Colonel Edward G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

I have received for review and comment a copy of the St. Anthony Falls hydropower feasibility study and environmental assessment.

If pursued, the project will be subject to the environmental review procedure outlined in Minnesota Statutes, 116D.04. Under rules promulgated by the Environmental Quality Board, the project will fall into a mandatory Environmental Assessment Worksheet category; the Department of Natural Resources will be the Responsible Governmental Unit for the review procedure. 1.

Any environmental implications of the project can be dealt with in this review process and in the permitting procedures of the appropriate state agencies.

If you have any further questions at this time, please feel free to contact me.

Sincerely,

Thomas Kalitowski

THOMAS KALITOWSKI
Chairman
Environmental Quality Board

TK:ps

AN EQUAL OPPORTUNITY EMPLOYER

A-18

ST. ANTHONY FALLS HYDROPOWER
CORPS RESPONSE TO MINNESOTA ENVIRONMENTAL QUALITY BOARD
October 28, 1983

1. Your comment is noted.

Metropolitan Council
Metropolitan Centre
300 Metro Square Building
Seventh and Robert Streets
St. Paul, Minnesota 55101
Office of the Chairman

November 1, 1983

Colonel Edward G. Rapp
District Engineer
St. Paul District
Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Attention: Planning

RE: Plan Formulation
Assessment for Hydropower at Upper and
Lower St. Anthony Falls, Minneapolis
Metropolitan Council Referral File No. 11629-1

Dear Colonel Rapp:

At its meeting on October 27, 1983, the Metropolitan Council considered the Draft Feasibility Report and Environmental Assessment for Hydropower at Upper and Lower St. Anthony Falls in Minneapolis. This consideration was based on a report of the Metropolitan and Community Development Committee, Referral Report. No. 83-109. A copy of this report is attached.

The Council adopted the following recommendations contained in Referral Report No. 83-109:

1. The Corps of Engineers should conduct an engineering evaluation of mitigating measures to assure a minimum flow of water comparable to the present flow over St. Anthony Falls while diverting water for hydropower production. | 1.

2. The Corps should identify the existence and boundaries of the Central Mississippi Riverfront Regional Park and discuss the impacts of the proposed project on this element of the regional parks system. | 2.

3. The Corps should continue its discussions with the City of Minneapolis to assure that alterations to the existing St. Anthony Falls area do not result in a change of character that would be detrimental to development plans for the riverfront area. | 3.

An Equal Opportunity employer

A-19

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO THE METROPOLITAN COUNCIL

November 1, 1983

1. An evaluation of providing flow over the falls while generating hydropower has been done. It is included in this report.

2. These items have been included in the report.

3. The Corps has coordinated closely with the city of Minneapolis with regard to potential solutions at St. Anthony Falls. Developmental plans were considered during this coordination.

4. The Corps should correct its reference to the lack of planned boat launches to correctly reference a proposed launch on Boom Island. | 4.

Sincerely,
METROPOLITAN COUNCIL

Gerald J. Isaacs
Chair

GJI/sb
Attachment

cc: Michael Cronin, Development Controls, City Planning Department, City of Minneapolis
Bill Barnhart, Intergovernmental Relations, City Coordinator's Office, City of Minneapolis
Gary Oberts, Metropolitan Council Staff

4. There have been a number of previous boat launch proposals involving Boom Island which is outside the direct influence of the proposed hydropower project area.

For Release: 4:00 p.m., 10.27.83 Business Item No. B-4

METROPOLITAN COUNCIL
Suite 300 Metro Square Building, Saint Paul, Minnesota 55101
291-6359

October 20, 1983

REPORT OF THE METROPOLITAN AND COMMUNITY DEVELOPMENT COMMITTEE
REFERRAL REPORT NO. 83-109

TO: Metropolitan Council

SUBJECT: Draft Feasibility Report and Environmental Assessment for Hydropower at Upper and Lower St. Anthony Falls, Minneapolis
Metropolitan Council District No. 6
Metropolitan Council Referral File No. 11629-1

Background

At its meeting of October 20, 1983 the Committee considered the attached report.

Issues and Concerns

Council member Gasper raised a previously unnoted concern about the impact a hydropower addition might have on the viability of a proposal for a Hennepin County resource recovery facility located also in the St. Anthony Falls area. The concern is that the two proposals might compete to supply a limited demand for electricity.

Recommendations

1. The Corps of Engineers should conduct an engineering evaluation of mitigating measures to assure a minimum flow of water comparable to the present flow over St. Anthony Falls while diverting water for hydropower production.
2. The Corps should identify the existence and boundaries of the Central Mississippi Riverfront Regional Park and discuss the impacts of the proposed project on this element of the regional parks system.
3. The Corps should continue its discussions with the City of Minneapolis to assure that alterations to the existing St. Anthony Falls area do not result in a change of character that would be detrimental to development plans for the riverfront area.
4. The Corps should correct its reference to the lack of planned boat launches to correctly reference a proposed launch on Boom Island.

Respectfully submitted,

Joan Campbell,
Chair

A-21

METROPOLITAN COUNCIL
Suite 300 Metro Square Building, Saint Paul, Minnesota 55101

MEMORANDUM October 18, 1983

TO: Metropolitan and Community Development Committee

FROM: Metropolitan Parks and Open Space Commission

SUBJECT: Draft Feasibility Report and Environmental Assessment for Hydropower at Upper and Lower St. Anthony Falls

At our meeting on October 17, 1983, the Metropolitan Parks and Open Space Commission reviewed the report prepared by the Environmental Planning Dept. (Gary Oberts) dated October 13, 1983.

The commission is very concerned about the potential negative impacts of this project upon the Central Mississippi Riverfront Regional Park. The following motion was unanimously approved.

Recommendation

That the Metropolitan Council should thoroughly review the full impacts of the Corps of Engineers plans for increased power generation at St. Anthony Falls, and that the Metropolitan Parks and Open Space Commission supports the recommendations of the staff report dated Oct. 13, 1983, for submission as comments to the Corps of Engineers, as requested by the Corps, by Oct. 28, 1983.

Respectfully submitted,

John McBride
Chair

METROPOLITAN COUNCIL
Suite 300 Metro Square Building, St. Paul, Minnesota 55101

October 13, 1983

TO: Metropolitan and Community Development Committee

FROM: Environmental Planning Department (Gary Oberts)

SUBJECT: Draft Feasibility Report and Environmental Assessment for Hydropower at Upper and Lower St. Anthony Falls, Minneapolis
Metropolitan Council District No. 6
Metropolitan Council Referral File No. 11629-1

INTRODUCTION

The U. S. Army Corps of Engineers in response to a U.S. House Committee on Public Works resolution (December 1, 1969) is examining the feasibility of additional hydropower generation at Upper and Lower St. Anthony Falls. The above referenced report evaluates the feasibility and environmental impact of adding 21.0 MW (megawatts) of capacity to the existing 12.4 MW generating station at the Upper Dam and 5.4 MW of capacity to the existing 8.0 MW generating station at the Lower Dam.

To achieve the additional power, two turbines with housing and appurtenances would be installed at the Upper Dam and one would be installed at the Lower Dam. Attachment 1 shows the location of the Corps recommended alternatives for location of these structures. The total cost of constructing these additions would be $33,798,000 (October 1982 prices) with annual benefits anticipated to be $2,509,000.

REVIEW AUTHORITY

The Council reviews the environmental impact of Federal projects in accordance with the National Environmental Policy Act (NEPA) of 1969. In the case of this report, the Corps is also soliciting Council comments on project feasibility as an affected agency. Presently there is not a proposal to begin construction, rather the Corps is making an effort to state interest and draw comments on the feasibility and potential impact of the hydropower addition.

ANALYSIS AND CONCERNS

By far the major concern raised by all Council staff members who reviewed this report was the impact on St. Anthony Falls itself. The project, if it proceeds as initially proposed, would increase the annual amount of time the falls are dry from the current 40 percent to 80 percent. This doubling of "dry time" would severely impact the aesthetics of the falls, which is the central attraction of the St. Anthony Falls historic district, the regional park and the Minneapolis riverfront development efforts.

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The Parks and Open Space staff indicates that implementation of the proposed hydropower addition would adversely impact the regional park system. Approximately $60 million in public investment will be made for the Central Mississippi Riverfront Regional Park surrounding the falls. The falls are an integral part of park user interpretation of the historic and scenic character of this river area. Any curtailment in the flow of water over the dam might detract from the character of the area and reduce the public's use and enjoyment of the park facilities.

Additionally, the City of Minneapolis planning staff, has stated its concern to Council staff by phone (written communication to follow) that altering the character of St. Anthony Falls would in turn alter the character of the falls area and detract from its potential as a desireable area for economic development. The St. Anthony Falls historic district is identified in the Minneapolis comprehensive plan and in the proposed Mississippi River critical area plan as an area for major mixed use development in addition to the regional park. Continuation of flow over the falls is seen by Minneapolis as essential to maintaining the character of the development area.

One other consideration for the St. Anthony Falls area is the national Great River Road corridor. The proposed alignment for the road through this portion of Minneapolis is along the west bank of the river. The major attraction to be viewed from the road in this vicinity is the falls. Again, reduction in the number of days during which water goes over the falls will likely detract from the public's perception of this feature and hence from the intent of the Great River Road program.

STAFF REVIEW COMMENTS

The addition of more hydropower facilities at the St. Anthony Falls sites presents no significant environmental problems with the exception of increasing the number of dry days at the falls. The proposal merely takes "run-of-the-river" flow and diverts it through power generating turbines. The idea of using a nonpolluting, renewable resource for power generation is one that should be given maximum consideration. Unfortunately, this proposal diverts that water away from a valued natural and historic resource.

It seems that the natural operation of the falls and power generation at the two existing plants do not have to be mutually exclusive. The Corps should explore more fully the feasibility of allowing a minimum flow to pass its intakes and proceed over the falls. An exploration of mitigating measures by the Corps would likely yield an alternative design approach that perhaps would not yield peak power generation, but would still result in hydropower while assuring the preservation of flow over St. Anthony Falls. Corps' engineering expertise seems to be ideally suited to come up with such a design that would solve the most significant environmental impact resulting from the proposal.

The feasibility report also needs to contain an identification and discussion of the regional park. The draft report speaks in generalities of park areas but does not identify that a massive public expenditure is underway to enhance the recreational resources of the St. Anthony Falls area along the river.

It should be pointed out that a boat launch is proposed for Boom Island. Page 71 of the Main Report incorrectly states that no direct access is planned for the river. The Boom Island launch will provide access both upstream and downstream through the locks.

CONCLUSIONS

1. The proposed addition of hydropower facilities at Upper and Lower St. Anthony Falls as proposed by the Corps would expand the power generating capacity of these two plans by 120 percent at a cost of $33,798,000.

2. The expansion as proposed would result in a doubling of the number of days that historic St. Anthony Falls is dry.

3. A $60 million regional park, major Minneapolis riverfront development, and the proposed Great River Road corridor all depend upon the preservation of St. Anthony Falls to be successful.

4. The addition of hydropower capacity, as proposed, would have a negative impact on the regional parks system.

RECOMMENDATIONS

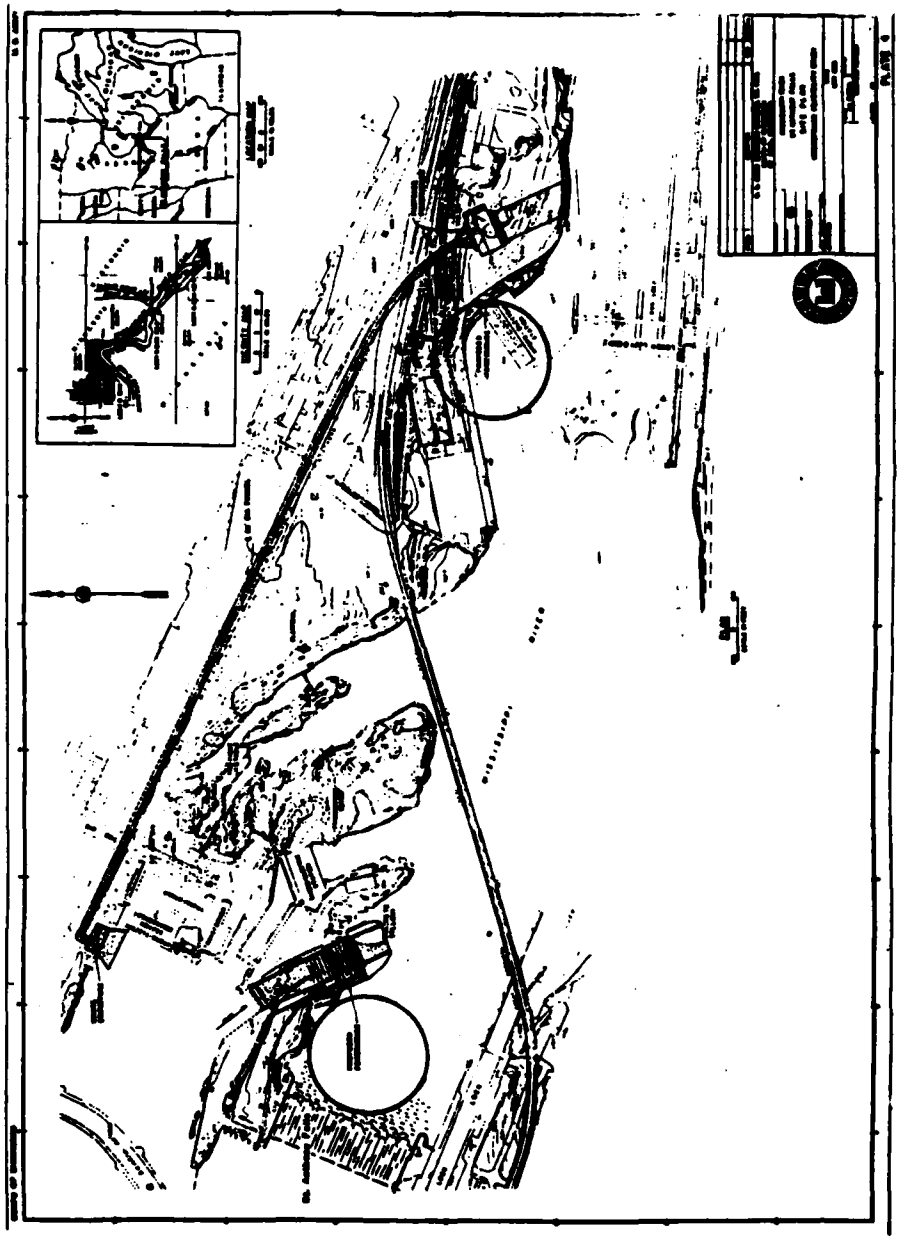
1. The Corps of Engineers should conduct an engineering evaluation of mitigating measures to assure a minimum flow of water comparable to the present flow over St. Anthony Falls while diverting water for hydropower production.

2. The Corps should identify the existance and boundaries of the Central Mississippi Riverfront Regional Park and discuss the impacts of the proposed project on this element of the regional parks system.

3. The Corps should continue its discussions with the City of Minneapolis to assure that alterations to the existing St. Anthony Falls area do not result in a change of characater that would be detrimental to development plans for the riverfront area.

4. The Corps should correct its reference to the lack of planned boat launches to correctly reference a proposed launch on Boom Island.

SE1160-PHENV2
10.13.83



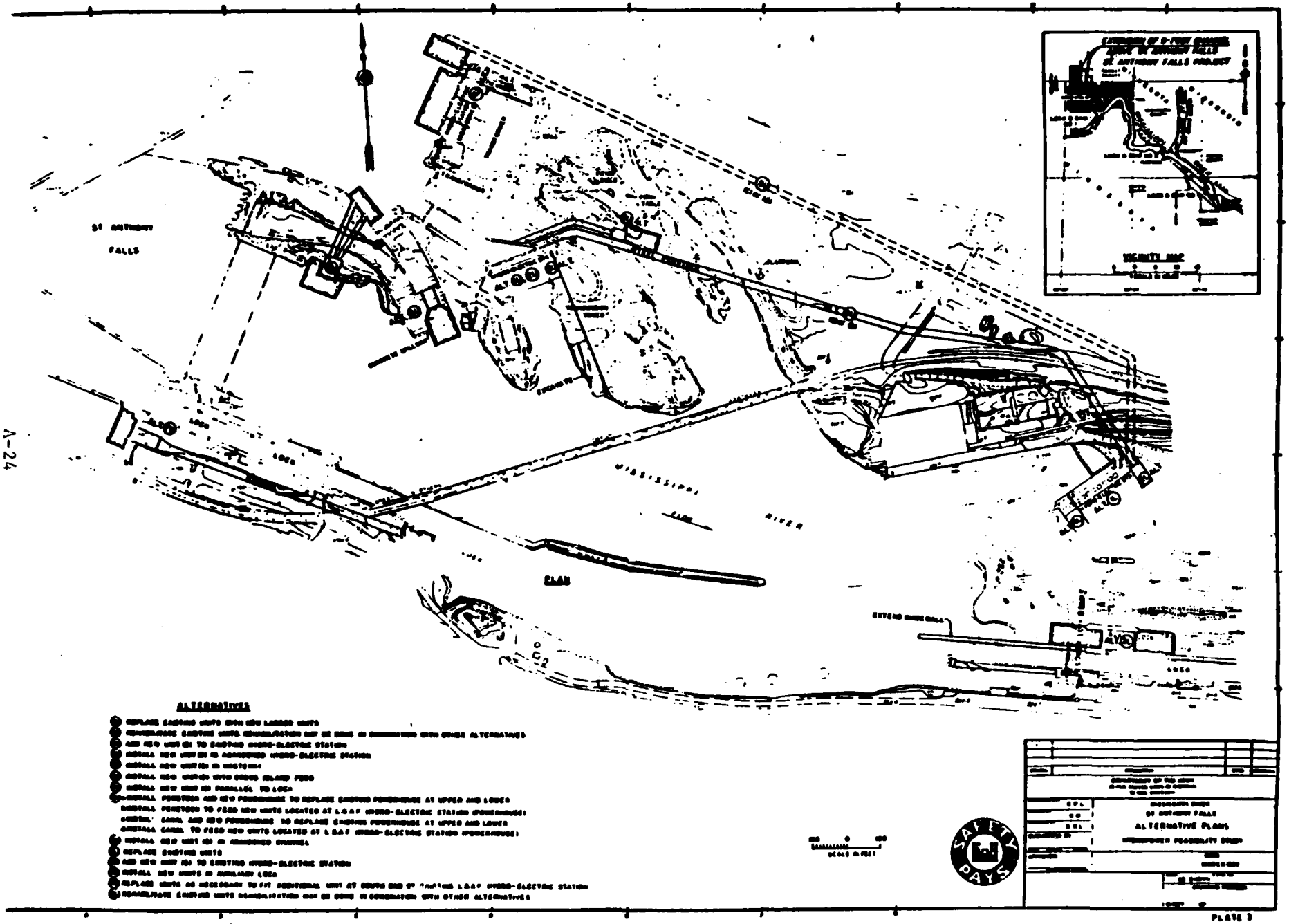

ST ANTHONY
FALLS
MISSISSIPPI
RIVER
PLAN
ALTERNATIVES
SAFETY PAYS

PLATE 3

OFFICE OF CITY CLERK
LYALL A SCHWARZKOPF CITY CLERK
304 CITY HALL MINNEAPOLIS MINNESOTA 55415
PHONE 348 2215

minneapolis
city of lakes

November 2, 1983

Colonel Edward G. Rapp, District Engineer
Department of the Army, St. Paul District
Corps of Engineers
1135 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

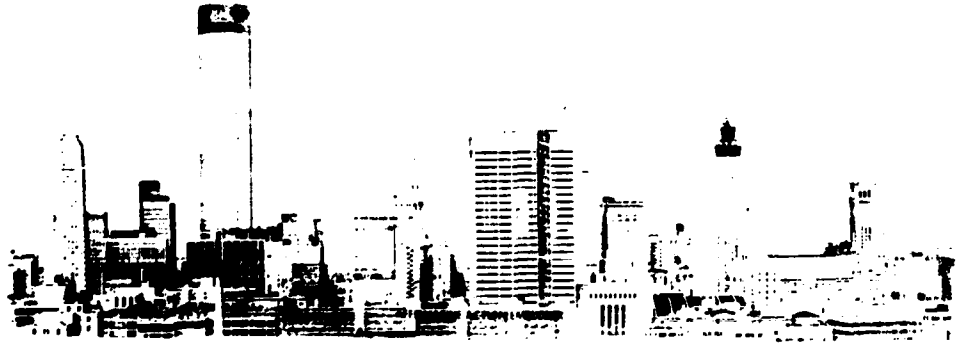
Dear Colonel Rapp:

Enclosed is a copy of a resolution of the City Council of the City of Minneapolis addressing proposed additional hydropower at St. Anthony Falls. This resolution in draft form was presented at the public meeting on this subject October 18, 1983.

Sincerely,

Lyall Schwarzkopf
City Clerk

enclosure



83R-

RESOLUTION

of the

CITY OF MINNEAPOLIS

Referred to _____ Comm

Date _____

By Alderman Slater

Advising the U. S. Corps of Engineers of the inadequacy of analysis for additional proposed hydropower development at St. Anthony Falls.

WHEREAS, the U. S. Corps of Engineers, in following a basically commendable national mandate to develop hydropower to the optimum energy potential on the nation's waterways, has completed a Draft Environmental Assessment and Feasibility Report on Upper and Lower St. Anthony Falls in Minneapolis; and

WHEREAS, those studies favor a project whose design to optimize cost benefit ratios, would increase the power generated at St. Anthony Falls from a total of 20.4 MW to 46.8 MW; and

WHEREAS, to generate such power, it would be necessary to so reduce the water available to St. Anthony Falls that a flow sufficient for a falls would be absent eight months per year, including our summer months; and

WHEREAS, it is the policy of the City of Minneapolis, as adopted in the Mills District Project Guidelines and Criteria, that an adequate flow of water over St. Anthony Falls should be maintained in all months, except December and January; and

WHEREAS, such flowage is considered an integral part of the amenities being carefully cultivated by City, Metropolitan, State and Federal programs to leverage local private investment; and

WHEREAS, the prospective private investment would total over 800 million dollars in over 6,000 future dwelling units, 1,000,000 square feet of specialty retailing, 600 hotel rooms and 1,400,000 square feet of special purpose office space in the St. Anthony Main, Riverplace, Mills District and Heritage Landing development areas surrounding the falls area; and

WHEREAS, the Feasibility Report for the project relates only to the aesthetics of the Falls with respect to recreation; and

WHEREAS, cessation of the Falls for a majority of the year is in opposition to the direction of the Minneapolis Heritage Preservation Commission's efforts in the St. Anthony Falls Historic District; and

WHEREAS, there has been no showing of additional electrical local power need to be met by the proposed action; and

WHEREAS, the economic feasibility of the proposed project is based on a cost of money which is unaccountably conservative; and

WHEREAS, the price received for electrical power generate[illegible]ssed on federal rather than local state forecasts;

WHEREAS, the U. S. Corps of Engineers has scheduled a public meeting to consider the adequacy of their analysis and the desirability of the projects that their studies indicate as being feasible;

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NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF MINNEAPOLIS:

That it finds current project analysis of the U.S. Corps of Engineers inadequate in reflecting future preservation and development efforts in the Central Riverfront area which will be adversely affected should the current proposed action for additional hydropower at St. Anthony Falls occur.

Be It Further Resolved that the Corps of Engineers consult with city staff and local developers to establish the variety and extent of existing and proposed development affected by the proposal.

Be It Further Resolved that the Corps of Engineers expand the Draft Environmental Assessment accordingly and withdraw the Statement of No Significant Impact.

Be It Further Resolved that the Corps of Engineers undertake an Environmental Impact Statement process, developing techniques to quantify and apply factors which reflect the extent of local action effected by the proposed water diversion.

Be It Further Resolved that the Corps of Engineers, in collaboration with local agencies, modify the alternatives analyzed, along with any mitigating measures to compare with a no-build alternative.

Be It Further Resolved that the Corps of Engineers be requested to facilitate local economic development by resisting the diversion of waters from St. Anthony Falls.

RECORD OF COUNCIL VOTE

Alderman	Aye	Nay	N.V.	Abs	Ovrd	Sust	Alderman	Aye	Nay	N.V.	Abs	Ovrd	Sust
Dziedzic	X						Scallon	X					
O'Brien	X						Howard	X					
Daugherty	X						Rockenstein	X					
White	X						Schulstad	X					
Slater	X						Hoyt	X					
Carlson	X						Pres. Reinvitz	X					
Kaplan	X												

X INDICATES VOTE — N.V. - Not Voting Abs — Absent Ovrd. - Vote to Override Sust. - Vote to Sustain

PASSED OCT 28 1983 19____

APPROVED OCT 31 1983 19____

~~NOT APPROVED~~

~~VETOED~~

ATTEST _____ City Clerk

_____ President of Council

_____ Mayor

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO CITY OF MINNEAPOLIS, CITY CLERK

November 2, 1983

Resolutions

1 and 2: The Corps conducted additional workshops and meetings with developers, city officials, and others, in response to these resolutions, in October and November 1983. Appropriate revisions have been made to the report and to the previous draft NED plan to account for this city's concerns. We believe that the revised NED plan now selects future preservation and development efforts in the Central Riverfront area. Through a combination of modifications to the spillway and horseshoe dam and the provision of a base flow, our NED plan's consideration of aesthetic flows is equal to or greater than that proposed by the city of Minneapolis in the Mill District plan.

Resolution 3: The FONSI is considered sufficient, considering the modifications that have been incorporated in the NED plan.

Resolution 4: An EIS is not warranted at this time. Recommended aesthetic and historic modifications to the NED plan can preserve the desired visual effects of water flowing over the existing upper falls spillways.

Resolution 5: The present conditions or "no-build" situation has been developed more fully in the final report. Various aesthetic measures have been identified that could be included with the NED plan. The current administration requires that the Corps identify and recommend the NED plan from the various alternatives, which we have done in this case.

Resolution 6: The Corps is presenting the findings in the final feasibility report as requested by Congress. We believe that the proposed development can supply economic power without significantly impacting on proposed local development plans.

Johnson Building Company

Minneapolis

501 Southgate Office Plaza
Minneapolis MN 55437
612 831-8777

November 4, 1983

Colonel Edward G. Rapp
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

RE: St. Anthony Falls Hydropower
Draft Feasibility Report and Environmental Assessment
September 1983

Dear Colonel Rapp:

Johnson Building Company would like our concerns expressed with regards to further development of hydroelectric power within the St. Anthony Falls National Historic District. We believe such development will have an extremely negative impact on the revitalization of this key area in Minneapolis. Johnson Building Company is the owner/developer of the Crown Roller Mill as well as a partner in the Standard and Northstar Woolen Mills. These buildings are significant historic structures within the National Historic District and are immediately adjacent to the upper St. Anthony Falls.

Our first and primary concern is the reduction in flow over the Falls which will occur if the new hydropower facility is constructed. The last paragraph of page 71 of the draft report states:

> "Any increase in flows through the upper generator and corresponding decrease in flows available to the falls could have a significant negative impact. The major natural attraction of the area is St. Anthony Falls. If the falls were dry due to hydropower requirements, the recreational/ aesthetic experience would be significantly lowered."

Your report further states "..and with the proposed added (hydropower) development, they may be dry about 80 percent of the time." Also in the report, reduction in flow over St. Anthony Falls is mentioned on pages EA-10 paragraph 5.03 and EA-11 paragraph 5.08. During the informational meeting on October 18, 1983 at the Earle Brown building on the University of Minnesota St. Paul campus, you indicated it might be possible to have the added hydropower and maintain a flow of approximately 2.4" over the falls. We find this proposed flow totally inadequate. 1.

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ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO THE JOHNSON BUILDING COMPANY

November 4, 1983

1. Further analysis of the flow over the falls and its appearance is included in this report. A flow has been selected which, with modifications to the structures at the falls, should provide a satisfactory appearance.

Secondly, we must take exception to the "Finding of No Significant Impact" in the environmental assessment portion of the draft feasibility report. This is disputed in other areas of the report as stated above. Currently the City of Minneapolis is promoting its waterfront districts (including the St. Anthony Falls Historic District) as areas of major social and economic redevelopment. Public and private developers, such as Johnson Building Company, are expected to spend in excess of $800 million reclaiming the waterfront as a natural resource. The focal point of this redevelopment is St. Anthony Falls. The environmental and social impacts of the added hydroelectric capacity at St. Anthony Falls and "corresponding decrease in flows available to the falls", have been ignored with respect to this urban redevelopment plan. 2.

Finally, the draft feasibility report relies heavily on the "cost benefit ratio" to justify building the new hydroelectric facility. This benefit ratio only addresses cost of construction versus operating profits a company such as NSP might achieve. Some of the other "costs" which must be accounted for include: 3.

1) Significantly reduced or delayed redevelopment projects on the Riverfront.

2) Loss of construction and permanent jobs due to Item 1.

3) Loss of aesthetic quality, both visual and audio, caused by reducing St. Anthony Falls to an anemic or non-existant flow.

4) Reduced property values of the waterfront owners.

5) Extreme negative impact on the use and viability of St. Anthony Falls as a recreational center and attraction in Minneapolis.

Additionally, the impact of the added transmission lines, transformers and other related items (page 83, 2nd paragraph of the report) is not addressed at all. 4.

In summary, the added 8.8 MW. of "dependable" capacity (page 86, last paragraph of the draft feasibility report) is not significant to NSP's current capacity in excess of 6,100 MW. The public costs, some of which are listed above, far exceed any benefits from the added hydropower. Even a 10% reduction in development along the Riverfront will cost twice as much as the proposed power plant. If the spill flows over the dam are as shown on page F-6 of the Appendices, the Falls will be dry 80% of the time. We believe this will cause a reduction in proposed developments far in excess of 10%. 5.

2. Further analysis of urban development issues has been included in this report.

3. These items have been addressed in this version of the report.

4. As stated in the Environmental Assessment, only short connections to the existing electrical distribution system would be required. These will be underground, avoiding any potential effect on migrating waterfowl or endangered species.

5. Your comment is noted.

We are concerned that the proposed additional hydroelectric plant at St. Anthony Falls is already predetermined to be built. We believe that adequate public input and adverse effects have not been sufficiently reviewed. 6.

For the reasons stated above, we strongly oppose the addition of more hydroelectric capacity at St. Anthony Falls. 7.

We would like to be informed of all meetings regarding this proposal and be placed on your mailing list for future reports. 8.

Very truly yours,

JOHNSON BUILDING COMPANY

David A. Phillips
Vice President

DAP:jm
cc: The Honorable Donald Fraser, Mayor, City of Minneapolis
Ms. Alice Rainville, President, City Council
Senator Rudy Boschwitz
Senator David Durenberger
Representative Bill Frenzel
Representative Bruce Vento
Representative Martin Sabo
Representative Gerry Sikorski

6. This project is not predetermined to be built. Public input was sought to identify issues which were not apparent during preparation of the report. These issues have been addressed in this report. This report will receive further review by higher organizational levels of the Corps with further opportunity for public review before submission to Congress for authority to proceed with the design phase of the project. During this phase, the detailed design is made and additional environmental analysis accomplished. Additional opportunity for public input would be available during this phase.

7. Your comment is noted.

8. You have been added to our mailing list.

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

REPLY TO ATTENTION OF

9 NOV 1983

Colonel Edward G. Rapp
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

RE: 309-HY-COE-F05073-MN(83590)

Dear Colonel Rapp:

The U.S. Environmental Protection Agency has reviewed the Draft Feasibility Report (DFR) and Environmental Assessment for added hydropower development on the Mississippi River at Upper and Lower St. Anthony Falls in Minneapolis, Minnesota. This study concludes that total hydroelectric capacity could be optimally increased from 12.4 MW (megawatts) to 33.4 MW at Upper St. Anthony Falls and from 8.0 MW to 13.4 MW at Lower St. Anthony Falls.

The DFR and proposed Finding of No Significant Impact (FONSI) states that there would be no significant impact above existing impacts for additional hydropower development. We agree that existing commercial and industrial development has already impacted the Mississippi River at St. Anthony Falls. However, when the impacts of existing hydropower are difficult to examine or unclear, firm conclusions on the additive impacts should be made with caution. 1.

The existing impacts due to the 1.0 foot of peaking at the Upper St. Anthony Falls and the 0.4 foot of peaking at the Lower St. Anthony Falls are not stated in the DFR. For example, existing water level fluctuations may cause resuspension and redistribution of soils and sediments in the shore zone defined by the fluctuations. There may be an opportunity for environmental enhancement by changing existing operating practices, when adding more hydropower capacity, to strict run-of-the-river where instantaneous outflow equals instantaneous inflow. 2.

Also, the impacts of hydropower on fisheries at St. Anthony Falls are not known and future impacts with additional hydropower capacity cannot be predicted. Regardless of the exiting mortality rate caused by impingment and entrainment, a greater percentage of the Mississippi River's flow will be passing through the turbines if additional hydropower were added, thereby increasing the total adverse impact to the fishery. We do not believe there is enough information currently available on fish mortality, fish migration and behavior to state with confidence that fish mortality will not be significant. The intake structures for any proposed hydropower development should include design features which permit future retrofitting of screens or deflection devices, if they are needed for mitigation. 3.

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO ENVIRONMENTAL PROTECTION AGENCY

November 9, 1983

1. The conclusions in this report were made with great caution. The potential impacts were investigated and then evaluated by a study team of biologists familiar with the area and conditions. Further analysis was conducted, applying techniques used for entrainment analysis by your agency, before a conclusion on entrainment was reached.

2. Water level fluctuations at Lower St. Anthony Falls result from operation of the navigation locks within a very small pool. This pool is heavily armored by riprap as well as natural rock of the gorge. At the upper falls pool, a 1-foot fluctuation is allowed for hydropower but not generally utilized because the pool is held 1 foot low to protect the flashboards. A large volume of water is required to operate the navigation lock and is primarily responsible for pool level fluctuation. This pool has been similarly protected from erosion and resuspension of sediment, and no problems have been identified. Since operating practices have been similar for 100 years, there seems no need to consider changing operating plans. In any case, the proposed project would operate as run-of-the-river to the extent allowed by operation of the navigation structures.

3. The analysis of the potential for entrainment mortality identified the equivalent adult fish which would be lost if every larval fish passing through the turbine was killed. This level of mortality was not found to be significant to the fishery. Considering that the expected mortality from turbine passage is 10 to 15 percent of the figure used for analysis, it can be concluded that a satisfactory assessment has been made and that adverse impacts would not be expected. The provision of retrofit capability for

The statements made in the DFR regarding preferential flow through turbines with higher efficiency on pages 25, 83 and EA-12 do not seem to agree. The FONSI is based on Corps of Engineer's proposal to recommend further authorization for Federal construction; the environmental assessment should be written with that assumption. 4.

If still considered clean, the excavated material used for construction could be used as clean cover for maintenance dredging spoil disposal sites in the Twin Cities area. This should be considered in the Final Feasibility Report. If you have any questions regarding our comments please contact Mr. Wayne Elson of our Environmental Review Branch at 312/886-6693. 5.

Sincerely yours,

Larry G. Reed, Deputy Director
Planning and Management Division

intake screens would be investigated during the next design phase. However, the elimination of entrainment of larval fish from such a large volume of water would be quite costly and technically difficult. Impingement mortality of larval fish would likely be higher than that from entrainment. Fish larger than larval stage are active swimmers and would probably avoid impingement since velocities would be kept low and attractors and barriers to escape would be avoided. Certainly anadromous down-migrants such as salmon would be of great concern, but no such situation exists at St. Anthony Falls, a permanent barrier to fish migration.

4. This report was prepared with the assumption that Federal construction would be recommended. However, it is our responsibility to evaluate any potential impacts that could occur as a result of the project. It is logical to assume that the new turbines would be operated first even if constructed by the Federal Government because the two new units would be more efficient than existing units and would each use a flow equivalent to the total used by all the existing units. As flows decreased below full capacity, it would be most practical to take small capacity units off line incrementally than to take a large unit off the line. Power distribution would be the same regardless of who developed the plant, and it seems that a mutually satisfactory operating agreement could be easily arrived at. Therefore, it seemed prudent to assume the worst case from an impact standpoint. In any event, as pointed out in the report, if the new turbines received second priority, their use would be somewhat restricted by the availability of water. Thus, less flow and less larval fish would be entrained than assessed in the report. The effect of larval fish entrainment that was found to be not significant in the "worst case" would be even less with the assumption of second priority use.

5. Your comment is noted.

NSP

Northern States Power Company

414 Nicollet Mall
Minneapolis, Minnesota 55401
Telephone (612) 330-5500

November 10, 1983

Colonel Edward G. Rapp
US Army Corps of Engineers
St Paul District
1135 US Post Office & Custom House
St Paul, MN 55101

We commend the Corps for undertaking the feasibility study and environmental assessment of additional hydropower at St Anthony Falls. This effort has greatly helped us in our own four year investigation of the falls' hydropower potential. Since NSP operates two small hydro plants at St Anthony Falls, this report is of major concern to us.

Your feasibility study primarily addresses federal development of additional hydropower at St Anthony Falls, as required when the Corps conducts a study of this type. However, the Corps and NSP agree that first priority for redevelopment belongs with NSP, the present licensee and owner of land and facilties on which the recommended plan ("5U + 2L") would be constructed.

NSP has conducted preliminary cost analysis of the Upper Dam and Lower Dam redevelopment plans recommended within the feasibility study. This analysis assumed NSP cost and operating parameters, including a 50 year federal license. Results of this preliminary cost analysis include estimated lifetime benefit/cost ratios of 1.6 for a 21 MW addition at the Upper Dam and slightly less than 1.0 for a 5.5 MW addition at the Lower Dam. The primary economic benefit obtained from added hydropower at St Anthony Falls would be the long-term reduction of fossil fuel usage on the NSP system since we believe that there is little additional dependable capacity available at the site.

Based on your feasibility report and our own ongoing studies, NSP intends to seek approval to develop additional hydropower at St Anthony Falls. However, additional study is needed before a final decision can be made regarding redevelopment. Your feasibility study considered a range of hydropower plant sizes and types in compiling the recommended plan for redevelopment.

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO NORTHERN STATES POWER COMPANY

November 10, 1983

1. Your interest is noted and your cooperation is appreciated.

Similar analysis must be conducted with consideration of NSP cost parameters. Also, the condition and future operability of existing hydropower equipment at the site must be assessed. These factors will help determine the size, type and timing of redevelopment which is most appropriate for NSP to pursue at St Anthony Falls.

NSP recognizes the valuable resource Minnesota and the city of Minneapolis have in scenic and historic St Anthony Falls. We support the need to balance electricity production at the falls with other concerns and priorities, including aesthetics. NSP will continue to work with the city, the Corps and others to reach an appropriate balance.

Thank you for the opportunity to provide input to the feasibility study.

E C Glass
Vice President
Corporate Planning & Development

pg

NSP CO ENERGY SUPPLY PLANNING DEPARTMENT MINNEAPOLIS
November 17, 1983

MEMORANDUM

Economic Analysis of Hydropower
Redevelopment at St Anthony Falls

INTRODUCTION

NSP has been studying redevelopment of the St Anthony Falls (SAF) hydropower site in Minneapolis since 1980. This memorandum documents NSP use of technical data available from the US Army Corps of Engineers to conduct economic analysis of redevelopment at the upper dam and/or lower dam of this site.

An initial screening analysis is first discussed, which was used to reduce the possible hydropower plant locations to those which are most economical and physically uncomplicated.

An economic analysis of three detailed redevelopment options as developed by the Corps is then discussed, including various sensitivity analyses which were conducted.

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BACKGROUND

NSP currently operates two run-of-river hydropower plants at the SAF site, these being the 12 MW Hennepin Island plant at the upper dam and the 8.3 MW Lower Dam plant. The operating condition of Hennepin Island is considered very good and this plant is expected to operate without significant problems for many years to come. Future operability of the Lower Dam plant is more uncertain. Both plants are up for relicensing with the FERC in year 2000.

NSP hired Stone & Webster Engineering Corporation in 1980 to conduct a technical analysis of additional hydropower at the upper dam. Hydropower additions at 12 MW and 24 MW were evaluated and found to be technically feasible. Economic analyses conducted by NSP for these redevelopment options indicated that they would be cost-effective.

In September of 1981, the St Paul District of the Corps published a "Reconnaissance Report" regarding development/redevelopment of hydropower on the upper Mississippi River. It was the conclusion of this report that the most economical site for implementation of hydropower was SAF.

In early 1982, the Corps initiated a feasibility study of hydro redevelopment at SAF, including technical and economic evaluation of redevelopment from a federal perspective. That study is summarized in the Corps' "Feasibility Report and Environmental Assessment", drafted September 1983 and due out in December 1983. NSP has made use of technical data from the Corps' report to conduct analysis from an NSP implementation perspective. This memorandum documents analysis conducted by NSP.

SUMMARY OF RESULTS

The Corps' initial screening analysis included seventeen possible redevelopment site locations, including eight involving added capacity at the upper dam, five involving added capacity at the lower dam, and four which would involve combining the upper dam and lower dam head to drive hydropower turbines at a single powerhouse. Any one of the upper dam options could be pursued in combination with any of the lower dam options; however, pursuance of a "combined" alternative would preclude pursuing any of the specific upper dam or lower dam options.

The Corps developed investment and operating cost estimates for each redevelopment option, and conducted economic analysis from a federal development perspective. NSP then conducted parallel economic analysis which indicated the most economical options for NSP development would be as follows:

Dam	Powerhouse Location	Approximate 50 Year Benefit/Cost Ratio for NSP Development
Upper	Wasteway #2	1.9
(and/or)		
Lower	Next to existing powerhouse	1.3
(or)		
Combined	Next to existing lower dam powerhouse (using above ground penstocks)	2.1

Detailed technical and economic analysis was then conducted by the Corps for each of the above redevelopment options. The size, type and number of turbines which are optimal from a federal development standpoint were defined in this analysis, as summarized below:

	Added Capacity (MW)	Annual Energy (GWh)	Annual Capacity Factor (%)	# Turbines	Type Turbines
Upper Dam	21.0	75	41	2	vertical
Lower Dam	5.5	19	39	1	bulb
Combined	28.0	84	34	2	vertical

NSP later conducted parallel economic analysis for each site plan listed above. Capital costs and other economic parameters used were those which would apply to NSP development. This analysis assumed a 50 year useful service life, with operation beginning in 1992. Various study parameters and results from an NSP development perspective are summarized below:

	Dependable Capacity (MW)	Investment Cost ($/kW) (1992 Operation)	Benefit/Cost Ratio First 20 Years	Benefit/Cost Ratio 50 Year Life
Upper Dam	2	1690	1.1	1.6
Lower Dam	0	2620	.64	.98
Combined	3	2330	.64	.92

This economic analysis indicated that redevelopment of the upper dam at SAF would be cost-effective to NSP. Redevelopment of the lower dam would be marginal and require a long payback period (perhaps slightly longer than the estimated 50 year service life). The combined redevelopment option would be the least economical overall, both because of its low benefit/cost (B/C) ratio and because it would preclude pursuing the economical upper dam option.

Also included as a part of the above analysis was the possibility of using the 350 acre upper dam reservoir for peaking operation of hydropower facilities. It was found that although dependable capacity and on-peak energy could be increased significantly, peaking operation would not be economical for NSP customers and could cause navigational complications upstream of SAF.

Various sensitivity analyses were conducted by NSP regarding the upper dam and lower dam redevelopment options. These analyses indicated the upper dam redevelopment option would be cost-effective to NSP over a significant variation of load growth, fossil fuel price escalation and other input assumptions. The lower dam redevelopment option would be cost-effective when assuming higher than expected load growth or higher than expected fossil fuel price escalation.

ADDITIONAL DISCUSSION

Existing Capacity

This analysis assumed that existing capacity at SAF can continue to operate in the future years without significant extraordinary maintenance or capital investment. This is considered to be a reasonable assumption at the upper dam, although somewhat questionable at the lower dam based on the general condition of facilities there.

Detailed Redevelopment Options

NSP conducted an analysis of the detailed redevelopment parameters as identified by the Corps for each dam (options 5u, 2L and 8ud). This included reviewing project implementation schedules and applying NSP construction cost parameters and other economic variables as apply to the NSP electric system.

Estimated project schedules were developed as would apply to NSP for each redevelopment cption. These schedules indicate that assuming project authorization in 1984, the earliest that commercial operation could occur is as follows:

1. 1992 for redevelopment option 5U
2. 1990 for option 2L
3. 1993 for option 8Ud

Redevelopment costs for the upper dam are similar to those estimated by Stone & Webster in 1980 for a similarly sized plant, when compared on a per kW basis and adjusted for in-service year. These comparative costs are summarized below:

	Added Capacity 12 MW	Added Capacity 24 MW
Stone & Webster Capital Estimate ($/kW for 1992 Operation)	2470	1880
% Difference from Corps Estimate for 21 MW plant	+ 49	+ 11

In reviewing annual energy production data as compiled by the Corps, NSP noted that somewhat less than realistic values were assumed for the flow required to fully power existing capacity at either the upper or lower dam. It is estimated that because of this, the Corps may have overstated the energy output of added capacity at SAF by a few percent. Comparison of the Corps energy production estimate for the upper dam development against Stone & Webster data resulted in the latter being about 6 percent lower.

Dependable Capacity

Currently, all 12 MW installed at the upper dam is considered dependable and is accredited by MAPP[1]. It is estimated that an additional 2 MW of capacity installed at the upper dam could be accredited on a run-of-river basis under MAPP procedures, which require use of median stream flow as available during the peak electric load periods of the year (June-August). Thus, 2 MW of the added 21 MW of the upper dam redevelopment option was assumed for this analysis to qualify as firm capacity.

At the lower dam, only a portion of the presently installed capacity is accredited by MAPP, again based on median stream flow and run-of-river rating procedures. Additional capacity installed at the lower dam would not qualify for any dependable capacity credit under these conditions.

The combined redevelopment option would have the same flow available to it for accreditation purposes as would the upper dam redevelopment. Adjusting for the increased head of the combined redevelopment, this option would qualify for about 3 MW of dependable capacity.

Use of Reservoir Storage for Peaking Operation

Although the SAF site has always been considered run-of-river, it was suggested very early in this study that use of the 350 acre upper pool at SAF for peaking operation be considered. Analysis indicated that approximately the following increased dependable capacity and on-peak shift of energy (9 AM - 9 PM weekdays) could be achieved:

	Additional Dependable Capacity (MW)*	Additional On-Peak Energy (GWh/Yr)*
Upper Dam	2.3	4.3
Lower Dam	1.2	2.2
Combined	3.5	6.5

*Based on 8 hr use of 2 ft storage

The conclusions of this analysis were that the economic value to NSP of implementing storage at SAF is nil or somewhat negative even when ignoring costs associated with implementation of the storage, and that storage could have an adverse impact on river navigation. Therefore, the use of pool storage for peaking purposes was not further studied.

[1] Mid-Continent Area Power Pool

Economic Analysis of Detailed Redevelopment Options

Life cycle economic analysis was conducted by NSP for each redevelopment option assuming operation beginning in 1992 and concurrent displacement of equivalent dependable capacity from a large coal-fueled unit. Because the redevelopment options qualify for little dependable capacity credit, the economic value of the hydropower additions primarily lies in the displacement of coal- and oil-produced energy on the NSP system. A 50 year useful life was assumed for each hydropower addition, which is equivalent to the FERC license period for a hydropower facility.

The levelized annual (gross) benefit of each redevelopment option to NSP is estimated as follows:

(1992 $)

	Energy Value		Capacity Value		Total
	$ Thousands	$/KW	$ Thousands	$/KW	($/KW)
Upper Dam	9,930	473	680	32	505
Lower Dam	2,650	482	0	0	482
Combined	10,320	368	1,020	36	404

Costs associated with the hydro redevelopment options include revenue requirements on investment and annual O&M costs. The levelized annual costs of each option are summarized below:

	Revenue Requirement On Capital		Plant O&M	Total
	$ Thousands	$/KW	($/KW)	($/KW)
Upper Dam	6,440	306	14	320
Lower Dam	2,540	462	32	494
Combined	11,750	420	17	437

The net levelized annual benefit of each redevelopment option is thus as summarized below:

	Net Annual Benefit (1992-2041) (1992 $)	
	$ Thousands	$/KW
Upper Dam	3,880	185
Lower Dam	- 70	- 12
Combined	- 890	- 32

Additional economic costs and parameters used in this analysis are summarized within the Appendix.

SO_2 Reduction

More than 90% of energy produced by each redevelopment option displaces coal burned on the NSP system. This reduced coal burn would in turn reduce sulfur dioxide (SO_2) emissions. Listed below is the approximate annual SO2 reduction associated with each redevelopment option:

	Estimated Annual SO_2 Reduction		
	Tons	Tons/MW	Tons/Millions $ Investment (1992 Operation)
Upper Dam	660	31	19
Lower Dam	210	38	15
Combined	720	26	11

The following table illustrates the net levelized annual cost per ton of annual SO_2 reduction:

	(1992 $)	
	First 20 Years (1992-2011)	50 Year Life (1992-2041)
Upper Dam	$0/ton*	$0/ton*
Lower Dam	4780	330
Combined	6400	1240

*Indicates there is a net annual saving associated with this development option, and thus no assignable penalty per ton of SO_2 reduction

Sensitivity Analysis

Sensitivity analyses were conducted to gauge the impact of various parameters on the economic value of the redevelopment options. Because the upper dam option was cost-effective in the baseline analysis (50 year B/C ratio = 1.6), sensitivity analysis primarily concentrated on input parameters which may affect the results in a pessimistic way in order to estimate how much a parameter must change in order to materially affect the results. Conversely, the lower dam appears marginal (50 year B/C ratio = .98); thus, parameters were generally altered so as to improve the economic results. No sensitivity analysis was conducted regarding the combined development option, which is considered the least desirable option because it has the lowest B/C ratio (50 year B/C ratio = 0.92) and because it would preclude persuance of the economical upper dam option.

Each sensitivity analysis is briefly discussed below.

Load Forecast:

The baseline economic analysis assumed the current "best estimate" of load growth, which lies between the mid values and low values of the official NSP forecast.

Analysis was conducted of the upper dam option assuming the low-range forecast values. This reduced the 50 year B/C ratio from 1.6 to 1.2.

Analysis was conducted of the lower dam option assuming the mid-range values of the load forecast. This increased the B/C ratio from .98 to 1.3 over 50 years.

Fossil Fuel Escalation:

The baseline economic analysis included average annual fossil fuel escalation rates (1983-2000) for coal and oil equal to 8.6% and 9.5%, respectively.

An analysis was conducted of the upper dam option assuming the fossil fuel escalation rates to be 2% or 4% per year below the baseline values. These alterations significantly impacted the B/C ratios. Average annual escalation rates of about 6% and 7% per year for coal and oil, respectively, would result in a B/C ratio of 1.0 over 50 years.

An analysis was conducted of the lower dam option assuming fossil fuel price escalation rates to be 2% or 4% per year higher than the baseline values. The results of these analyses indicate that fossil fuel price escalation 2% per year above the baseline values would result in a B/C ratio of about 1.6 over 50 years.

Minimum Dam Flow:

A concern of some regarding upper dam redevelopment is that adding hydro power at this site will increase the percentage of time the spillway will be dry, reducing aesthetics at the site. One possible solution may be maintaining a minimum flow over the spillway for aesthetic purposes, which would reduce somewhat the capacity and energy value of hydropower at the upper dam. There has been no such similar concern regarding the lower dam spillway.

A sensitivity analysis was conducted assuming 750 cfs of flow would have to be constantly maintained over the upper dam spillway. This would affect the output of existing hydropower

capacity at the upper dam as well as new capacity obtained via redevelopment. It is estimated that such a flow requirement would cause the redevelopment option to lose its 2 MW capacity credit and that average annual energy output would be reduced from 75 GWh to approximately 64 GWh.

The result of maintaining minimum flow was to reduce the economic value of the upper dam redevelopment option, the B/C ratio being decreased from 1.6 to 1.3 over 50 years. It should be noted this sensitivity analysis is highly approximate in that the actual flow requirement necessary to maintain aesthetic appeal is not known at this time and also that there may be a capital cost associated with accomplishing a constant spillway. No such capital cost was included in this sensitivity analysis.

Prepared by:
R M Running

pg

APPENDIX

NSP Economic/Cost Data for Detailed Analysis

Economic Parameters

Discount rate (MAR):	12.25%/year
Escalation rate for capital and operating costs:	7.5%/year
Study Period:	50 years

Coal Plant Cost Parameters

Capital Investment (1983 Operation)	$883/kW
Levelized Annual Revenue Requirement (LARR):	17.2%/year
Fixed O&M (1983 $):	$6.3 kW-yr

Hydro Plant Parameters

	Added Capacity (MW)	Annual Energy (GWh)	Annual Capacity Factor (%)	Dependable Capacity (MW)	# Turbines	Type Turbines
Upper Dam	21.0	75	41	2	2	vertical
Lower Dam	5.5	19	39	0	1	bulb
Combined	28.5	84	34	3	2	vertical

Capital Investment

	1983 Operation $1000's	1983 Operation $/kW	1992 Operation ($/kW)	LARR	Operating Cost (1983 $)
Upper Dam	18,500	880	1690	18.75%	65,000
Lower Dam	7,500	1370	2620	18.17%	40,000
Combined	34,100	1270	2330	18.60%	109,000

11/10/83

GOELZER & RICHARDSON
1503 Washington Avenue South
Minneapolis, Minnesota 55454

15 November 1983

Colonel E. G. Rapp
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office and Customs House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

We are the owners of two mill buildings, the Standard Mill and the North Star Woolen Mill, in the west bank Milling District of the St. Anthony Falls Historic District. As architects and developers we intend to renovate the buildings for residential, commercial and office uses, following both the Urban Design Guidelines and the Mills District Plan, as adopted by the Minneapolis City Council. The recent proposal by the Army Corps of Engineers to construct a second hydroelectric facility at the Falls greatly disturbs us, jeopardizing redevelopment in the entire historic district. 1.

At the outset we should point out that the plan referred to as the "Mills District Plan" on pages 34 and 71 of your main report has been formally adopted by the Minneapolis City Council and will be the planning document for all development in the west bank Milling District. 2.

Because of the importance of the historic St. Anthony Falls district to the city, state and nation, the impact of your proposal directly and indirectly affects a very large segment of the public. We do not understand, therefore, why, on page 3, the Corps states "an intensive public involvement program" was not warranted. This site is most central to the city and its inhabitants, being the location of the city's beginning and its primary symbol. It is just this kind of historic site which requires full public discussion, review and involvement before such significant alterations are proposed or undertaken. In addition, the finding of "no significant impact" outlined in your letter to the attention of the Planning Division, Environmental Resources Branch, does not reflect or address the concerns detailed in the body of the main report and draft environmental assessment texts. On page 71 of the main report your text says, "any...decrease in flows available to the Falls could have a significant negative impact. The major natural attraction of the area is St. Anthony Falls. If the Falls were dry due to hydropower requirements, the recreational/aesthetic experience would be significantly lowered." On page 88 the main report says that the Platteville limestoneshelf which forms the Falls "breaks down...where exposed to severe weathering. It should be left exposed only where some deterioration can be tolerated." Should the roller dam be dry about 80 per cent 3. 4. 5.

A-40

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO GOELZER AND RICHARDSON

November 15, 1983

1. The revised NED plan incorporates design of the powerhouse consistent with the attributes of the flow over the falls and is consistent with the Mills District plan.

2. Comment noted.

3. Corps studies of the added hydropower potential at St. Anthony Falls were initiated as a result of the National Hydropower Study in 1978-1981. A Corps hydropower reconnaissance study was completed for Upper and Lower St. Anthony Falls and five other Mississippi River sites in the St. Paul District in September 1981. A public notice on the findings and availability of the report, and copies of the report were distributed to the public on May 13, 1982. Possible concern about maintaining flows over the Upper St. Anthony Falls spillway was not raised as an issue in response to this preliminary report. The issue did not surface until quite late in the current feasibility study.

4. The revised report corrects this inconsistency.

5. Less water over the two spillways does not expose the Platteville limestone mentioned in the report. The pools behind the two roll dams would have to be artificially dewatered to do this.

of the time, the upper Horseshoe Falls will also be dry, perhaps for greater periods of time and would be exposed to severe weathering. Finally, in the draft text of your environmental assessment you state that "diverting water from St. Anthony Falls...may result in a significant increase in th- frequency and duration of periods during which no water would flow over t:. Falls and would detract from the historic and aesthetic character of the historic district and structures within the district, especially St. Anthony Falls." 5. (cont.)

The Minnesota State Historic Preservation Officer, Russell Fridley, in his letter on pages E-46 and E-47 of the appendices, has very clearly requested more information "on the historical components of the district as well as on the project itself" before making "an appropriate determination of effect." These concerns would, we feel, suggest that there would be a significant environmental impact as a reult of the project, an impact which should be addressed through a full environmental impact study. 6.

For a number of years the City of Minneapolis, along with developers in the District, has proposed making the area more accessible to the public by providing upgraded riverfront facilities and development, including a possible marina or boat tie up. Such features are being considered currently by the Parks and Recreation Board, Great River Road planners, and developers. In the report appendix, page E-86, the U.S. Department of the Interior finds "it is unfortunate that sport fishing is not being promoted in this area... Both fishery resources and water-oriented recreation should also improve," which may "...necessitate providing public access for recreational boating and fishing. Although conflicts between commercial navigation and recreational use are inevitable, these uses presently co-exist in other urban areas of the upper Mississippi River." While the development of the hydroelectric facility by the Corps may not include such public recreational facilities, the active discouragement of them by the Corps contradicts the plans of the City, the U.S. Department of the Interior, metropolitan planners and developers. It has been estimated by the Minneapolis Community Development Agency that approximately $800 million will be spent in the near future on current development projects and proposal in the central riverfront area of Minneapolis. Discouraging public use of and access to the river and its amenities is not compatible with such plans and is not in the best interests of the city. 7.

We strongly urge the U.S. Army Corps of Engineers to work with the city and developers in the District to prepare a full environmental impact statement for the proposed St. Anthony Falls hydroelectric facility. The potential for significant negative impacts upon the District is so great, in comparison to the proposed benefits, that a complete study must be undertaken. 8.

6. Since the draft report, additional information was provided to the SHPO. Based upon this information, the SHPO has stated that the revised NED plan will not have a significant effect on the St. Anthony Falls Historic District.

7. The Corps does not advocate boating and marinas in the immediate area of St. Anthony Falls because of the high hazard situation involving the falls, treacherous currents, and navigation tows and barges.

8. The revised environmental assessment in conjunction with the modified NED plan adequately assesses and provides for minimum environmental impacts from the proposed hydropower development.

As owners and developers, we are willing to work with the Corps in its study in an effort to develop the riverfront for the benefit of the entire metropolitan region.

Sincerely,

N. Christopher Richardson
Partner

Peter Goelzer
Partner

cc: U.S. Department of the Interior, National Park Service
Advisory Council on Historic Preservation
U.S. Senator David Durenberger
U.S. Senator Rudy Boschwitz
U.S. Representative Martin Sabo
U.S. Environmental Protection Agency
Federal Energy Regulatory Commission
Minnesota State Historical Society

DOWNTOWN COUNCIL OF MINNEAPOLIS

15 SOUTH 5TH STREET, MINNEAPOLIS, MINNESOTA 55402 · TELEPHONE 338 3807

November 16, 1983

Colonel E. G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Customs House
St. Paul, Minnesota 55101

Re: Proposed hydropower development
at St. Anthony Falls

Dear Colonel Rapp:

On behalf of the Downtown Council of Minneapolis, I wish to report that by action of its Board of Directors and its Riverfront Committee, the Downtown Council is on record as supporting Resolution No. 83R-446, copy enclosed, as passed by the Minneapolis City Council, October 28, 1983. Indeed, we believe the final sentence of the resolution could be strengthened and clarified by amending it to read: "Be It Further Resolved that the Corps of Engineers be requested to facilitate local economic development by resisting the proposed diversion of waters from St. Anthony Falls as defined in The Corps of Engineers report."

Respectfully submitted,

Henry Kingman, Jr.
Chairman
Downtown Council Riverfront Committee

HK/jz

cc: Mayor Donald Fraser
John F. Hodnett
Alderman Alice Rainville
Alderman Jacqueline Slater

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO DOWNTOWN COUNCIL OF MINNEAPOLIS

November 16, 1983

1. See comments to the city of Minneapolis letter dated November 2, 1983.

MILL DISTRICT ASSOCIATES
Suite 520, Lumber Exchange Building
10 South Fifth Street
Minneapolis, Minnesota 55402

16 November 1983

Colonel E. G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Customs House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

Mill District Associates, a corporation formed to encourage the multiple use and development of the downtown west bank riverfront, was organized in 1981 by the land and building owners within the area bounded by the west bank of the Mississippi River, Third Avenue, Washington Avenue and Interstate 35W. Members of the M.D.A. are pledged to work cooperatively to assist in development of the riverfront, following unanimously agreed upon objectives which would preserve and enhance the usage of the milling district's riverfront. Because of our many interests in the area we are writing in response to the "Draft Feasibility Report and Environment Assessment; Hydropower; St. Anthony Falls Locks and Dams, Mississippi River," as presented by you in the public hearing of October 18, 1983.

Over the past year our group has worked closely with the City of Minneapolis in formulating the Mills District Plan. That plan, adopted formally by the Minneapolis City Council, will generate $250 million of private investment, 4,000 construction jobs, and 5,000 permanent jobs. According to the plan, The Mills District is "one of the most significant and architecturally rich historic districts in Minnesota," and "occupies the most favorable location for large-scale development in Minneapolis..." The plan shows that "the riverbank will be developed as a public amenity with promenades, bike paths, restaurants, parkways, canals, and landscaping, all orchestrated to highlight views of the Mississippi River and St. Anthony Falls." 1.

Your proposal to construct a hydroelectric facility at the upper lock and dam, thereby redirecting the flow of water away from both the Horseshoe Dam and the Roller Dam so that both would be dry approximately 80 per cent of each year, is of great concern to our group. We do not agree that there is "no significant impact" upon the District and its environs. 2.

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO MILL DISTRICT ASSOCIATES

November 16, 1983

1. Your interest is noted.

2. Your comment is noted.

We urge the U.S. Army Corps of Engineers to prepare a full environmental impact statement, working with the Minnesota State Historic Preservation Officer, the Minneapolis Historic Preservation Commission, the Minneapolis Community Development Agency and the Parks and Recreation Board as well as interested private parties such as the Mill District Associates. A proposal that the city's major natural resource, indeed the very symbol of its historical beginnings and growth, be so drastically altered demands full public participation, review and assessment of both the positive and negative impacts upon that resource. 3.

The M.D.A. pledges to work cooperatively with the Corps and other interested agencies and parties to fully study and assess your proposal for additional *hydroelectric* generating capability at the St. Anthony Falls 4.

This position was formally adopted by a quorum of the Mill District Associates at our November 16, 1983 meeting. A list of our board of directors is attached.

Sincerely yours,

Ben Miller
President

Enc.

Board of Directors

Mill District Associates

Will Rodeck, Minnesota Gas Company
Gregory J. Hayes, Hayes Contractors, Inc.
Charles R. Krusell, Industry Square Development Company
Ray Lappegaard, J. L. Shiely Company
Ben Miller, Riverside Industries, Inc.
David Nasby, General Mills, Inc.
N. Christopher Richardson, Standard Mill and North Star Woolen Mill Partnership
Al Smith, Crown Mill Corporation
Reiko Weston, Fuji-Ya, Inc.
Alan J. Wilsensky, St. Anthony Warehouse Co.
Harry Wirth, Waterfront Companies
Bob Johnson, Johnson Building Company
James Klein, Wunder, Klein, Donahue Co.
Shelly Walsh, Walsh Grain Co.

3. Public involvement has been increased and considerations to prevent causing adverse impacts have been made; therefore, no environmental impact statement will be required.

4. Your participation is appreciated.

THE JEFFERSON COMPANY

November 16, 1983

Colonel Edward G. Rapp
District Engineer
St. Paul District
U. S. Army Corps of Engineers
1135 U. S. Post Office & Custc House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

I am writing as the head of The Jefferson Company and have been active in the redevelopment of the Main Street/Riverfront area of downtown Minneapolis for many years. I believe we were the first serious developers in this area.

There has been a very recent flurry over the Corps' proposal to use the major part of the water going over St. Anthony Falls for additional electrical generation. The implication of this, not only to us but to the other developers and to the City in general, would be extremely negative. While there has been a good deal of discussion on the part of the Corps at meetings about how this could be mitigated to some extent by a variety of methods, it strikes me that the proposal on the table has nothing to do with any mitigation at all and, indeed, the suggestions made seem to me to be very pretty pictures having to do with conditions which are not anywhere near the same, for example, a picture of a dam up on the border wilderness area. 1.

I have been to two presentations by Corps personnel and a disturbing element is the apparent interest to discuss alternatives but not a willingness to do it in a formal way, that is, environmental impact studies or clear cooperative activities with the City, Heritage Preservation Commission, and other interested parties, public and private. 2.

In any case, I would strongly hope that the Corps will act accordingly to resolutions and requests by the Minneapolis City Council, the Downtown Council and other interested groups, as well as private developers such as myself and other neighbors. We have put a lot of time and effort into recouping this area for the City and to have it damaged by insensitivity on the part of the Corps is very difficult to accept. I hope you will use your influence to see to it that proper and careful consideration is given to all factors involved with the river, the falls, and its use for the Minneapolis community who will live and work here long after the current actors have left the stage. 3.

Yours sincerely,

Louis N. Zelle
Chairman of the Board

LNZ:jh

219 MAIN STREET S.E. • MINNEAPOLIS, MINNESOTA 55414 (612) 379-1316

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO THE JEFFERSON COMPANY

November 16, 1983

1. The techniques for making a volume of water appear greater than it is were demonstrated by the pictures of a dam in the Boundary Waters because it was the only demonstration of the technique available to us. The technique would be used in the proposed project to impact turbulence to a relatively small volume of water providing the appearance of St. Anthony Falls as it would look at a greater flow and still allowing the larger volume to be used for the generation of electricity.

2. The Corps has worked with many parties and agencies during this study. We have, to a greater extent, coordinated with the city, Heritage Preservation Commission, and other interested parties during the preparation of the final feasibility report.

3. This report has been expanded to consider aspects of the project not developed in sufficient detail during the past studies.

FUJI-YA

finest Japanese cuisine

Colonel E. G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post office and Customs House
St. Paul, Minnesota 55101

November 16, 1983

Dear Colonel Rapp,

Fuji-Ya Restaurant opened for business in 1959 in Downtown Minneapolis operating in quarters that did not allow for expansion of our successful business. We felt a free standing building near downtown but with aesthetic ammenities available to our customers would be our goal. The site which offered an ideal combination was the one where Fuji-Ya is now built-overlooking the St. Anthony Falls on the bank of the Mississippi River. The site was purchased in 1962 and the new location was opened in 1968. The building was expanded in 1974 and in 1976. The building has an all glass front to afford the diners an optimum view of the falls and the river. We now serve approximately 100,000 people per year. While the main reason for dining at the Fuji-Ya is the fine Japanese food, the view of the falls is definitely a factor in attracting people to the restaurant. 1.

In addition to the restaurant operation Fuji-Ya has plans to develop property both upriver and downriver from our present building. A 200 room hotel would attract another 110,000 people and additional restaurant and retail development would attract 125,000 more. The total present and planned development on Fuji-Ya's property alone will bring nearly 350,000 viewers to the falls. 2.

The other developers in the Mills District area plan on several times this number of viewers, and the planned regional park additional numbers. All of these people want to see and hear the falls. If the water over the Horseshoe dam and the Roller dam is diminished by a hydroelectric power plant the main attraction to this area is threatened.

We at Fuji-Ya ask that every consideration be given to the aesthetics of the river and falls and that a full enviornmental impact statement be made before there is any consideration given to building a hydroelectric facility at St. Anthony Falls. 3.

Sincerely yours,

Wayne Johnson
Assistant to President

420 SOUTH FIRST STREET MINNEAPOLIS, MINNESOTA 55401 339.2226 339.2227

A-47

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO FUJI YA RESTAURANT

November 16, 1983

1. Your comment is noted.

2. In this report, we intend to provide flow over the falls to equate with, at least, the visual aspects of the existing condition.

3. We believe that the revised plan presented in this report addresses public concerns and does not cause significant environmental impacts. Therefore, no environmental impact statement is required.

MINNEAPOLIS
PARK & RECREATION BOARD

November 17, 1983

Col. Edward G. Rapp
U. S. Army Corps of Engineers
1136 U. S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

Enclosed is the Minneapolis Park and Recreation Board's serious concerns about the diversion of St. Anthony Falls for the generation of hydropower.

This is the official board response for the public hearing held on October 18, 1983 at the University of Minnesota's Earl Brown Continuing Education Center, St. Paul, Minnesota.

Yours truly,

Albert D. Wittman
Assistant Superintendent
for Planning

ADW/ck

Enc.

A-48

President:
Patricia Hilmoyer

Vice President:
Walter Rost

Commissioners:
Nancy L. Anderson
Patricia D. Baker
Tom Bates
Dale W. "Skip" Gilbert
William Hallstrom
Raoul Lopez
Scott Nielsen

Secretary:
Del Gieen

Superintendent:
David L. Fisher

310 South Fourth Avenue
Minneapolis, MN 55415
Phone 1-612-348-2142

MINNEAPOLIS PARK AND RECREATION BOARD

AN ACTION, RESOLUTION OR ORDINANCE

In accordance with Chapter 3, Section 1, of the City Charter, there is herewith submitted to you, the Mayor of the City of Minneapolis, an action, resolution or ordinance adopted by the Minneapolis Park and Recreation Board which you may approve by affixing your signature hereinbelow or if you disapprove of same to return to the Board, with your objection thereto, by depositing the same with the Secretary of the Board to be presented to the Board at their next meeting where the question of its passage will be put again before the Board.

9.1 THAT THE BOARD ADOPT A RESOLUTION URGING THAT ANY PLANNED DEVELOPMENT OF HYDRO POWER FROM ST. ANTHONY FALLS NOT MINIMIZE THE VISUAL, ENVIRONMENTAL OR DYNAMIC IMPACT OF THE FALLS, CAPTIONED AS FOLLOWS:

RESOLUTION NO. 83-123

REGARDING THE FEASIBILITY REPORT
FOR HYDRO POWER AT ST. ANTHONY FALLS,
LOCKS AND DAMS, MINNEAPOLIS, MINNESOTA

A-49

PASSED NOV. 2—1983

Secretary of the Board

APPROVED November 9, 1983

Mayor

RESOLUTION NO. 83-123

REGARDING THE FEASIBILITY REPORT
FOR HYDRO POWER AT ST. ANTHONY FALLS,
LOCKS AND DAMS, MINNEAPOLIS, MINNESOTA

WHEREAS, the Falls of St. Anthony have been a premier landmark in the city of Minneapolis since its beginning, and

WHEREAS, the city's Central Riverfront is focused on the falls, and

WHEREAS, the city's Central Riverfront is in a state of dynamic change, and

WHEREAS, the city's Central Riverfront is being planned and redeveloped in accordance with that dynamic change, and

WHEREAS, the Minneapolis Park and Recreation Board is one of the city's governmental units playing a major role in the redevelopment of the Central Riverfront, and

WHEREAS, the Board has prepared a master plan for a Central Riverfront Regional Park that encompasses both shores of the river and Nicollet Island, and

WHEREAS, such regional park includes 150 acres of land which adjoins 150 acres of Mississippi River between Plymouth Avenue and I-35W, and

WHEREAS, the Central Riverfront Regional Park features the viewing and interpretation of St. Anthony Falls, and

WHEREAS, the Minneapolis Park and Recreation Board is the responsible agent of the city to prepare, complete and implement plans for the Great River Road route through the Central Riverfront, and

WHEREAS, the viewing and interpretation of St. Anthony Falls fulfills objectives of the Great River Road, and

WHEREAS, over fourteen million dollars have been expended for planning, acquisition and redevelopment of the regional park land and the Great River Road route, and

WHEREAS, it is anticipated that an additional thirty million dollars will be expended in the next 5 to 10 years to complete the acquisition and development of the regional park and Great River Road, and

WHEREAS, such regional park and Great River Road route are the open space and amenity components of the city's Central Riverfront redevelopment, and

WHEREAS, the total redevelopment of the city's Central Riverfront is expected to include a private sector investment of over 800 million dollars, and

WHEREAS, the Falls of St. Anthony are a major focus of the public and private redevelopment of the city's Central Riverfront.

NOW, THEREFORE, BE IT RESOLVED that any plan for the further development of hydro power derived from St. Anthony Falls should not minimize the visual, environmental or dynamic impact of the falls nor diminish in any way the role of the falls in any aspect of the city's Central Riverfront redevelopment, and

BE IT FURTHER RESOLVED that in completing the Feasibility Report for Hydro power that the report reflect the response of the community at the public hearing on October 18, 1983 and that the Corps of Engineers assure continuing public input into the report, and

BE IT ALSO RESOLVED that a second public hearing be held on the completion of the final report to assure that there is full public knowledge of the contents of the report and adequate time for public reaction.

Adopted by the Minneapolis Park and Recreation Board on this 2nd day of November, 1983.

Patricia Hillmeyer, President

Del Green, Secretary

APPROVED:

Donald M. Fraser, Mayor

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ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO MINNEAPOLIS PARK AND RECREATION BOARD

November 17, 1983

Resolution 1: The Corps of Engineers final hydropower proposal includes a base flow release and modifications to tne main overflow spillway and horseshoe dam to maintain visual aesthetics. The base flow would be guaranteed during periods that presently experience spillway overflow.

Resolution 2: The proposed project has been revised to reflect the response of the community at the public meeting and in subsequent correspondence.

Resolution 3: A second public meeting was held on February 14, 1984. There will be a 120-day comment period on the Division Engineer's Public Notice for this final feasibility report.

National Trust for Historic Preservation

MIDWEST REGIONAL OFFICE 407 SOUTH DEARBORN STREET SUITE 710 CHICAGO ILLINOIS 60605 (312) 353-0096

November 17, 1983

Colonel Edward G. Rapp
District Engineer
St. Paul District
U. S. Army Corps of Engineers
1135 U. S. Post Office and
Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

It has come to our attention that the Corps of Engineers has held a public hearing and several workshops on a feasibility study for the construction of hydroelectric facilities on the upper St. Anthony Falls, a part of a state designated historic district as well as a district listed in the National Register of Historic Places. We have requested a copy of this feasibility study and may submit additional comments after we have had an opportunity to review it in detail. The National Trust for Historic Preservation was chartered by the U. S. Congress in 1949 and fosters the preservation of the nation's diverse cultural and architectural heritage for all Americans. The National Trust meets these responsibilities by advocating the ethic of stewardship, strengthening local, state and national preservation efforts, influencing public policy, and shaping the values and methods of preservation. The Midwest Regional Office provides assistance to eight states including Minnesota. 1.

We are aware through discussions with your staff that the Corps has determined that an Environmental Impact Statement is not required. We have also been advised that the Corps is aware of its separate responsibility to comply with provisions of Section 106 of the National Historic Preservation Act as amended--that is to allow the Advisory Council on Historic Preservation an opportunity to comment on any proposed federal undertaking which may have an effect on any property listed in or eligible for inclusion in the National Register of Historic Places. We understand that there has been no determination of effect to date and that the Corps has been in consultation with both the State Historic Preservation Officer for Minnesota and with Michael Quinn of the Advisory Council. 2.

Headquarters Office 1785 Massachusetts Avenue N.W. Washington D.C. 20036 (202) 673-4000

A-51

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO NATIONAL TRUST FOR HISTORIC PRESERVATION

November 17, 1983

1. A copy of the September 1983 draft report was provided to the National Trust for Historic Preservation in response to Mr. Tim Turner's phone call.

2. A determination of no adverse effect has been received from the Minnesota State Historic Preservation Officer (letter of November 21, 1983) for the revised NED plan. The Advisory Council concurs with this determination with conditions. These conditions have been made a part of this report and as such, represent the St. Paul District's compliance with Section 106 of the National Historic Preservation Act of 1966, as amended.

As a sitting member of the Advisory Council, the National Trust monitors this process closely. We have been actively involved in promoting preservation in the St. Anthony Falls Historic District through our grants and through technical assistance from our staff. We hope any undertaking which may be implemented as a result of your study will protect the character of this important historic district. 3.

As stated earlier, we may submit additional detailed comments after we have had an opportunity to review the feasibility study. We would appreciate being kept informed of your efforts to reach a determination of effect in accordance with the Advisory Council's regulations (36 CFR 800).

Sincerely,

Tim Turner
Regional Director

cc: Russell Fridley, SHPO
Michael Quinn, Advisory Council
Louis Zelle, Trustee
Christopher Owens, Advisor
Laurel Ulland, Advisor
Ian Spatz, Director of Public Policy, NTHP

3. We believe that our revised NED plan has addressed public concerns and that it does protect the character of the St. Anthony Falls Historic District.

Department of Energy
Washington, D.C. 20585

NOV 17 1983

Mr. Louis Kowalski
Chief, Planning Division
Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

Dear Mr. Kowalski:

We have reviewed the proposed hydropower factilities at St. Anthony Falls on the Upper Mississippi River, as presented in your draft technical report dated May 1983. We are pleased to advise you that power from either of the proposed developments studied could be marketed to repay all costs associated with the power produced.

We understand that you expect to recommend the authorization of the upper and lower falls plants. While the output of these plants could be readily marketed, we believe that the combined falls site may be a more attractive alternative. We urge you to reevaluate its potential benefits. The evaluation should consider a substantially larger installed capacity for the site. The benefit and cost curves (Figure 6-3) are nearly parallel from the recommended 28 MW capacity to a capacity of at least 38 MW. The $70,000 drop in net benefits from a 36 MW plant to a 36.2 MW plant is very small (4.4 percent) and could be eliminated or reversed by more precise cost estimates developed at the advanced engineering and design stage. The criteria governing your evaluations are very conservative and should militate toward selecting a project that more fully develops the energy and capacity potential of the site. 1.

The reevaluation should also consider the power foregone at the combined falls site by spilling 1200 cfs of flow to provide the difference between the hydraulic capacities of the existing upper and lower plants. Approximately 16 million kWh of net energy annually is foregone (23 million kWh increase in generation, less 7 million kWh to replace the loss of generation at the existing lower plant). The benefit from this energy, together with the associated increase in capacity benefits, would raise the benefit-cost ratio for the combined falls plant to about 1.8. This ratio is essentially equal to that of the combined upper and lower plants. 2.

The projected electric power loads of the preference customers within a 100-mile radius of the project (46 municipal utilities and 24 cooperatively-owned utilities) could readily absorb the potential output of the proposed project. The approximately 1000 MW demand of these customers and their 4-billion kilowatthour annual energy load greatly exceed the proposed project's 28 MW of capacity and 83.7 million kWh of annual generation. Between now and 1988, which is probably the earliest year the project could be completed, the energy

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO DEPARTMENT OF ENERGY

November 17, 1983

1. The comments concerning the combined plant costs and benefits are acknowledged. The District has recommended the upper and lower falls plants for authorization and this is the NED plan, based on our feasibility determinations. (Reference figures 6-3 and 6-4 of the Technical Appendix.)

   We concur that the combined plan should be looked at closer in an advance engineering and design stage. However, we can identify pro and con features of the combined plan at this time. See the following comments.

2. This paragraph presents an interesting observation which shows that the combined plan would require 1,200 to 1,700 cfs flow passage over the St. Anthony Falls spillway with the combined plan. This flow requirement is necessary to supply the needs of the existing lower plant (4,500 cfs) that are over and above the design capacity of the upper plant (3,300 cfs). This incremental difference is 1,200 cfs using the design capacity of the two plants, or 1,700 cfs if the "flat-out" capacity of the two plants is used. The combined plan could possibly meet the aesthetic desires of the city and area developers. There are also "drawbacks" for the combined plan scenario that must be recognized at this stage of study. The most important of these drawbacks are:

   a. The U.S. Fish and Wildlife Service and the Minnesota State Historical Society both indicated objections to the combined plan in early study meetings and in correspondence.

loads of the preference customers are expected to grow by about 0.5 billion kWh and the capacity demands are expected to grow by about 130 MW. These power increases are about 5 times the output of the proposed St. Anthony Falls project.

Power from the project would be marketed under guidelines set forth in Section 5 of the Flood Control Act of 1944. Specific institutional and marketing arrangements would be developed to transmit and dispose of the power to encourage the most widespread use at the lowest possible rates to consumers consistent with sound business principles. Preference in the sale of power would be given to public bodies and cooperatives. The enclosed Department of Energy Order RA 6120.2 provides marketing policy guidance.

We appreciate the opportunity to work with you on the marketability aspects of this important renewable energy project. We look forward to continuing this close working relationship in subsequent phases of development.

Sincerely,

Daniel M. Ogden, Jr., Director
Power Marketing Coordination
Conservation and Renewable Energy

cc: Carl Stephan, St. Paul District
Corps of Engineers
Orv Bruton, Portland
Corps of Engineers

CE-1 (2)
CE-90 (2)

CE-92:TPrice:pkm:11-17-83

A-54

b. The costs of the combined plan could escalate dramatically because of the relatively unknown conditions under Main Street, the proposed combined plan conduit route.

c. Initial contacts with city of Minneapolis officials indicated that they might prefer the combined plan. They even suggested that the combined plan conduit alignment might be moved toward the Mississippi River, into Father Hennepin Bluffs Park. Alternative 8Ub is something like the city suggestion, but plan 8Ub was identified as being more costly than the 8Ud combined plan alternative, during early plan formulation.

d. Corps design staff indicate that the combined plan design and cost would escalate dramatically if the conduit was not located in limestone, under Main Street, as contemplated in plan 8Ud.

e. There are lost power benefits for 1,200 or 1,700 cfs over the upper falls spillway, as noted by the Department of Energy. This benefit loss is substantial, as noted in DOE's letter.

f. Northern States Power Company finds the combined plan alternative has a less than 1.0 benefit-cost ratio, using their own evaluation procedures.

united power association

elk river, minnesota 55330 • phone 612-441-5121

December 5, 1983

Mr. Louis Kowalski, Chief
Planning Division
St. Paul District
U. S. Corp of Engineers
1135 U. S. Post Office and
Customs House
St. Paul, MN 55101

Dear Mr. Kowalski:

This is to inform you that United Power Association (UPA) which is a generation and transmission rural electric cooperative serving fifteen member distribution rural electric cooperatives in the northeastern portion of Minnesota is interested in receiving power from the proposed Anthony Falls Hydroelectric Project being studied by the Corp of Engineers.

We understand that this expression of interest of receiving power from the Anthony Falls project has no binding effect on UPA but rather will simply allow us to make the decision to purchase or not purchase power at a later date.

Sincerely,

UNITED POWER ASSOCIATION

Philip O. Martin
General Manager

AJR/mz

A-55

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO UNITED POWER ASSOCIATION

December 5, 1983

1. Your interest is noted.

Hutchinson
Utilities
Commission

Hutchinson Minnesota
[illegible]

December 6, 1983

Louis Kowalski
Chief, Planning Division
St. Paul District
U.S. Corps of Engineers
1135 U.S. Post Office & Customs House
St. Paul, MN 55101

Dear Mr. Kowalski:

This correspondence refers to the November GLECA Bulletin.

The peak load for the Hutchinson Utilities Commission was 32,400 KW's during the summer months.

We generate with gas and oil and would be very interested in purchasing hydro power.

I understand the above is not an offer or a committment to buy.

Yours very truly,

HUTCHINSON UTILITIES COMMISSION

R. H. Alexander
General Manager

lp

H. N. Erk
President
E. Bud Daggett
Vice President
Thomas B. Lake
Secretary
R. H. Alexander
General Manager

Tel 612 587-4746

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ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO HUTCHINSON UTILITIES COMMISSION

December 6, 1983

1. Your interest is noted.

HENNEPIN COUNTY HISTORICAL SOCIETY

2303 THIRD AVENUE SOUTH MINNEAPOLIS, MINNESOTA 55404 • (612) 870-1

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Executive Director

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MYRTLE G. SCHUMANN

December 3, 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Proposed hydropower
at St. Anthony Falls

At its December 1, 1983 meeting the Hennepin County Historical Society Board of Directors voted to express to the Corps of Engineers their deep concern over the plan of the engineers to divert water from St. Anthony Falls for additional hydroelectric power. 1.

St. Anthony Falls is the birthplace of Minneapolis. Hennepin County Historical Society currently has under consideration a multimillion dollar development of a river history interpretive center/archive at the Falls. The impact of nearly totally diverting the flow of water over the Falls would negate the historical and cultural values of the Falls. 2.

We strongly oppose the Corps of Engineers submitting a Feasibility Study to the United States Congress that does not include an Environmental Impact Study as part of the study. 3.

The Hennepin County Historical Society Board gives its unanimous support to Alderman Slater's proposed City Council Resolution feeling it reflects the position of our members. 4.

Thank you for your consideration. Please feel free to contact the Board if you have any comments on our position.

Sincerely,

C. Blaine Harstad

C. Blaine Harstad, President

cc: Representative Martin Olav Sabo
Senator Dave Durenberger
Senator Rudy Boschwitz
Governor Rudy Perpich
Oliver Byrum, Director
Mpls. City Planning Dept.
Alderman Jackie Slater
Mayor Don Fraser
David L. Fisher, Supt.
Mpls. Park & Recreation
Patricia Hillmeyer, Pres
Mpls. Park Bd. Commiss

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ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO HENNEPIN COUNTY HISTORICAL SOCIETY

December 9, 1983

1. Your concern is noted.

2. The historical and cultural value of the falls has been taken into consideration in our revised NED plan. The plan provides for the appearance of flows consistent with the city of Minneapolis Mills District plan.

3. The impacts of the revised NED plan do not require the completion of an Environmental Impact Statement.

4. Alderman Slater's resolutions have been addressed in our response to the November 2, 1983 letter from the city of Minneapolis.

Dakota Electric Association

FARMINGTON, MINNESOTA 55024
TELEPHONE 463 7134

December 14, 1983

Mr. Louis Kowalski
Chief, Planning Division
St. Paul District
U.S. Corps of Engineers
1135 U.S. Post Office & Customs House
St. Paul, MN 55101

Dear Mr. Kowalski:

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On behalf of Dakota Electric Association I'd like to advise you of the interest Dakota Electric has in obtaining power from any facilities that might be installed at St. Anthony Falls. As a rural electric cooperative the Dakota Electric Association qualifies for preference treatment should this power become available.

Sincerely,

Dick Okerberg
GENERAL MANAGER

RDO:psg

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO DAKOTA ELECTRIC ASSOCIATION

December 14, 1983

1. Your interest is noted.

Minnesota Pollution Control Agency

December 29, 1983

Colonel Edward G. Rapp
U.S. Army Corps of Engineers
St. Paul District
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

Re: Hydropower, St. Anthony Falls Locks and Dams
Mississippi River

This letter is in response to your letter of September 28, 1983, which transmitted a copy of your draft feasibility report and environmental assessment for hydropower potential on the Mississippi River at the upper and lower St. Anthony Falls. The draft report indicated that there was a potential for 21.0 and 5.4 megawatts of added feasible power potential at upper and lower St. Anthony Falls. This added power potential is an addition to the already installed capacity currently under license to Northern States Power Company.

We have reviewed the referenced documents and discussed the implications of your proposed projects with members of your staff. At the present time we are not in a position to present final comments on your proposed report. The items of discussion with your staff included many points where problems still existed. Your staff is aware of our concerns and the essential items of our concerns have been transmitted in comments from other agencies. 1.

At this time we would like to indicate that the MPCA intends to process Section 401 certification for this project at a future time, when the final report has been developed. We request that you submit an application for certification allowing an adequate review and comment period, once the decision is made to proceed with the project.

Phone _____
1935 West County Road B2, Roseville, Minnesota 55113-2785
Regional Offices • Duluth/Brainerd/Detroit Lakes/Marshall/Rochester
Equal Opportunity Employer

ST. ANTHONY FALLS HYDROPOWER

CORPS RESPONSE TO MINNESOTA POLLUTION CONTROL AGENCY

December 29, 1983

1. We look forward to your comments on the final version of the feasibility report which addresses your concerns and those of other agencies.

If you have any questions regarding our position on this matter, please feel free to contact me or Mr. Louis Flynn of my staff at (612) 296-7289.

Sincerely,

Barry C. Schade
Director
Division of Water Quality

BCS/LLF:nmp

cc: Joseph Alexander, Minnesota Department of Natural Resources
Robert F. Welford, U.S. Fish and Wildlife Service
Elmer Shannon, U.S. EPA, Chicago

UNIVERSITY OF MINNESOTA
TWIN CITIES

St. Anthony Falls Hydraulic Laboratory
Department of Civil and Mineral Engineering
Mississippi River at Third Avenue S.E.
Minneapolis, Minnesota 55414
(612) 373-2782

February 1, 1984

Colonel Ed Rapp
Corps of Engineers
St. Paul District
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Ed:

I would like to make some comments concerning the "Draft Feasibility Report and Environmental Assessment for Hydropower Potential on the Mississippi River at Upper and Lower St. Anthony Falls, Minnesota."

First of all, I would like to point out that there are some items relevant to the Laboratory's existence that were not considered during your assessment. As you probably know, a great majority of research projects conducted at this facility depend on river water from intakes positioned close to the channel presently supplying the existing Hennepin Island Plant. To date, there has been no conflict of interest between MSP and the St. Anthony Falls Hydraulic Laboratory over water use: run-of-the-river supply has been adequate for both concerns. However, full development of the river's hydropower potential could restrict the Laboratory's water use to 40 cfs; the amount guaranteed under legal mill rights. Since the Laboratory can easily use upwards of 300 cfs for many studies, such a restriction could virtually eliminate the St. Anthony Falls Hydraulic Laboratory's competitive edge in terms of research. Presently, we are one of the few institutions having a hydropower educational and research program in the United States. It would be unfortunate if a hydropower project was instrumental in hampering our hydropower research and educational program. We would like to ask that consideration be given to our needs for up to 300 cfs flow for research purposes. It should also be pointed out that the favored development scheme involves construction in which equipment must move across the Laboratory area. Any construction traffic passing over land to Wasteway No. 2 must drive over the Laboratory's Sediment Laboratory and Supply Channel roofs. From an aerial view, this roof appears as a parking lot at the entrance of the Laboratory. However, this parking lot/roof is a reinforced concrete slab with a 15 ton load limit. Stone and Webster has incorporated this restriction in their report to

1.

2.

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ST. ANTHONY FALLS HYDROPOWER
CORPS RESPONSE TO UNIVERSITY OF MINNESOTA
ST. ANTHONY FALLS HYDRAULIC LABORATORY
February 1, 1984

1. Use of excess water for added hydropower development at Upper St. Anthony Falls would be subject to prior rights such as those held by Northern States Power Company and the St. Anthony Falls Hydraulic Laboratory. Laboratory personnel advised us earlier in the study that their average water use was 20 to 30 cfs daily, although the laboratory capability was as high as 300 cfs. The 20 to 30 cfs rate was determined to be inconsequential to the hydro development flow analysis. It is our further understanding that the 300 cfs rate was used only once during a 2 or 3 month period on an 8-hour day basis. Again, the added hydropower development would be subject to this use, if it is determined to be an established prior water right that must be honored.

Northern States Power Co., and acknowledgement of this fact was noted in the reviewed subject document. I only make reference to this point since it should be emphasized that catastrophic damage could result due to negligence of this fact.

2. (cont.)

On a positive note, I am enclosing two architectural renderings that we made some time ago in which we had invisioned utilizing the space occupied by Wasteway No. 2 for expansion of our existing experimental laboratory. Dual use of the area could certainly be made. I think that you will note that the proposed underground building with a park on the roof would fit very nicely into the general scheme of development of the river front and would minimize public concern over additional development in this area. We had originally invisioned that our experimental laboratory could be combined with additional hydropower development. The only difference being that intakes to penstocks would be in place at the existing waste way control gates, thereby eliminating the proposed headrace canal. Should this proposed development proceed more seriously, I would like to have the opportunity to discuss this with you further.

3.

Also, for your review I am enclosing a Christmas card that I received from one of my colleagues at the Bavarian Hydraulic Laboratory. The reason I am enclosing this is that the photograph is actually of a working hydraulic model of a proposed hydropower scheme. The weirs shown in the photograph are very old, being one of the oldest hydraulic structures in Europe. Therefore, there was considerable public opposition to any development of hydropower in this area. Thus, a very detailed architectural rendering of the entire development had to be incorporated into the hydraulic model which was visited by public officials on numerous occasions. This is a classic example of good public relations.

In summary, this letter simply points out our concerns regarding hydropower development in the St. Anthony Falls area, which are basically that of our needs for water for research and our concerns for the structural integrity of the Laboratory during the construction period. I also feel that the architectural rendering does illustrate how careful integration of the plant into its surroundings could result in a facility which we all could be proud of.

Please do not hesitate to call on me if you have any further questions.

Very truly yours,

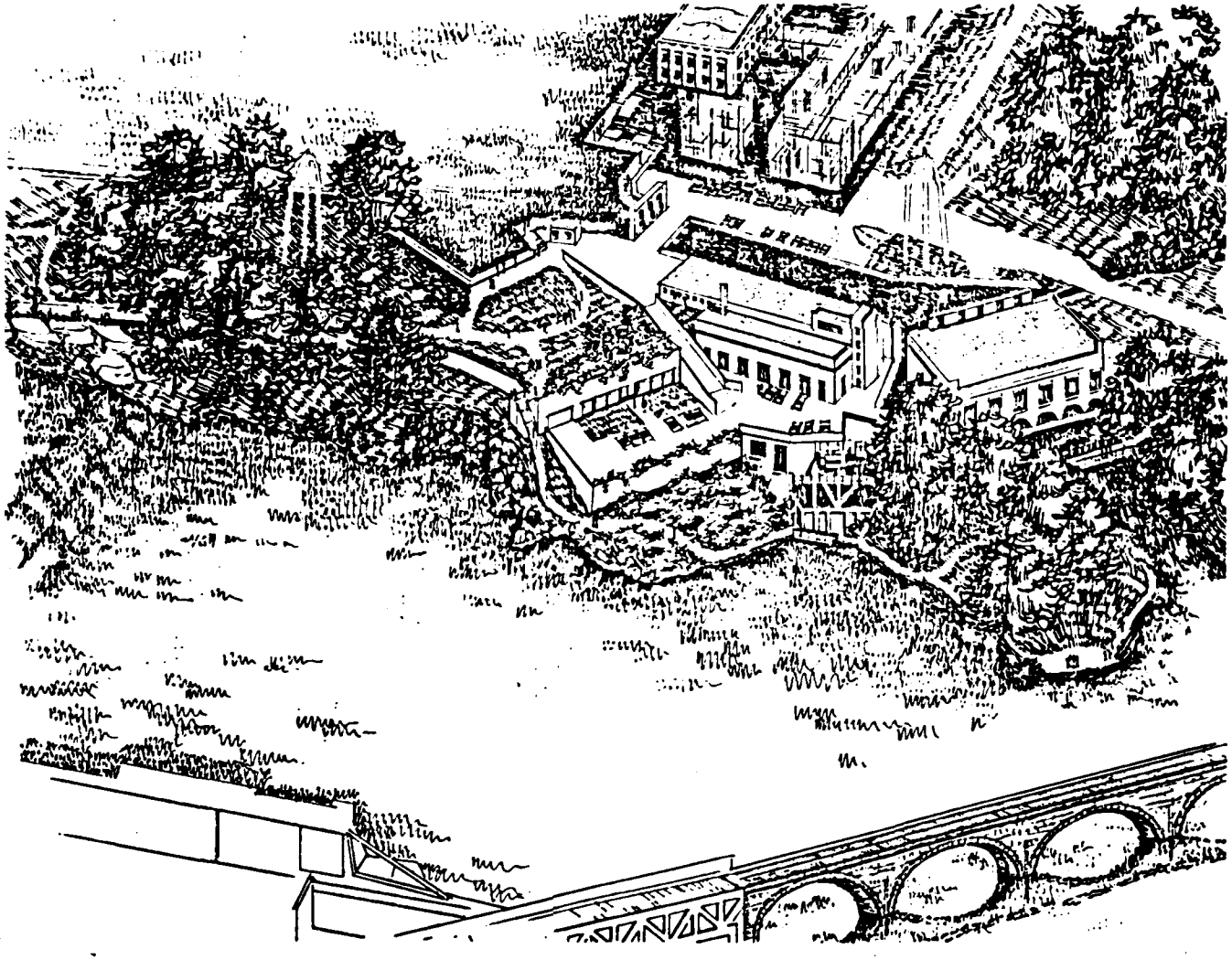
Roger E. A. Arndt
Director

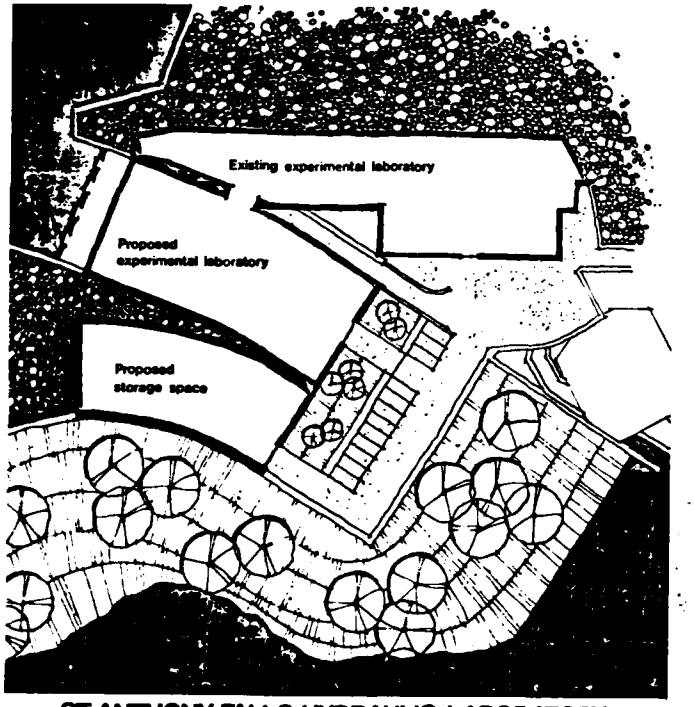
REAA: jb

Enclosures

2. The 15-ton load limit on the parking lot/roof would be observed during construction and operation of the proposed hydro plant. Heavier items would be brought in by barge.

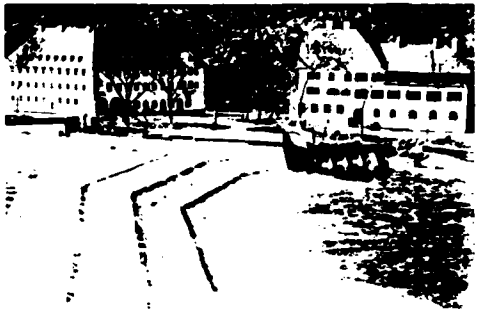
3. The concept of penstocks in place of an open-channel inlet canal could be considered in the design phase, if expansion plans for the experimental laboratory ever become a reality. We understand that there are no current plans for such an expansion, which would, of necessity, involve Northern States Power Company and land ownership.





ST ANTHONY FALLS HYDRAULIC LABORATORY
University of Minnesota

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ERNEUERUNG DES TECHNISCHEN INSTITUTS IN LANDSHUT
GEPLANTE WASSERKRAFTANLAGE AM EINLAUF DES TUNNELS
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JAHR 1984

TECHNISCHE UNIVERSITAET MUENCHEN
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FUER WASSERBAU
UND WASSERWIRTSCHAFT
OSKAR VON MILLER INSTITUT

HUBLIND FRANZ KNAUSS GUENTHER

EXHIBIT B

CULTURAL RESOURCES COORDINATION

ENVIRONMENTAL ASSESSMENT

ST. ANTHONY FALLS HYDROPOWER

MINNEAPOLIS, MINNESOTA

EXHIBIT B

CULTURAL RESOURCES COORDINATION

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MINNESOTA HISTORICAL SOCIETY
FOUNDED IN 1849
690 Cedar Street, St. Paul, Minnesota 55101 • (612) 296-6126

23 November 1982

Mr. Wayne A. Knott
Chief, Environmental Resources Branch
Planning Division
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: NCSPD-ER
Alternatives for hydropower development at Upper and Lower St. Anthony Falls Locks and Dams.

MHS Referral File Number: 0-573
(PLEASE REFER TO THIS NUMBER IN ALL FUTURE CORRESPONDENCE)

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council of Historic Preservation (36CFR800).

The project is located in part within the boundaries of the St. Anthony Falls Historic District, and in the vicinity of the Pillsbury "A" Mill, a National Historic Landmark.

Additional information from John Anfinson of your office has indicated that the only feasible alternatives (as determined by the Corps of Engineers staff) are 5U, 8U(d), and 2L. Our comments are therefore directed only to those alternatives. Utilizing the plan of March 1982 showing alternative plans for the Hydropower Feasibility Study and the descriptions on the enclosure in your 18 August 1982 letter we have the following comments:

Alternative 5U -- the current concrete spillway appears to have relatively little historic value in the early development of the St. Anthony Falls area. However, we would like to review the detailed plans for the new spillway to assess any visual impact it might have on the district as a whole.

Alternative 8U(d) -- the installation of a canal (presumably under Main Street) will undoubtedly have a significant impact on buried components (intakes and tail races, vaults, etc.) associated with the Pillsbury "A" and with the other milling operations constructed along this street. These portions of the "A" Mill are extremely important components of this landmark milling facility. Therefore, before we can comment on the effect of the project on this area, additional information as to the configuration of the mill components under the street and the impact of the canal on these components must be considered. Additionally, Main Street itself is in part surfaced as originally constructed, and there may be an impact on this significant component of the district.

Alternative 2L -- this alternative indicates an addition to the existing hydroelectric station. This building, while not within the boundaries of the St. Anthony Falls Historic District, is potentially eligible for inclusion in the District. We recommend that the building itself be used again as the hydro plant since it is now vacant. Any plans and specifications relative to work on or additions to the lower hydro station should be submitted to the SHPO office for review and determination of effect. An addition to the structure would impair its integrity.

In summary, before we can make an appropriate Determination of Effect for the proposed project, we will need more information on the existing historical components of the district as well as on the project itself. We should emphasize that St. Anthony Falls Historic District as a whole is, historically, an extremely important area, and the National Landmark Status of the Pillsbury "A" make it an especially sensitive structure.

If you have any questions, please contact Robert Clouse, Head Archaeologist, or Dennis Gimmestad, Acting Assistant State Historic Preservation Officer, Minnesota Historical Society, Fort Snelling History Center, St. Paul, MN 55111.

Sincerely,

Dennis A. Gimmestad

for Russell W. Fridley
State Historic Preservation Officer

MINNESOTA HISTORICAL SOCIETY

FOUNDED IN 1849 690 Cedar Street St. Paul Minnesota 55101 • (612) 296-6126

20 June 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Planning Environmental Resources
Hydropower development at Upper and
Lower St. Anthony Falls Locks and Dams.

MHS Referral File Number: O-573
(PLEASE REFER TO THIS NUMBER IN
ALL FUTURE CORRESPONDENCE)

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council of Historic Preservation (36CFR800).

Based upon consideration of the physical and historical natures of the Upper and Lower Falls sites, the State Historic Preservation Office concurs with the findings of the May 1983 Technical Report that both sites are feasible and appropriate for the construction of a new hydro-electric plant. Each site offers opportunity to construct a compatible-use facility which would be economically beneficial while at the same time fitting into the significant historical association of St. Anthony Falls with the production of hydro-power.

The Upper Falls site would occupy an abandoned spillway located at mid-river, observable from the Third Avenue Bridge as well as from both the East and West Banks of the St. Anthony Falls Historic District. The existing spillway establishes precedent for artifical diversion of the river in this area. Further, similar man-made diversions exist in the present Hydro-electric Station and in the Hydrology Laboratory immediately adjacent to the spillway. The SHPO concurs that the optimum location for an additional hydro-electric facility from a technical and associative standpoint would be in this spillway. Design of the new facility would require serious consideration in order to respect the historic environment. The above-grade portion of the structure should be of low profile and attempt to echo the character of the district in use of facing materials and design motifs.

The proposed Lower Falls site likewide has long-time association with hydro-power. Although presently under-utilized, the existing structure at this site is a building of distinctive architectural design, and while not included within the St. Anthony Falls Historic District, appears to be eligible for listing in the National Register of Historic Places under both architectural and historical criteria. The construction of a new hydro-electric facility continguous with this structure is appropriate provided this construction would respect the design of the historic building.

In either of the above mentioned sites, it is imperative that the SHPO be an active participant in all subsequent reviews relative to design as it affects the historical environment of the St. Anthony Falls District.

If you have any questions regarding our review of this area, please contact Charles Nelson, Historical Architect, Minnesota Historical Society, Fort Snelling History Center, St. Paul, MN 55111.

Again, thank you for your participation in this important effort to preserve Minnesota's heritage.

Sincerely,

Dennis A Gimmestad

for Russell W. Fridley
State Historic Preservation Officer

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

September 28, 1983

Planning
Environmental Resources

Mr. Russell Fridley
State Historic Preservation Officer
Minnesota Historical Society
Fort Snelling Historical Center
St. Paul, Minnesota 55111

Dear Mr. Fridley:

Hydropower development at St. Anthony Falls raises a number of questions regarding historic preservation. The Minnesota State Historic Preservation Officer has resolved two of these questions (20 June 1983 letter, MHS File No. 0-573) finding the proposed project both feasible and appropriate for the St. Anthony Falls National Register Historic District - provided that the construction design adheres to the historical context of the Historic District. One important question has yet to be resolved, however: how will significantly reducing the amount of water flowing over St. Anthony Falls and the frequency of times during which it would flow would affect the character of the Historic District.

Adding the new hydropower plant at St. Anthony Falls would reduce the amount, duration and frequency of water flow over the Falls. The existing Northern States Power plant runs wide-open using 3,800 cubic feet of water per second (cfs); any water in excess of this amount flows over the Falls. According to the water flow measurements at the Anoka gauge between 1931 and 1980, more than 3,800 cfs occurred at St. Anthony Falls 5 of the 12 months for 75 per cent of the years examined, 10 of 12 months for approximately 60 per cent of the years examined and for all 12 months for 48 per cent of the years examined. (See Table 1) With the addition of the new hydropower plant, which would require up to 6,200 cfs for a total of 10,000 cfs when combined with the existing plant, one of 12 months would have yielded flowage over the Falls in 75 per cent of the years (April) 3 of 12 months for 50 per cent of the years and 8 of 12 months for less than 30 per cent of the years (see Table 1).

A second consideration of water flow at St. Anthony Falls is how much water is required to maintain the historical environment - if water over the Falls is regarded as important. Photo #1 shows the Falls with approximately 2,600 cfs, photo #2 shows the Falls with approximately

2,289 cfs and photo #3 shows the Falls with approximately 1840 cfs flowing over the Falls (based on readings at the Anoka guage subtracting 3,800 cfs). (Slides of these photos are being processed and will be mailed to your office as soon as they are ready.)

In order to determine how the Corps of Engineers can best carry out its responsibility to cultural resources we would like the Minnesota State Historic Preservation Officer's opinion as to the impact of redirecting water from St. Anthony Falls to a new hydropower station. In order to maintain our current schedule and to know the SHPO's position before our 18 October 1983 Public Meeting, we request your input by 17 October 1983. If a written response is not feasible in this time a verbal response will suffice in the interim. If you have any questions, please call John Anfinson of my staff at 725-7632.

Sincerely,

Enclosures

Robbin Blackman
Acting Chief
Environmental Resources

MINNESOTA HISTORICAL SOCIETY
FOUNDED IN 1849
690 Cedar Street St. Paul, Minnesota 55101 • 612 296-6126

21 November 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Hydropower development at Upper and Lower St. Anthony Falls Locks and Dams.

MHS Referral File Number: O-573
(PLEASE REFER TO THIS NUMBER IN ALL FUTURE CORRESPONDENCE)

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council of Historic Preservation (36CFR800).

The question that must be addressed by the State Historic Preservation Office is whether the nearly total diversion of water by the hydropower scheme proposed in the draft feasibility report and environmental assessment for hydropower at St. Anthony Falls constitutes adverse effect on the quality of the historical, architectural, archaeological, cultural, or engineering characteristics that qualify the existing horseshoe dam and upper spillway and the district as a whole for listing on the National Register of Historic Places.

The existing "Falls" is actually a complex of artificial structures including the horseshoe dam, upper spillway, several raceways, a navigational lock and lower dam, and associated power houses, all of which were built between the late 19th century and 1960. These structures are the last in a long series of engineering triumphs and debacles begun in the mid-1800s to impound the Mississippi's flow and divert it through mill wheels and turbines for the purposes of industry.

Examined in this light, it is the opinion of the SHPO that to again utilize water impounded by the existing dams is consistent with the structures' original purposes and the district's history, and therefore does not constitute an adverse effect.

The proposal described in the draft feasibility report will result in the complete cessation of flow over the horseshoe dam and spillway for most of the year. This also appears to be consistent with the district's industrial history. During the period of maximum hydropower use at the turn of the century, it is likely that nearly all the river's flow was being diverted through canals and headraces to power turbines. That the flow was chronically inadequate is well documented in Lucile Kane's The Waterfall That Built a City (especially Chapter 8, "Stretching the Power"). By the 1880s mill owners added steam engines to provide power during periods of low water. Although information directly bearing on this question is not available, it appears quite likely that the spillways were dry for much of the year.

However, this condition is inconsistent with the other major association of the falls as a natural waterfalls. The modern horseshoe dam and upper spillway are the direct successors of the historic natural Falls of St. Anthony, and remain as representative of the natural falls in the public's mind. The spectacle of water flowing over the falls (or, now, running down the spillway) is one that the public has come to expect. Viewing the modern structures as successors to the natural falls, we believe that to completely eliminate the flow of water over the spillway except during very high water would constitute an adverse effect on the historic district.

In summary, we conclude that diverting water from the spillway to generate additional hydroelectric power will have no adverse effect, so long as some flow over the spillway is maintained.

Historically, the falls and their use have changed continuously. The city of Minneapolis, Corps of Engineers, private developers, and other interested parties must review and balance the many sometimes competing uses for the Falls in the context of present and future needs. We support this process and urge that a thorough public discussion of the issues be completed before final decisions are made.

Sincerely,

Russell W. Fridley

Russell W. Fridley
State Historic Preservation Officer

MINNESOTA HISTORICAL SOCIETY
FOUNDED IN 1849
690 Cedar Street, St. Paul, Minnesota 55101 • (612) 296-6126

22 December 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Hydropower development at Upper and Lower St. Anthony Falls Locks and Dams

MHS Referral File Number: O-573

You have requested that we review five alternatives for providing a roughened surface for the spillway at St. Anthony Falls.

Of the five alternatives you have submitted to us, the corrigated concrete spillway (alternate #2) is the most preferable. This treatment provides a uniform appearance over the entire spillway and is minimally visible during dry periods.

Alternative #4, the locating of boulders on the spillway, would, in our opinion, constitute an adverse effect on the St. Anthony Falls Historic District by creating an image with no historic precedent. Alternatives #1 and #3 are undesirable primarily due to their checkerboard appearance. We believe that we have insufficient information to comment on the effects of alternative #5.

We expect to review further information on this action before issuing a final opinion of effect. If you have questions on our review, please contact Ted Lofstrom, Environmental Assessment Officer, Fort Snelling History Center, St. Paul, Minnesota 55111.

Sincerely,

Russell W. Fridley
State Historic Preservation Officer

Advisory
Council On
Historic
Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

JAN 9 1984

Mr. Wayne A. Knott
Chief, Environmental Resources Branch
Planning Division
St. Paul District
Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, MN 55101

On December 19, 1983 we received your letter seeking the comments of the Council on your finding of no adverse effect for the development of hydropower at Upper St. Anthony Falls in Minneapolis, Minnesota. The Corps has identified effects of two kinds that will result from this project. First, the project entails construction of a structure to house the hydroelectric facility. As proposed this structure would be located within the St. Anthony Falls Historic District. Secondly, the project will divert a large amount of water, possibly up to 6,200 cubic feet per second (cfs) from the Falls themselves.

Your letter reports that concerning the first issue the Corps and the Minnesota State Historic Preservation Officer (SHPO), have agreed that introducing a structure is acceptable, provided it is designed to be compatible with the general historic environment of the area. In light of the history of industrial use of the Falls, documented by the material accompanying your letter, we agree with this approach, but note that your proposal does not contain specific provisions to ensure such compatibility. We believe that provisions should be explicitly set out and should include participation by the Minnesota SHPO, as he suggested, and Council review of the proposed design.

In addressing the diversion of water from St. Anthony Falls, you also report a basic consensus between the Corps and the Minnesota SHPO. In response to the Minnesota SHPO's recommendation that some water flow be maintained at the Falls, the Corps has proposed diverting 350 cfs from the capacity of the proposed hydroelectric facility to the Falls. This will ensure flow over the Falls of 350 cfs when water in the river is between 3,800 cfs, when all water might be diverted and used by owners of pre-existing rights, and 10,000 cfs, when the proposed hydroelectric facility would be operating at full capacity. In reviewing this proposal, however, we find there is insufficient information for us to respond.

Your letter does not explain how the Corps reached the conclusion that a flow of 350 cfs would avoid adverse effects to the historic attributes of the Falls. In addition, while your letter describes this amount of water, it provides no photographs of its appearance. From the chart showing historic flows, it appears that flows as low as 350 cfs occasionally occur. If any photographs showing such a level of flow are available, they would assist our evaluation.

Your letter also does not report the Minnesota SHPO's evaluation of the proposed flow of 350 cfs. While the Minnesota SHPO has recommended that water flow be maintained, there is no indication that he agrees that 350 cfs is sufficient. You should consult with the Minnesota SHPO as well as the Council on this matter.

Finally, you asked our comment on "rustication" of the lower roll dam to cause turbulence, enhancing the appearance of water flow. While we believe this measure has merit, we are unable to comment upon the specific alternatives you outline. Again, if more detailed information is available, such as photographs of the Prairie Portage Dam, here you indicate rustication has been installed, this would aid our consideration.

As you know, a considerable amount of public interest has been generated by the effects of the proposed hydroelectric facility. Because of the level of public concern and the historical importance of the St. Anthony Falls Historic District, we believe a meeting to consider your proposals would be appropriate. It would also be useful to present your recommendations of maintaining a water flow of 350 cfs and rusticating the lower roll dam to interested parties. We will be in contact with your office to discuss this matter further.

If we can be of any assistance, please contact Michael Quinn at (202) 786-0505. Thank you for your consideration in this matter.

Sincerely,

Jon L. Klima
Chief, Eastern Division
of Project Review

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

[illegible] 2 1984

Mr. Wayne A. Knott
Chief
Environmental Resources Branch
Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, MN 55101

Dear Mr. Knott:

Thank you for your letter of January 16, 1984, supplying additional information concerning the proposed hydropower facility at St. Anthony Falls in Minneapolis, Minnesota. We appreciate your prompt response on this matter.

After reviewing this information, we are pleased to find that it supplies much of the information we had requested. As we have confirmed in our discussions with Mr. Dave Berwick of your office, Mike Quinn of the Council will participate in the public meeting now scheduled for February 14, 1984 in Minneapolis. As we suggested in our earlier letter, the proposals for maintaining water flow and rusticating the surface of the dams will be presented at this meeting for public review. We believe this meeting will be very useful in our consideration of the impacts of the project.

We appreciate your cooperation and look forward to meeting with your staff on the 14th.

Sincerely,

Don L. Klima
Chief, Eastern Division
of Project Review

MINNESOTA HISTORICAL SOCIETY
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31 January 1984

Mr. Wayne A. Knott
Chief, Environmental Resources
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Environmental Resources Branch
Planning Division
Alternative to modifications of the
horseshoe dam at Upper St. Anthony Falls
for proposed hydropower development

MHS Referral File Number: O-573
(PLEASE REFER TO THIS NUMBER IN
ALL FUTURE CORRESPONDENCE)

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council of Historic Preservation (36CFR800).

This letter is in response to your questions regarding the effect of "Alternative 2" on the spillway and on proposed modifications to the horseshoe dam. These questions were contained in your letters of January 5 and 19, 1984.

"Alternative 2" is the proposal to enhance the appearance of water flowing over the spillway by applying a horizontally ribbed concrete overlay over the entire surface of the spillway. In as much as the spillway surface itself is recent, the overlay will not affect the integrity of the existing structure, and the treatment is even and unobtrusive when dry, we conclude that "Alternative 2" will have no effect on the historic qualities of the St. Anthony Historic District.

You also made two proposals in your January 5 letter to enhance the appearance of water flow over the Horseshow Dam. You substituted the concrete overlay proposal in the January 19 letter. We conclude that this treatment will have no effect on the Horseshoe Dam for the same reasons we cited for the spillway.

Again, thank you for your participation in this important effort to preserve Minnesota's heritage.

Sincerely,

for Russell W. Fridley
State Historic Preservation Officer

cc: David Berwick

DISPOSITION FORM

For use of this form, see AR 340-15; the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NCSPD-PF	Information Workshop on Hydropower Proposal, St. Anthony Falls, 14 February 1984

TO MEMO FOR RECORD FROM NCSPD-PF DATE 15 February 1984 CMT 1
Mr. Stephan/lp/7472

1. The subject workshop was conducted at the University of Minnesota's Earle Brown Continuing Education Center. The workshop was designed to present the revised Corps of Engineers proposal to add hydropower to Upper and Lower St. Anthony Falls, Minneapolis, Minnesota.

2. The Corps proposal provides for adding 21.0 megawatts of capacity at Upper and 5.4 megawatts at Lower St. Anthony Falls. The proposal also provides for a minimum 700 cfs release over the horseshoe and main upper falls spillways whenever the added power units are generating. The proposal provides for modification of the main upper falls spillway and the horseshoe spillway to give the appearance of greater flow.

3. Comments received at the workshop on the Corps proposal are summarized as follows:

a. City of Minneapolis - Letter and resolution signed by the Mayor and the City Council President, dated 14 February 1984, (inclosure 1).

b. State Historic Preservation Officer (SHPO), Russell Fridley - Stated that the SHPO believed the Corps had made the "right decision" in revising the draft plan to incorporate and accommodate aesthetics for the falls area. SHPO supports the currently recommended plan.

c. Advisory Council on Historic Preservation, Mike Quinn - expressed approval of the Corps proposal.

d. Minnesota Department of Transportation, Andrew Golfis - approved of Corps proposal.

e. Minneapolis City Planning, John Berg - Concurs with Minneapolis City Council resolution.

f. Minneapolis Park Board, Robert Mattson - Concurred with the Corps proposal. Mr. Mattson also wants continued dialogue with the Corps of Engineers and Northern States Power Company. The Park Board is interested in improving aesthetics during the dry years also. The Park Board is interested in opening up the Old Mill Canal on the West Bank, with 25 to 50 cfs flow, and a museum.

g. Northern States Power Company (NSP), Steve Caskey - NSP is still interested in developing the added power, but no final decision has been made. NSP wants to look further at power development with their own analysis.

DA FORM AUG 80 2496 PREVIOUS EDITIONS WILL BE USED *U.S.G.P.O. 1982—386-546

MEMO FOR RECORD 15 February 1984
SUBJECT: Information Workshop on Hydropower Proposal, St. Anthony Falls, 14 February 1984

h. Minneapolis Downtown Council, Henry Kingman - Will recommend that the Downtown Council support the city of Minneapolis resolution of 14 February 1984.

i. City Planning, Gordon Wagner - Cautioned that the city of Minneapolis and the public should be vigilant that the FERC does not approve a maximum hydropower development proposal by some other non-Federal developer.

j. Citizen, John Helmeke - Supported returning St. Anthony Falls to its pre-1835 pristine condition.

4. SUMMARY: support for the Corps recommended hydropower plan, presented at the 14 February 1984 workshop, was confirmed by everyone who spoke, except for one individual.

Carl W. Stephan

1 Incl
as

CARL W. STEPHAN
Project Manager
Plan Formulation Branch
Planning Division

minneapolis

city of lakes

MAYOR DONALD M. FRASER

February 14, 1984

Edward G. Rapp, Colonel
Corps of Engineers
St. Paul District

Dear Colonel Rapp:

Since you presented your revised proposal for hydropower development at the St. Anthony Falls to the Mayor and members of the Council last Friday, the Energy and Technology Committee and Intergovernmental Relations Committee of the Minneapolis City Council have met and considered the attached resolution supporting the proposal.

As stated in the resolution, the City of Minneapolis is interested in pursuing consideration of licensed production of hydropower and in working on a landscaping design for the Central Riverfront adjacent to the Falls in order to maximize pedestrian use and enjoyment.

Please keep us informed as your proposal moves through the steps of public review.

Thank you for your efforts to address our initial concerns and for your presentations to Minneapolis policymakers and staff.

Sincerely,

Alice W. Rainville
President, City Council

Donald M. Fraser
Mayor

cc: Members of the City Council
Members of the Parks and Recreation Board
Members of the Historic Preservation Commission

DMF: jh



February 14, 1984

RESOLUTION

CITY OF MINNEAPOLIS

Regarding Hydropower Development

at St. Anthony Falls

WHEREAS, the U.S. Corps of Engineers presented a drafted plan in September 1983 for development of hydropower at St. Anthony Falls which appeared to threaten the beauty of the only major falls on the Mississippi River by diverting water and drying up the falls; and

WHEREAS, the Corps of Engineers has now presented a revised plan which will maintain a minimum 700 cubic feet per second flow of water over the falls and will, in addition, rusticate the spillways to enhance the sight and sound of falling water; and

WHEREAS, the revised proposal from the Corps of Engineers still provides for adding 21.0 megawatts of electrical generating capacity at the Upper and 5.4 megawatts of capacity at the Lower St. Anthony Falls, thus stimulating safe and economical energy and economic development;

NOW THEREFORE, the City Council and Mayor of Minneapolis:

1) Express support for the U.S. Corps of Engineers' proposal to develop hydropower at the Upper and Lower St. Anthony Falls;

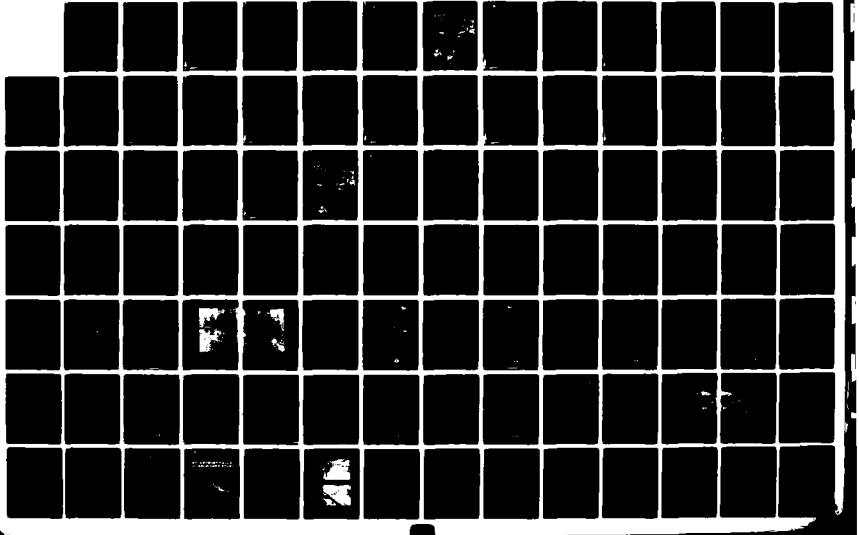
2) Express interest in coordinating with NSP in becoming the FERC licensee for electrical energy produced through implementation of this proposal; and

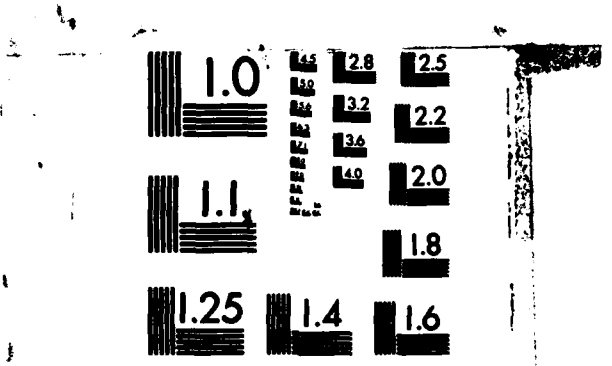
3) State the importance of City participation in the final design of the project in order to maximize the scenic vista of the falls and pedestrian enjoyment of the riverfront adjacent to the falls;

FURTHERMORE, the City Council and Mayor of Minneapolis express appreciation for the efforts of the U.S. Corps of Engineers in adapting the plan for hydropower development to take account of the aesthetic and historic preservation concerns of Minneapolis citizens.

AD-A140 262 FEASIBILITY REPORT FOR HYDROPOWER ST ANTHONY FALLS LOCKS AND DAMS MISSISSIPPI RIVER MINNEAPOLIS MINNESOTA (U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT

UNCLASSIFIED FEB 84 F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

FEB 22 1984

Colonel Edward G. Rapp
Corps of Engineers
District Engineer
1135 U.S. Post Office
and Custom House
St. Paul, MN 55101

Dear Colonel Rapp:

This is in response to your request for comments concerning the proposed hydropower development at St. Anthony Falls in Minneapolis, Minnesota. The information you have provided, as well as the discussions with your staff, and our participation in the public workshop on February 14, 1984, have been extremely helpful in our review. We are in basic agreement with your finding that the project, as presently proposed, will have no adverse effect on the historic attributes of the St. Anthony Falls Historic District. However, there are certain concerns, primarily dealing with future consultation on design issues, that we believe need to be explicitly addressed in the finding on this project. To provide for these, as well as to reiterate your proposal, we will concur with your finding of no adverse effect subject to the following conditions:

1. The building housing the hydroelectric generators will be located in the area of Wasteways No. 1 and No. 2, as shown generally in the Conceptual View, Upper St. Anthony Falls, of August 1983, prepared by the Corps. Final plans for the location and design of the powerhouse will be developed in consultation with the Minnesota State Historic Preservation Officer (SHPO) and submitted to the SHPO for approval.

2. Rules governing the hydropower facility will require that a flow of 700 cubic feet per second be maintained over the dam structures while the faclity is in operation.

3. The surface of the horseshoe and lower roll dams will be roughened or "rusticated" to enhance the appearance of water flow. The design of the rustification will be developed in consultation with the Minnesota SHPO and submitted to the SHPO for approval.

If you agree with these conditions, please sign on the concurrence line below, return this letter to us, and also send a copy to the Minnesota SHPO. These will then be incorporated into your determination and compliance with Section 106 of the National Historic Preservation Act and the Council's regulations will be complete.

We appreciate your cooperation in this matter and the consideration that has been afforded the historic properties involved.

Sincerely,

Don L. Klima
Chief, Eastern Division
of Project Review

Concurrence: February 24, 1984

I concur in principal with the above conditions as they relate to the St. Paul District's compliance with Section 106 for our feasibility study. These condition are incorporated into the recommendations which I will be forwarding to higher authority.

My recommendations support these conditions in a manner consistant with the formulation of a feasibility study. Should the Corps continue its involvement in the hydropower development at St. Anthony Falls, future studies may indicate that these specific recommendations are no longer feasible. At that point, these recommendations would be used as a basis for formulating a new set of recommendations that would preserve the historic-aesthetic values of the area and maintain the finding of no significant impact.

Edward G. Rapp
Colonel, Corps of Engineers
District Engineers

EXHIBIT C

FISH AND WILDLIFE COORDINATION ACT

ENVIRONMENTAL ASSESSMENT
ST. ANTHONY FALLS HYDROPOWER
MINNEAPOLIS, MINNESOTA

EXHIBIT C
FISH AND WILDLIFE COORDINATION ACT

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United States Department of the Interior

IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
St. Paul Field Office, Ecological Services
570 Nalpak Building
333 Sibley Street
St. Paul, Minnesota 55101

October 24, 1983

Colonel Edward G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

The U.S. Fish and Wildlife Service has reviewed the draft Feasibility Report, Environmental Assessment and Appendices for hydropower development on the Upper Mississippi River at Upper and Lower St. Anthony Falls in the Twin Cities, Minnesota.

The Service has been involved in this project since early 1981. On July 27, 1983, we submitted a draft Fish and Wildlife Coordination Act (FWCA) Report on the selected alternative for hydropower development at St. Anthony Falls. This report is contained in Appendix E of your above referenced documents. Recommendations contained in the draft FWCA Report were developed in an attempt to avoid, minimize or compensate for possible adverse project-related impacts to fish and wildlife resources in the St. Anthony Falls area. After reviewing the draft Feasibility Report and Environmental Assessment, we have no additional recommendations to offer. This letter and our July 27, 1983, report therefore constitute our final FWCA report for this project.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

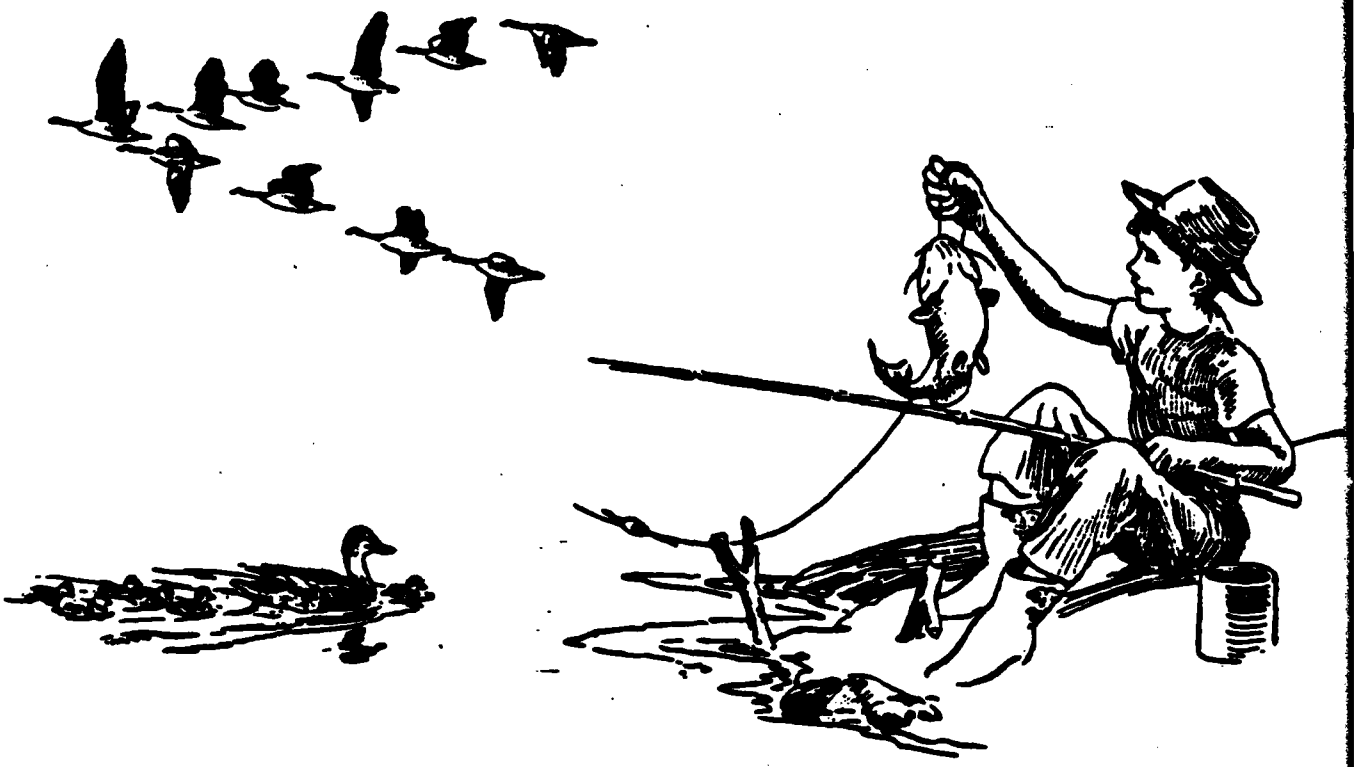
We look forward to working with District personnel on other hydropower projects proposed for development on the Upper Mississippi River.

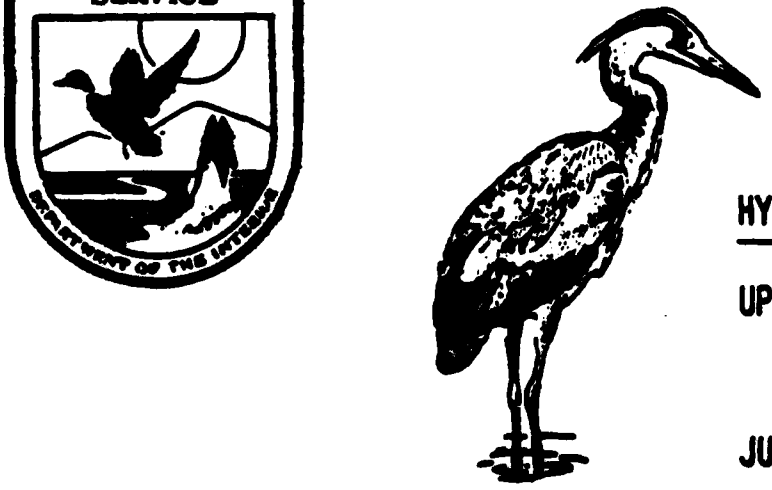
Sincerely,

Robert F. Welford
Field Office Supervisor

cc: MN DNR, St. Paul
MN PCA, Roseville
US EPA, Chicago

DRAFT: FISH AND WILDLIFE COORDINATION ACT REPORT





HYDROPOWER DEVELOPMENT:

UPPER MISSISSIPPI RIVER
ST. ANTHONY FALLS

JULY, 1983

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office, Ecological Services
570 Nalpak Building
333 Sibley Street
St. Paul, Minnesota 55101

July 27, 1983

Colonel Edward G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

This is our draft Fish and Wildlife Coordination Act Report for the possible construction of additional hydropower generating facilities at Upper and Lower St. Anthony Falls on the Upper Mississippi River in Minneapolis and St. Paul, Minnesota. This report will address those items listed in our scope of work for FY 1983 and will generally expand on our previous comments on this project contained in our March 3, 1981 and March 25, 1983 Planning Aid Letters.

Existing Fish and Wildlife Resources

The project encompasses the locale known as St. Anthony Falls (SAF) which contains the upper and lower dam areas. The upper dam consists of the Corps of Engineers' Upper St. Anthony Falls (USAF) lock and dam, a horsehoe dam, a limestone and concrete wall (dam), and two utility-owned hydropower plants, one of which is operating. The lower dam area contains the Corps of Engineers' Lower St. Anthony Falls (LSAF) lock and dam, an intermediate dam, and an existing utility-owned hydropower plant.

The area around St. Anthony Falls has been subject to the effects of human settlement since the early 19th century and alterations of the aquatic and terrestrial resources have occurred since then. Today the SAF area is surrounded by urban developments including commercial and light industrial buildings, railroads, and highways.

Fish and wildlife populations are somewhat limited in the SAF pools in comparison to other areas on the Upper Mississippi River primarily because of the lack of shallow water habitat, the relatively small size of the pools, and industrial development along the riverbanks. Although fish populations may be limited in size, recent electrofishing surveys conducted by the Minnesota Department of

Natural Resources show a diverse fishery in the pools, including a high percentage of smallmouth bass, an important sport fish (Table 1).

There is no commercial fishing in the SAF area. However, sport fishing is common in the pools despite the relative lack of quality fishing habitat, (i.e., backwater and shallow water areas) and poor public access to the river. In 1976, a creel census was conducted by the Minnesota Department of Natural Resources from the junction of the Minnesota and Mississippi Rivers to the Coon Rapids Dam (Tureson 1978). Total angling effort from the river between the Ford Dam and St. Anthony Falls was approximately 22.06 man-hours per acre with an estimated harvest of 7.55 pounds per acre. In comparison, total angling effort in Pools 4 and 5 were 10.9 and 12.5 man-hours per acre, respectively, with an estimated harvest of 7.6 and 9.9 pounds per acre, respectively (Daley and Skrypek 1964).

Terrestrial habitat is limited along the SAF pools. Vegetation is primarily confined to landscaping and parkland along the wooded bluffs. Although somewhat scarce, these areas do provide habitat for a variety of non-game species such as songbirds and small mammals. Waterfowl occasionally use areas of the upper pool outside the main channel. Due to firearm restrictions, hunting is prohibited in the SAF area. An inventory of common vegetation, fish, and wildlife which occur within this area of the Upper Mississippi River can be found in the Final Report, Environmental Assessment of the Northern Section of the Upper and Lower St. Anthony Falls, prepared for the St. Paul District Corps of Engineers.

Several federally listed endangered or threatened species have been known to occur in this general area of the Upper Mississippi River. The bald eagle (Haliaeetus leucocephalus), a threatened species, winters on the Upper Mississippi River, concentrating below dams or near the mouths of tributaries where fish provide a ready food supply. Also, the endangered Higgins' eye pearly mussel (Lampsilis higginsi) has been found in portions of the Mississippi and Minnesota Rivers. Historically, the endangered peregrine falcon (Falco peregrimus) has also been known to occur in this general area. Comments on endangered or threatened species have been provided under separate cover (Appendix A).

Future Setting

Fish and wildlife resources in the SAF area have already been affected by the extensive industrial and commercial development of the downtown Upper Mississippi River corridor. In general, remaining habitats are either under public ownership as parkland or under the regulatory jurisdiction of local, state, or federal agencies.

Aquatic resources may actually improve in future years with the growing demand for urban-oriented recreation and the efforts of public and private sectors to "clean up" the river. Future improvements in water quality will ultimately improve both fishery resources and recreational opportunities.

Planning Recommendations

Our March 25, 1983 Planning Aid Letter provided several recommendations to avoid, minimize, and compensate for project-related losses to fish and wildlife resources. Our primary recommendation was the selection of Alternative A as the final plan for hydropower development at St. Anthony Falls. In your June 6, 1983 response to our Planning Aid Letter, we were pleased to learn that the St. Paul District had selected that alternative. Our Planning Aid Letter also provided other recommendations. After reviewing the District's responses to these recommendations and accompanying information, the following comments and recommendations are provided for your consideration in developing final plans for the St. Anthony Falls hydropower project. Service recommendations noted below were initially provided on Pages 3-7 in our March 25, 1983 Planning Aid Letter. Responses to these recommendations from the St. Paul District are contained in the District's June 6, 1983 letter (Appendix B).

1. Service Recommendation: "To assess potential impacts, information is needed from the St. Paul District concerning the anticipated diversion of flows presently going over the falls which will be used for additional hydropower generation. The information should include a comparison of normal flows and with-project flows. In general, we would recommend that such flows deviate as little as possible from existing conditions. If oxygen levels below SAF are depressed as a result of flow diversion, reaeration of flows passing through the turbines may be necessary."

   District Response: "The information you requested is enclosed. Flow deviations would be limited to those necessary to supply the added turbines. The combined alternative would have substantially reduced the flow into the lower falls pool and will not be recommended, at least in part, because of the flow deviation. Oxygen levels meet water quality standards more than 93 percent of the time in the metropolitan area above lock and dam 1. It is not anticipated that dissolved oxygen levels would be significantly depressed as a result of diversion. Turbulent flows in the tailraces would offset some of the decrease resulting from diversion."

Comment: We have reviewed the information provided. Our concern over flow diversion and oxygen levels below St. Anthony Falls is lessened with the District's selection of Alternative A. Alternative B would have diverted flows out of the lower pool. Under Alternative A, flows diverted for hydropower generation will be discharged in the downstream vicinity of the falls. In the unlikely event that oxygen levels are substantially reduced as a result of hydropower generation, turbine design should take into account the possible need for aeration devices in the future.

2. Service Recommendation: "As identified in the Reconnaissance Report, existing hydropower generation at SAF utilizes a limited storage-and-release mode of operation. To avoid and minimize additional adverse impacts to fish and wildlife resources, operation of the proposed hydropower facilities should be within these existing constraints with no additional storage-and-release of flows beyond existing conditions."

District Response: "It was recognized in the Reconnaissance Report for SAF that, because of potential adverse impacts resulting from pool fluctuations, operation of any additional hydropower must be confined to existing operating limits."

Comment: We are pleased to note that the proposed turbines would be operated within existing limits.

3. Service Recommendation: "Small trash racks or large screens should be placed in front of the intake area to prevent passage of larger fish. Screening devices should be considered to minimize entrainment losses. To minimize fishery impacts, the approach area should be devoid of lights and structural projections which would attract fish into the intake area. Recommended approach velocities for intakes at major powerplants is 0.5 feet per second or less to allow fish to escape. Approach velocities at this site should be as low as possible." a. b.

"Although study results are variable, we would recommend use of horizontal Kaplan-type turbines with adjustable blades as proposed. To minimize fish mortality, turbines should be operated at maximum efficiency. Cavitation should be minimized and large clearances provided between the vanes of the runners and between runners and wicket gates." c.

"We recommend that studies be conducted by the Corps of Engineers to determine the potential for turbine-related impacts to fishery resources on the Upper Mississippi River, including hydropower proposed at St. Anthony Falls. In 1980, an ichthyoplankton study was conducted for the Northern States Power Riverside Plant upstream of St. Anthony Falls at River Mile 857 (Heberling et al. 1981). The study found a variety of species and larval stages in the drift including a sizable number of channel catfish, an important sport fish. Projecting these data by simple proportion, an estimated 5.5 million channel catfish larvae may have drifted past this facility over the summer period. d.

"It is unfortunate that no information exists concerning an assessment of turbine-related mortality of fish from the existing hydropower facilities at SAF. To illustrate our concern at this location, flows are presently divided between the falls area and the Northern States Power Hydropower Plant. If turbine-related mortality is substantial in a worse-case situation, increasing the hydropower capacity at this site, which will result in a greater diversion of flows through turbine units, may have a significant adverse impact on fish populations in the SAF and downstream areas. This concern becomes even more important in future years as attempts are made to "clean up" the river and promote recreational uses, including sport fishing."

"Although turbine mortality studies have been conducted at several locations, we do not feel their results are applicable to a large warm-water river like the Upper Mississippi River. Information concerning turbine-related mortality for important fishes of the Upper Mississippi River is vital to assess the probable impacts of hydropower development. We suggest these studies be conducted as soon as possible to provide this information for use in the early stages of planning. If a more suitable site does not exist, the Northern States Power Hydropower Plant contains both Francis and Kaplan turbines and may provide the opportunity for study."

District Response:

a. "Trash racks would be installed to prevent damage to the turbines and entrainment of large fish. It would not be cost effective to install small mesh screens with sufficient capacity to handle the flow to the

turbines without clogging. Lighting would be held to a minimum in location, wattage, and hours of use. However a certain minimum would be required for safety in operation and maintenance of the units."

b. "Approach velocities of 0.5 foot per second are not attainable. Hydropower installations use a proportionally greater flow than steam plants. Velocities are expected to be approximately two to three feet per second which, based on fish passage studies, should allow the majority of adult game fish to escape impingement on the trash screens."

c. "The characteristics of the upper falls site dictate that a vertical type propeller turbine with fixed blades be installed. A horizontal bulb turbine with a Kaplan (adjustable blade) runner would be installed at the lower falls site. Turbines at both sites would be set in place, relative to the tailwater, to meet requirements for high efficiency and minimal cavitation, conditions which favor the survival of entrained fish. Clearances between various parts are determined by design considerations."

d. "Considerable coordination has taken place between the Fish and Wildlife Service, Minnesota Department of Natural Resources, and the Corps of Engineers with regard to the recommendation that studies be conducted to determine turbine-related impacts. It was agreed that an analysis of potential entrainment would be conducted by employing the ichthyoplankton drift data for the NSP Riverside Plant which was cited in your letter. The total drift was apportioned according to lock and power plant flows at the upper falls. A ten percent reduction was made for upstream withdrawals but no reduction was made for natural mortality. For the purpose of analysis, it was assumed that there would be total mortality of larval fish passing through the turbine. It is probable that this is an overly conservative estimate, which will be discussed further in later paragraphs. Since flows were low in 1980, the majority of the flow would have passed through turbines. Thus, this condition is considered to be a realistic "worse-case" analysis of the impact of hydropower additions to the SAF area. In order to assess the value of the larval fish, their numbers were expressed in terms of the number of adults to which they would be equivalent. The Horst method of

calculating equivalent adults, multiplying larva to adult survival rates by numbers of larvae, which was used in the Riverside Report, was also used for this analysis. The numbers of equivalent adult fish which would be entrained appeared to be low, especially most of the game fish. However, no population data for Pool 1 were available to which the mortality estimates could be compared. Creel census data are available but tend to be biased because most of the data are from bank fishermen when fishing for certain species such as walleye."

"The initial mortality estimates indicated that the equivalent of no more than the creel limits of several fishermen per year would be eliminated. The Minnesota DNR suggested that the survival rates used for game fish tended to underestimate the potential mortality and that several adjustments might be made to improve the accuracy of estimation. While it is agreed that the estimation of equivalent adults could be improved, it should be noted that the method of estimating larval drift could be substantially improved as well."

"Turbine mortality studies conducted at SAF could not be used to predict the impacts of new units because of the difference in hardware. The installed Francis units with multiple blades would tend to cause greater numbers of injuries from striking parts of the machinery than the new large diameter units with few blades and large clearances. Thus, information would not be transferable."

"Prototype studies conducted on units similar to those proposed indicated that the survival rate of fish passing through a turbine is parallel and usually equal to the percent efficiency at which the unit is running. Mortality rates of five to ten percent appear inevitable but may be the total caused by the unit. Head differentials are low and would not be a factor in mortality. The primary cause of mortality in the type of unit proposed would be pressure changes including cavitation. High efficiencies and deep turbine settings (relative to the tailwater) prevent cavitation and these values are included in design criteria. It is reasonable that, if the proposed units were run in preference to the installed units, the impact of the St. Anthony Falls area on the fishery might actually decrease."

"After reviewing the information discussed above, the biologists from the three agencies agreed that no significant impacts on the fishery could be predicted to result from the installation of additional hydropower. It was determined that sufficient information was developed in the analysis of larval drift data and that turbine mortality studies would not be required. It was also agreed that improved methods of determining larval drift, additional information on fish populations in the river, or improvements in fish habitat quality in the vicinity would be cause to acquire additional data on the fishery resources of the SAF area."

Comment:

Response a and b - no additional comments.

Response c and d - We view the proposed hydropower development at SAF to be a unique situation in comparison to other proposed hydropower locations on the Upper Mississippi River. At present, adverse impacts to aquatic organisms may occur from passage over SAF, under gates in the dam, or from passage through existing turbines. Unfortunately, these impacts have not been assessed. Since baseline information on fish populations is lacking, it is impossible to predict what positive or negative impacts will occur from the operation of the proposed turbine units and associated flow diversion from SAF. Although a worse-case analysis of larval fish mortality was conducted by District biologists for the proposed project, the lack of baseline fishery data and, in particular, an assessment of existing impacts from the falls, dam gates, and existing turbines makes it impossible to predict impacts associated with the proposed project. In general, the absence of baseline fishery data will be a major problem in assessing impacts for all hydropower proposals on the Upper Mississippi River.

As stated previously, we view the SAF hydropower project as a unique situation in comparison to other locations on the Upper Mississippi River proposed for hydropower development. The District's response to our previous recommendations describes the coordination which has taken place between our respective agencies and the Minnesota Department of Natural Resources. We recommend the following measures to minimize additional adverse impacts

to aquatic resources in the SAP area from operation of the proposed turbines:

1. The design of the proposed turbines may cause less mortality to entrained organisms than existing turbines which are predominantly of the Francis type. We therefore recommend that the proposed turbines be operated in preference to the existing units when flows are insufficient for operation of all units combined.

2. Previous turbine mortality studies have suggested that mortality is directly related to operating efficiency. We therefore recommend that turbines be operated at maximum efficiency to minimize related mortality of entrained organisms.

4. Service Recommendation: "Construction impacts should be minimized. If dredging is required, suitable upland disposal sites must be utilized for disposal, especially if the dredged material is contaminated. Turbidity and impacts to benthic organisms should be minimized. Existing transmission lines and crossings should be utilized for electric transmission."

District Response: "It is anticipated that dredging would not be required. Cofferdams would be placed to allow dry excavation but only a small area of river bottom would be disturbed. This technique would create less turbidity increases and benthic impacts than other construction methods although short-term impacts would be associated with placement and removal of cofferdams. Suitable upland disposal sites would be used to dispose of excavated material."

"The generators would be connected by overhead line to the switch gear in the Main Street Hydro Plant. From there, existing substation transformers, transmission lines, and crossings would be utilized."

Comment: Response noted - no additional comments.

5. Service Recommendation: "Adverse impacts associated with a diversion of flows completely away from SAF and the lower pool are not known but would likely be more severe than the diversion likely to occur in Alternative A, where flows would be diverted only a short distance downstream of the falls. Adverse impacts to the wooded bluffs are not anticipated under Alternative A. We therefore recommend

that Alternative B be dropped from further consideration and Alternative A selected as the final plan for hydropower development at SAF."

District Response: "The plan which you refer to as Alternative A has been selected as the recommended plan."

Comment: Response noted - we are pleased the District selected Alternative A as the final plan for hydropower development at SAF.

Under the heading of Mitigation Measures in the March 25, 1983 Planning Aid Letter, the Fish and Wildlife Service offered the following items for consideration by the St. Paul District:

Item 1. "Consideration should be given to the installation of large riprap in the tailrace areas to provide habitat for fish and benthic organisms. Riprap should also be used to protect any shoreline areas which may require stabilization from erosion. Riprap should extend below the ordinary high-water mark to provide habitat for aquatic organisms."

District Response: "Riprap would be placed to prevent scour of the shoreline and tailrace areas. Large riprap would be placed in tailrace areas and all riprap would extend below the normal pool elevation."

Comment: Response noted - no additional comments.

Item 2. "A supply of fresh water could be added to the backwater areas immediately below the Main Street Hydro Plant. These backwaters are the only such habitat in this area of the River. The addition of river water into the upper portions of these areas, via a culvert or similar means, would improve their habitat value for fish and wildlife. Since these backwaters are also part of the Father Hennepin Bluffs Park which receives substantial public use, improvements to water quality will also improve the aesthetic value of this area in general."

District Response: "A flow of fresh water into the abandoned tailrace areas on Hennepin Island would certainly be beneficial. This is evident where water from the Hennepin Island Hydro Station trash rack

sluiceway flows into part of the tailrace area. Benthic life is common and diverse, and the water is clear and aerated."

"A five-foot sluiceway connects a portion of the tailrace to the upper pool via the Main Street Station. Northern States Power Company officials have indicated that they would be willing to consider the opening of this sluiceway which is presently closed by stoplogs. It is estimated that the flow would be greater than the Hennepin Island Sluice and, on that basis, would appear to be sufficient to improve the water quality in a portion of the tailrace area. The Minneapolis Park Board should be consulted before action is taken on this item. It does not depend on the hydro project for implementation."

Comment: We continue to recommend that this mitigation project be pursued by the St. Paul District for implementation as part of the SAF hydropower project.

Item 3. "Public access to the Upper Mississippi River is limited in the SAF area. There are presently no public boat launching facilities between Lower St. Anthony Falls and Lock and Dam No. 1. Although not a mitigative measure as such, we request that consideration be given to providing public boating access and facilities for shoreline and pier fishing. Tureson (1978) found that bank fishing accounted for approximately 75% of the angling effort in the SAF area while pier fishing comprised only 5%. Improvements might also include facilities for the handicapped and elderly."

District Response: "High banks, commercial barge traffic, lack of public land, and significant safety considerations are some of the reasons for the lack of public boat access and shore fishing facilities near the SAF hydro plants. Pool 1 also has high banks but less commercial congestion and fewer safety hazards. However, the City of Minneapolis is not encouraging the addition of boat launching or improved fishing access."

Comment: It is unfortunate that sport fishing is not being promoted in this area of the Upper Mississippi River. As measures are taken to "clean up" the river, both fishery resources and water-oriented recreation should also improve. This may necessitate

providing public access for recreational boating and fishing. Although conflicts between commercial navigation and recreational uses are inevitable, these uses presently coexist in other urban areas of the Upper Mississippi River. In the future, public access may receive a high priority in this reach of the river as well.

Summary

We view the SAF hydropower project as a unique situation in comparison to other locations on the Upper Mississippi River where hydropower has been proposed. In addition to industrial/commercial development along the river corridor, the presence of St. Anthony Falls, and the comparatively high head differential, hydropower generation already exists at both proposed locations.

Our primary concern with the proposed project is potential impacts to fishery resources from operation of the proposed turbines and associated diversion of flows from SAF. Unfortunately, the lack of baseline fishery data and information concerning the effects of the falls, locks and dams, and existing hydropower generation on aquatic resources makes it impossible to accurately predict aquatic impacts resulting from operation of additional turbines. However, since hydropower generation already exists at both proposed locations, additional adverse impacts from the proposed turbines may not be significant.

The recommendations contained in this draft Fish and Wildlife Coordination Act Report are provided for your review and comment and were developed in an attempt to avoid, minimize, and compensate for possible adverse project-related impacts to fish and wildlife resources in the SAF area. Please contact Mr. Gary Wege (725-7131) of my staff if you have any questions concerning this report.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and are consistent with the intent of the National Environmental Policy Act of 1969.

Sincerely,

James L. Smith

James L. Smith
Acting Field Office Supervisor

cc: MN DNR, St. Paul
MN PCA, Roseville
US EPA, Chicago

REFERENCES

DALEY, S.A. and J. SKRYPEK, 1964. Angler creel census of Pools 4 and 5 of the Mississippi River, Goodhue and Wabasha Counties, Minnesota, 1962-1963. Minnesota Department of Conservation Investigational Report No. 227, 49 pp.

HEBERLING, G.D., K.N. MUELLER, and J.W. WEINHOLD, 1981. 1980 Riverside Generating Plant NPDES Section 316b Supplement. Northern States Power Company, 56 pp.

TURESON, F. 1978. A creel census and water surface use study of the Mississippi River from the Coon Rapids Dam to the mouth of the Minnesota River, May 8 to September 30, 1976. Minnesota Department of Natural Resources Management Report No. 3, 39 pp.

Table 1.

Electrofishing survey results from Pool 1, Lower St. Anthony Falls, and Upper St. Anthony Falls to Coon Rapids Dam. (From Minnesota Department of Natural Resources, unpublished data).

Species	Pool 1 & LSAF		USAF To Coon Rapids Dam		Ford Dam To Coon Rapids Dam	
	Number	% Total	Number	% Total	Number	% Total
Gizzard Shad	10	5	2	1	12	2
Bigmouth Buffalo	2	1	1	<1	3	1
Quillback	--	--	3	1	3	1
River Carpsucker	1	1	--	--	1	<1
White Sucker	1	1	2	1	3	1
Hog Sucker	--	--	6	2	6	1
Golden Redhorse	--	--	1	<1	1	<1
Silver Redhorse	6	3	41	12	47	9
Shorthead Redhorse	10	5	62	19	72	14
Carp	101	53	114	34	215	41
Emerald Shiner	4	2	1	<1	5	1
Channel Catfish	1	1	--	--	1	<1
Northern Pike	3	2	2	1	5	1
American Eel	--	--	1	<1	1	<1
White Bass	--	--	1	<1	1	<1
Smallmouth Bass	50	26	75	23	125	24
Green Sunfish	2	1	3	1	5	1
Rock Bass	--	--	4	1	4	1
Black Crappie	--	--	4	1	4	1
Freshwater Drum	1	1	7	2	8	2
Burbot	--	--	1	<1	1	<1
Total	192	100%	331	100%	523	100%
Effort (min.)	100		180		280	
Fish/Min.	1.92		1.83		1.87	

APPENDICES

APPENDIX A

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL MINNESOTA 55101

RECEIVED
6-21-83

REPLY TO
ATTENTION OF:

20 JUN 1983

Environmental Resources Branch
Planning Division

Mr. Richard Berry
Field Office Supervisor
U.S. Fish and Wildlife Service
570 Nalpak Building
333 Sibley Street
St. Paul, Minnesota 55101

Dear Mr. Berry:

The Corps of Engineers is preparing an environmental assessment for the addition of hydropower on the Mississippi River at St. Anthony Falls, Minneapolis, Hennepin County, Minnesota. The assessment will include an evaluation of the potential effect of the project on endangered and threatened species.

Existing generating capacity would be supplemented with two vertical shaft, fixed blade, propeller turbines which would be installed in wasteway 2 at the upper falls and a single horizontal shaft, adjustable blade bulb turbine. Excavation would be done behind cofferdams so no dredging would be required. Riprap would be installed to prevent erosion. The existing electrical distribution system would be used to transmit the power; only a connection between it and the new generators would be required.

Two species of birds, the Arctic peregrine falcon (Falco peregrinus), listed as an endangered species, and the bald eagle (Haliaeetus leucocephalus), listed as a threatened species, may migrate through the project area, or be present on a transient basis in spring and fall. It is unlikely that the birds would use the falls area because of its proximity to human activity. However, no trees, which might be used by the birds, would be removed. No new transmission lines would be required so there would be no hazard to birds in flight. This project, therefore, would not be expected to have any negative effect on the birds.

In addition, no effect on the endangered mussel (Lampsilis higginsi) would be expected because poor water quality in the project area has eliminated mussels from the river for a substantial distance.

We ask that you review and comment on this analysis. Your comments will be included in the environmental assessment which will be issued in the near future.

Sincerely,

Wayne A. Knott
Chief, Environmental Resources Branch
Planning Division

APPENDIX A

July 5, 1983

Mr. Wayne Knott
Chief, Environmental Resources Branch-Planning Division
United States Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

This replies to your letter of June 20, 1983, concerning the potential impacts on federally endangered or threatened species from the proposed St. Anthony Falls hydropower project in Minneapolis, Hennepin County, Minnesota. Based on the information contained in your above referenced letter, we concur with your determination that the proposed project will have no effect on any federally listed endangered or threatened species.

This precludes the need for further action on this project as required under Section 7 of the Endangered Species Act of 1973, as amended. Should this project be modified or new information indicates endangered species may be affected, you should reinitiate consultation with this office.

Sincerely,

Richard F. Berry
Field Supervisor

bcc: RO (SE)
SPFO (SE) Leach
SPFO (Wege) Project Files (SAF Hydropower Project)
SPFO Reading File

SPFO:GWege:jms:07/05/83:x7131

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL MINNESOTA 55101

REPLY TO
ATTENTION OF:

6 JUN 1983

RECEIVED
6-8-83

Environmental Resources Branch
Planning Division

Mr. Richard F. Berry
Field Office Supervisor
St. Paul Field Office, Ecological Services
U.S. Fish and Wildlife Service
570 Nalpak Building
330 Sibley Street
St. Paul, Minnesota 55101

Dear Mr. Berry:

This letter responds to your planning aid letter dated March 25, 1983, for the possible construction of additional hydropower generating facilities at Upper and Lower St. Anthony Falls on the Upper Mississippi River in Minneapolis, Minnesota.

A technical report has been completed by the North Pacific Division of the Corps of Engineers. The report evaluated the feasibility of adding generating capacity at St. Anthony Falls and showed that three alternative sites could be used. Two vertical axis, fixed blade, propeller units could be installed at the upper falls, for an installed capacity of 21.0 megawatts. Each unit would discharge 3,100 cubic feet per second (cfs). A single unit could be added at the lower falls power plant to produce 5.4 megawatts using 3,600 cfs. This unit would be a horizontal axis Kaplan (adjustable blade) bulb unit. A combined falls power plant would utilize the combined head of both falls. This alternative would consist of two vertical axis, fixed blade, propeller units, generating 28.0 megawatts and using 5,500 cfs.

A tentative selection has been made which would recommend that the upper and lower falls alternatives be developed. A detailed description of the proposed plants is given in the technical report. A feasibility report and environmental assessment are scheduled for completion in July 1985.

Your recommendations have been reviewed and several meetings have been held with your staff and the Minnesota Department of Natural Resources to discuss how these recommendations might be implemented. Our responses to your recommendations are enclosed.

Sincerely,

Louis Kowalski

Louis Kowalski
Chief, Planning Division

Enclosures

RECOMMENDATIONS AND RESPONSES CONCERNING
POSSIBLE CONSTRUCTION OF ADDITIONAL HYDROPOWER
GENERATING FACILITIES AT UPPER AND LOWER
ST. ANTHONY FALLS

RECOMMENDATIONS

1. Recommendation: "To assess potential impacts, information is needed from the St. Paul District concerning the anticipated diversion of flows presently going over the falls which will be used for additional hydropower generation. The information should include a comparison of normal flows and with-project flows. In general, we would recommend that such flows deviate as little as possible from existing conditions. If oxygen levels below SAF are depressed as a result of flow diversion, reaeration of flows passing through the turbines may be necessary."

Response: The information you requested is enclosed. Flow deviations would be limited to those necessary to supply the added turbines. The combined alternative would have substantially reduced the flow into the lower falls pool and will not be recommended, at least in part, because of the flow deviation. Oxygen levels meet water quality standards more than 93 percent of the time in the metropolitan area above lock and dam 1. It is not anticipated that dissolved oxygen levels would be significantly depressed as a result of diversion. Turbulent flow in the tailraces would offset some of the decrease resulting from diversion.

2. Recommendation: "As identified in the reconnaissance report, existing hydropower generation at SAF utilizes a limited storage-and-release mode of operation. To avoid and minimize additional adverse impacts to fish and wildlife resources, operation of the proposed hydropower facilities should be within these existing constraints with no additional storage-and-release of flows beyond existing conditions."

Response: It was recognized in the Reconnaissance Report for St. Anthony Falls that, because of potential adverse impacts resulting from pool fluctuations, operation of any additional hydropower must be confined to existing operating limits.

3. Recommendation: "Small trash racks or large screens should be placed in front of the intake area to prevent passage of larger fish. Screening devices should be considered to minimize entrainment losses. To minimize fishery impacts, the approach area should be devoid of lights and structural projections which would attract fish into the intake area. Recommended approach velocities for intakes at major power plants is 0.5 feet per second or less to allow fish to escape. Approach velocities at this site should be as low as possible. a. b.

"Although study results are variable, we would recommend use of horizontal Kaplan-type turbines with adjustable blades as proposed. To minimize fish mortality, turbines should be operated at maximum efficiency. Cavitation should be minimized and large clearances provided between the vanes of the runners and between runners and wicket gates. c.

"We recommend that studies be conducted by the Corps of Engineers to determine the potential for turbine-related impacts to fishery resources on the Upper Mississippi River, including hydropower proposed at St. Anthony Falls. In 1980, an ichthyoplankton study was conducted for the Northern States Power Riverside Plant upstream of St. Anthony Falls at River Mile 857 (Heberling et al. 1981). The study found a variety of species and larval stages in the drift including a sizeable number of channel catfish, an important sport fish. Projecting these data by simple proportion, an estimated 5.5 million channel catfish larvae may have drifted past this facility over the summer period. d.

"It is unfortunate that no information exists concerning an assessment of turbine-related mortality of fish from the existing hydropower facilities at SAF. To illustrate our concern at this location, flows are presently divided between the falls area and the Northern States Power Hydropower Plant. If turbine-related mortality is substantial in a worse-case situation, increasing the hydropower capacity at this site which will result in a greater diversion of flows through turbine units may have a significant adverse impact on fish populations in the SAF and downstream areas. This concern becomes even more important in future years as attempts are made to "clean up" the river and promote recreational uses including sport fishing.

"Although turbine mortality studies have been conducted at several locations, we do not feel their results are applicable to a large warm-water river like the Upper Mississippi River. Information concerning turbine-related mortality for important fishes of the Upper Mississippi River is vital to assess the probable impacts of hydropower development. We suggest these studies be conducted as soon as possible to provide this information for use in the early stages of planning. If a more suitable site does not exist, the Northern States Power Hydropower Plant contains both Francis and Kaplan turbines and may provide the opportunity for study."

Response:

a. Trash racks would be installed to prevent damage to the turbines and entrainment of large fish. It would not be cost effective to install small mesh screens with sufficient capacity to handle the flow to the turbines without clogging. Lighting would be held to a minimum in location, wattage and hours of use. However, a certain minimum would be required for safety in operation and maintenance of the units.

b. Approach velocities of 0.5 foot per second are not attainable. Hydropower installations use a proportionally greater flow than steam plants. Velocities are expected to be approximately 2 to 3 feet per second which, based on fish passage studies, should allow the majority of adult game fish to escape impingement on the trash screens.

c. The characteristics of the upper falls site dictate that a vertical type propeller turbine with fixed blades be installed. A horizontal, bulb turbine with a Kaplan (adjustable blade) runner would be installed at the lower falls site. Turbines at both sites would be set in place, relative to

the tailwater, to meet requirements for high efficiency and minimal cavitation, conditions which favor the survival of entrained fish. Clearances between various parts are determined by design considerations.

d. Considerable coordination has taken place between the Fish and Wildlife Service, Minnesota Department of Natural Resources, and Corps of Engineers with regard to the recommendation that studies be conducted to determine turbine-related impacts. It was agreed that an analysis of potential entrainment would be conducted by employing the ichthyoplankton drift data for the NSP Riverside Plant which was cited in your letter. The total drift was apportioned according to lock and power plants flows at the upper falls. A 10-percent reduction was made for upstream withdrawals but no reduction was made for natural mortality. For the purpose of analysis it was assumed that there would be total mortality of larval fish passing through the turbine. It is probable that this is an overly conservative estimate, which will be discussed further in later paragraphs. Since flows were low in 1980, the majority of the flow would have passed through turbines. Thus, this condition is considered to be a realistic "worst case" analysis of the impact of hydropower additions to the St. Anthony Falls area. In order to assess the value of the larval fish, their numbers were expressed in terms of the numbers of adults to which they would be equivalent. The Horst method of calculating equivalent adults, multiplying larva to adult survival rates by numbers of larvae, which was used in the Riverside Report, was also used for this analysis. The numbers of equivalent adult fish which would be entrained appeared to be low, especially most of the game fish. However, no population data for pool 1 were available to which the mortality estimates could be compared. Creel census data are available but tend to be biased because most of the data are from bank fishermen who are at a disadvantage compared to boat fishermen when fishing for certain species, such as walleye.

The initial mortality estimates indicated that the equivalent of no more than the creel limits of several fishermen per year would be eliminated. The Minnesota DNR suggested that the survival rates used for game fish tended to underestimate the potential mortality and that several adjustments might be made to improve the accuracy of estimation. While it is agreed that the estimation of equivalent adults could be improved, it should be noted that the method of estimating larval drift could be substantially improved as well.

Turbine mortality studies conducted at St. Anthony Falls could not be used to predict the impacts of new units because of the difference in hardware. The installed Francis units with multiple blades would tend to cause greater numbers of injuries from striking parts of the machinery than the new large diameter units with few blades and large clearances. Thus, information would not be transferable.

Prototype studies conducted on units similar to those proposed indicated that the survival rate of fish passing through a turbine is parallel and usually equal to the percent efficiency at which the unit is running. Mortality rates of 5 to 10 percent appear inevitable but may be the total caused by the unit. Head differentials are low and would not be a factor in mortality. The primary cause of mortality in the type of unit proposed would be pressure changes including cavitation. High efficiencies and deep turbine settings

(relative to the tailwater) prevent cavitation and these values are included in design criteria. It is reasonable that, if the proposed units were run in preference to the installed units, the impact of the St. Anthony Falls area on the fishery might actually decrease.

After reviewing the information discussed above, the biologists from the three agencies agreed that no significant impacts on the fishery could be predicted to result from the installation of additional hydropower. It was determined that sufficient information was developed in the analysis of larval drift data and that turbine mortality studies would not be required. It was also agreed that improved methods of determining larval drift, additional information on fish populations in the river, or improvements in fish habitat quality in the vicinity would be cause to acquire additional data on the fishery resources of the St. Anthony Falls area.

4. Recommendation: "Construction impacts should be minimized. If dredging is required, suitable upland disposal sites must be utilized for disposal especially if the dredged material is contaminated. Turbidity and impacts to benthic organisms should be minimized. Existing transmission lines and crossings should be utilized for electrical transmission."

Response: It is anticipated that dredging would not be required. Cofferdams would be placed to allow dry excavation but only a small area of river bottom would be disturbed. This technique would create less turbidity increases and benthic impacts than other construction methods although short-term impacts would be associated with placement and removal of cofferdams. Suitable upland disposal sites would be used to dispose of excavated material.

The generators would be connected by overhead line to the switch gear in the Main Street Hydro Plant. From there, existing substation transformers, transmission lines, and crossings would be utilized.

5. Recommendation: "Adverse impacts associated with a diversion of flows completely away from SAF and the lower pool are not known but would likely be more severe than the diversion likely to occur in Alternative A, where flows would be diverted only a short distance downstream of the falls. Adverse impacts to the wooded bluffs are not anticipated under Alternative A. We therefore recommend that Alternative B be dropped from further consideration and Alternative A selected as the final plan for hydropower development at SAF."

Response: The plan which you refer to as Alternative A has been selected as the recommended plan.

MITIGATION MEASURES

Under the heading of Mitigation Measures you have offered the following for consideration:

Item 1. "Consideration should be given to the installation of large riprap in the new tailrace areas to provide habitat for fish and benthic organisms. Riprap should also be used to protect any shoreline areas which may require

stabilization from erosion. Riprap should extend below the ordinary high water mark to provide habitat for aquatic organisms."

Response: Riprap would be placed to prevent scour of the shoreline and tailrace areas. Large riprap would be placed in tailrace areas and all riprap would extend below the normal pool elevation.

Item 2. "A supply of fresh water could be added to the backwater areas immediately below the Main Street Hydro Plant. These backwaters are the only such habitat in this area of the river. The addition of river water into the upper portions of these areas, via a culvert or similar means, would improve their habitat value for fish and wildlife. Since these backwaters are also part of the Father Hennepin Bluffs Park which receives substantial public use, improvements to water quality will also improve the aesthetic value of this area in general."

Response: A flow of fresh water into the abandoned tailrace areas on Hennepin Island would certainly be beneficial. This is evident where water from the Hennepin Island Hydro Station trash rack sluiceway flows into part of the tailrace area. Benthic life is common and diverse and the water is clear and aerated.

A 5-foot sluiceway connects a portion of the tailrace to the upper pool via the Main Street Station. Northern States Power Company officials have indicated that they would be willing to consider the opening of this sluiceway which is presently closed by stoplogs. It is estimated that the flow would be greater than the Hennepin Island Sluice and, on that basis, would appear to be sufficient to improve the water quality in a portion of the tailrace area. The Minneapolis Park Board should be consulted before action is taken on this item. It does not depend on the hydro project for implementation.

Item 3. "Public access to the Upper Mississippi River is quite limited in the St. Anthony Falls area. There are presently no public boat launching facilities between Lower St. Anthony Falls and Lock and Dam 1. Although not a mitigative measure as such, we request that consideration be given to providing public boating access and facilities for shoreline and pier fishing. Tureson (1978) found that bank fishing accounted for approximately 75% of the angling effort in the SAF area while pier fishing comprised only 5%. Improvements might also include facilities for the handicapped and elderly."

Response: High banks, commercial barge traffic, lack of public land, and significant safety considerations are some of the reasons for the lack of public boat access and shore fishing facilities near the St. Anthony Falls hydro plants. Pool 1 also has high banks but less commercial congestion and fewer safety hazards. However, the city of Minneapolis is not encouraging the addition of boat launching or improved fishing access.

INFORMATION NEEDED

The items listed under the category of Information Needed have been discussed in previous paragraphs but are reiterated here.

1. No water level changes are planned.

2. Information on potential diversion of flows is included.

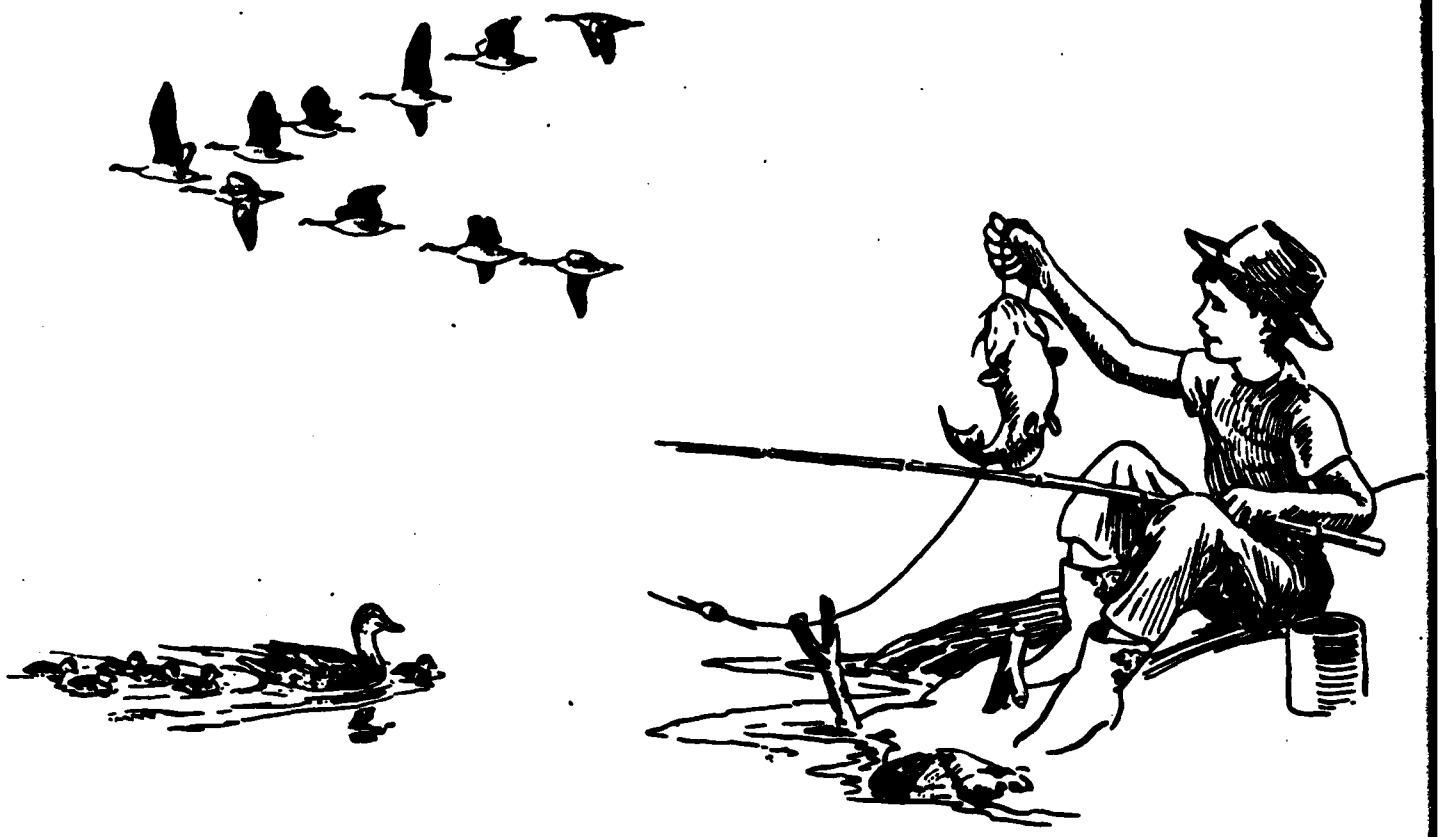
3. It was determined that turbine mortality studies would not be conducted.

4. Engineering plans and the technical report are included.

5. Dredging would not be required.

6. Mitigation features are discussed.

PLANNING AID LETTER



U.S. FISH & WILDLIFE SERVICE

DEPARTMENT OF THE INTERIOR

HYDROPOWER DEVELOPMENT:

UPPER MISSISSIPPI RIVER
ST. ANTHONY FALLS

MARCH, 1983

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St. Paul Field Office, Ecological Services
570 Naipak Building
333 Sibley Street
St. Paul, Minnesota 55101

March 25, 1983

Colonel Edward G. Rapp
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Rapp:

This is our planning aid letter for the possible construction of additional hydropower generating facilities at Upper and Lower St. Anthony Falls on the Upper Mississippi River in Minneapolis and St. Paul, Minnesota. This report will address those items listed in our scope of work for FY 1983 and will generally expand on our previous comments on this project contained in our attached March 3, 1981 letter.

Existing Fish and Wildlife Resources

The project encompasses the locale known as St. Anthony Falls (SAF) which contains the upper and lower dam areas. The upper dam consists of the Corps of Engineers' Upper St. Anthony Falls (USAF) lock and dam, a horseshoe dam, a limestone and concrete wall (dam), and two utility owned hydropower plants, one of which is operating. The lower dam area contains the Corps of Engineers' Lower St. Anthony Falls (LSAF) locks and dam, an intermediate dam, and an existing utility owned hydropower plant.

The area around St. Anthony Falls has been subject to the effects of human settlement since the early 19th century and alterations of the aquatic and terrestrial resources have occurred since then. Today, the St. Anthony Falls area is surrounded by urban developments including commercial and light industrial buildings, railroads, and highways.

Fish and wildlife populations are somewhat limited in the SAF pools in comparison to other areas on the Upper Mississippi River primarily because of the lack of shallow water habitat, the relatively small size of the pools, and industrial development along the riverbanks. Although fish populations may be limited in comparison to other areas, recent electrofishing surveys conducted

by the Minnesota Department of Natural Resources show a diverse fishery in the pools including a high percentage of smallmouth bass, an important sport fish (Table 1).

There is no commercial fishing in the SAF area. However, sport fishing is common in the pools despite the relative lack of quality fishing habitat including backwater and shallow water areas and poor public access to the river. In 1976, a creel census was conducted by the Minnesota Department of Natural Resources from the junction of the Minnesota and Mississippi Rivers to the Coon Rapids Dam (Tureson 1978). Total angling effort from the river between the Ford Dam and St. Anthony Falls was approximately 22.06 man-hours per acre with an estimated harvest of 7.55 pounds per acre. In comparison, total angling effort in Pools 4 and 5 were 10.9 and 12.5 man-hours per acre, respectively, with an estimated harvest of 7.6 and 9.9 pounds per acre, respectively (Daley and Skrypek 1964).

Terrestrial habitat is quite limited along the SAF pools. Vegetation is primarily confined to landscaping and parkland along the wooded bluffs. Although somewhat scarce, these areas do provide habitat for a variety of non-game species such as songbirds and small mammals. Waterfowl occasionally use areas of the upper pool outside the main channel. Due to firearm restrictions, hunting is prohibited in the SAF area. An inventory of common vegetation, fish, and wildlife which occur within this area of the Upper Mississippi River can be found in the Final Report, Environmental Impact Assessment of the Northern Section of the Upper and Lower St. Anthony Falls, prepared for the St. Paul District Corps of Engineers.

Several federally designated endangered or threatened species have been known to occur in this general area of the Upper Mississippi River. The bald eagle (Haliaeetus leucocephalus), a threatened species, winters on the Upper Mississippi River, concentrating below dams or near the mouths of tributaries where fish provide a ready food supply. Also, the endangered Higgin's eye pearly mussel (Lampsilis higginsi) has been found in portions of the Mississippi and Minnesota Rivers. Historically, the endangered peregrine falcon (Falco peregrinus) has also been known to occur in this general area.

These endangered species comments constitute informal consultation only. They do not fulfill the requirements of Section 7 of the Endangered Species Act, as amended. Attached is a discussion of federal agencies' major responsibilities under the act.

Future Setting

Fish and wildlife resources in the SAF area have already been affected by the extensive industrial and commercial development of the downtown Upper Mississippi River corridor. In general, remaining habitats are either under public ownership as parkland or under the regulatory jurisdiction of local, state or federal agencies. Aquatic resources may actually improve in future years with the growing demand for urban water-oriented recreation and the efforts of public and private sectors to "clean up" the river. Future improvements in water quality will ultimately improve both fishery resources and recreational opportunities.

Alternative Evaluation

At this time, the St. Paul District is evaluating two alternatives for the construction of additional hydropower facilities at SAF:

Alternative A - - This alternative involves the installation of two 3.0-meter horizontal tube turbine units in Wasteway Number 2 at USAF (Alternative 5 U in reconnaissance report), and installation of two similar units landward of the Lower Dam Hydro Plant (Alternative 2 L in reconnaissance report).

Alternative B - - This alternative is an end-around proposal that would supplement existing hydropower facilities and involve construction of a covered canal or tunnel along or under Main Street. The project begins from immediate upstream of the Old Main Street Station in the upper pool to a new LSAF powerhouse adjacent to the existing LSAF hydropower station. Two horizontal turbine units would be installed in the new powerhouse.

Potential Impacts and Planning Recommendations

Alternative A

1. Diversion of flows for additional hydropower generation may adversely impact downstream aquatic resources. Due to the absence of baseline biological data on the SAF pools, it is difficult to assess impacts associated with any diversion of flows from the St. Anthony Falls area. Possible impacts include loss of aquatic habitat and a decrease in water quality immediately below the falls.

Recommendation To assess potential impacts, information is needed from the St. Paul District concerning the

anticipated diversion of flows presently going over the falls which will be used for additional hydropower generation. The information should include a comparison of normal flows and with-project flows. In general, we would recommend that such flows deviate as little as possible from existing conditions. If oxygen levels below SAF are depressed as a result of flow diversion, reaeration of flows passing through the turbines may be necessary.

2. Fluctuation of water levels for storage-and-release operation of hydropower facilities can adversely affect fish and wildlife resources and recreational uses both upstream and downstream of the powerhouse. Depending on minimum low flows and the frequency and duration of such operation, adverse impacts can be significant.

Recommendation As indentified in the reconnaissance report, existing hydropower generation at SAF utilizes a limited storage-and-release mode of operation. To avoid and minimize additional adverse impacts to fish and wildlife resources, operation of the proposed hydropower facilities should be within these existing constraints with no additional storage-and-release of flows beyond existing conditions.

3. Turbine-related mortality (impingement and entrainment) of fish is a concern with all hydropower development proposed on the Upper Mississippi River. Results of previous studies are variable and may not be applicable to hydropower development on the river.

Recommendation Small trash racks or large screens should be placed in front of the intake area to prevent passage of larger fish. Screening devices should be considered to minimize entrainment losses. To minimize fishery impacts, the approach area should be devoid of lights and structural projections which would attract fish into the intake area. Recommended approach velocities for intakes at major power plants is 0.5 feet per second or less to allow fish to escape. Approach velocities at this site should be as low as possible.

Although study results are variable, we would recommend use of horizontal Kaplan-type turbines with adjustable blades as proposed. To minimize fish mortality, turbines should be operated at maximum efficiency. Cavitation

should be minimized and large clearances provided between the vanes of the runners and between runners and wicket gates.

We recommend that studies be conducted by the Corps of Engineers to determine the potential for turbine-related impacts to fishery resources on the Upper Mississippi River, including hydropower proposed at St. Anthony Falls. In 1980, an ichthyoplankton study was conducted for the Northern States Power Riverside Plant upstream of St. Anthony Falls at River Mile 857 (Heberling et al. 1981). The study found a variety of species and larval stages in the drift including a sizeable number of channel catfish, an important sport fish. Projecting these data by simple proportion, an estimated 5.5 million channel catfish larvae may have drifted past this facility over the summer period.

It is unfortunate that no information exists concerning an assessment of turbine-related mortality of fish from the existing hydropower facilities at SAF. To illustrate our concern at this location, flows are presently divided between the falls area and the Northern States Power Hydropower Plant. If turbine-related mortality is substantial in a worse-case situation, increasing the hydropower capacity at this site which will result in a greater diversion of flows through turbine units may have a significant adverse impact on fish populations in the SAF and downstream areas. This concern becomes even more important in future years as attempts are made to "clean up" the river and promote recreational uses including sport fishing.

Although turbine mortality studies have been conducted at several locations, we do not feel their results are applicable to a large warm-water river like the Upper Mississippi River. Information concerning turbine-related mortality for important fishes of the Upper Mississippi River is vital to assess the probable impacts of hydropower development. We suggest these studies be conducted as soon as possible to provide this information for use in the early stages of planning. If a more suitable site does not exist, the Northern States Power Hydropower Plant contains both Francis and Kaplan turbines and may provide the opportunity for study.

4. Construction of the proposed project and any necessary transmission lines may impact fish and wildlife resources in the project area.

Recommendation Construction impacts should be minimized. If dredging is required, suitable upland disposal sites must be utilized for disposal especially if the dredged material is contaminated. Turbidity and impacts to benthic organisms should be minimized. Existing transmission lines and crossings should be utilized for electrical transmission.

Alternative B

Potential impacts associated with Atlernative B include those identified above for Alternative A. Although existing flows over SAF would likely be diverted to some extent under Alternative A, these flows would be discharged in the same general vicinity of SAF and remain in the lower pool. However, under Alternative B, flows diverted from SAF would be discharged directly into Upper Pool 1, bypassing the lower SAF pool. In addition, there will be some adverse impacts to terrestrial habitat along the bluffs from construction of the canal or tunnel.

Recommedation Adverse impacts associated with a diversion of flows completely away from SAF and the lower pool are not known but would likely be more severe than the diversion likely to occur in Alternative A, where flows would be diverted only a short distance downstream of the falls Adverse impacts to the wooded bluffs are not anticipated under Alternative A. We therefore recommend that Alternative B be dropped from further consideration and Alternative A selected as the final plan for hydropower development at SAF.

Mitigation Measures

The following mitigation measures are offered for your consideration. We feel these projects will provide benefits to fish and wildlife resources.

1. Consideration should be given to the installation of large riprap in the new tailrace areas to provide habitat for fish and benthic organisms. Riprap should also be used to protect any shoreline areas which may require

stabilization from erosion. Riprap should extend below the ordinary high water mark to provide habitat for aquatic organisms.

2. A supply of fresh water could be added to the backwater areas immediately below the Main Street Hydro Plant. These backwaters are the only such habitat in this area of the river. The addition of river water into the upper portions of these areas, via a culvert or similar means, would improve their habitat value for fish and wildlife. Since these backwaters are also part of the Father Hennepin Bluffs Park which receives substantial public use, improvements to water quality will also improve the aesthetic value of this area in general.

3. Public access to the Upper Mississippi River is quite limited in the St. Anthony Falls area. There are presently no public boat launching facilities between Lower St. Anthony Falls and Lock and Dam 1. Although not a mitigative measure as such, we request that consideration be given to providing public boating access and facilities for shoreline and pier fishing. Tureson (1978) found that bank fishing accounted for approximately 75% of the angling effort in the SAF area while pier fishing comprised only 5%. Improvements might also include facilities for the handicapped and elderly.

Information Needed From the St. Paul District

Once a final plan for hydropower generation has been selected by the St. Paul District, the following information is needed on the selected plan in order to prepare our draft Fish and Wildlife Coordination Act Report.

1. Information concerning the extent of any water level fluctuations beyond existing conditions due to the operation of the proposed facilities.

2. A comparison of existing and with-project flows to identify the extent of any diversion of flows from St. Anthony Falls for hydropower generation.

3. Results of the turbine mortality studies.

4. Engineering plans for the selected alternative including turbine and powerhouse location, design and operation.

5. Dredging needs and potential dredged material disposal sites should be identified. If dredging is necessary, material should be analyzed for contaminants.

6. A discussion concerning the feasibility of mitigation measures proposed above.

Summary

The general lack of baseline biological information for all pools on the Upper Mississippi River makes it difficult to accurately assess impacts to fish and wildlife resources from installation and operation of hydropower facilities. Flow diversion for additional hydropower generation could be detrimental to fishery resources immediately below the falls. Information on the extent of any such diversion, and proposed minimum low flows which will be maintained over the falls is needed to make an assessment of aquatic impacts. We feel the diversion of flows from the falls to Upper Pool 1 under Alternative B may result in adverse impacts to fishery resources beyond those associated with Alternative A. Therefore, we recommend that Alternative B be dropped from further consideration. Turbine-related mortality of important fishes should be studied in order to make sound biological decisions for hydropower operation on all areas of the Upper Mississippi River, including St. Anthony Falls.

These comments have been prepared under the authority of and in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and the Endangered Species Act of 1973, as amended, and are consistent with the intent of the National Environmental Policy Act of 1969.

Sincerely,

Richard F. Berry

Richard F. Berry
Field Office Supervisor

Attachment

cc:MN DNR, St.Paul
MN PCA, Roseville
US EPA, Chicago
US COE, St.Paul (Env.Reg.Branch)

REFERENCES

DALEY, S.A. and J. SKRYPEK, 1964. Angler creel census of Pools 4 and 5 of the Mississippi River, Goodhue and Wabasha Counties, Minnesota, 1962-1963. Minnesota Department of Conservation Investigational Report No. 227, 49 pp.

HEBERLING, G.D., K.N. MUELLER, and J.W. WEINHOLD, 1981. 1980 Riverside Generating Plant NPDES Section 316b Supplement. Northern States Power Company, 56 pp.

TURESON, F. 1978. A creel census and water surface use study of the Mississippi River from the Coon Rapids Dam to the mouth of the Minnesota River, May 8 to September 30, 1976. Minnesota Department of Natural Resources Management Report No. 3, 39 pp.

Table 1.

Electrofishing survey results from Pool 1, Lower St. Anthony Falls, and Upper St. Anthony Falls to Coon Rapids Dam. (From Minnesota Department of Natural Resources, unpublished data).

Species	Pool 1 & LSAF		USAF To Coon Rapids Dam		Ford Dam To Coon Rapids Dam	
	Number	% Total	Number	% Total	Number	% Total
Gizzard Shad	10	5	2	1	12	2
Bigmouth Buffalo	2	1	1	<1	3	1
Quillback	--	--	3	1	3	1
River Carpsucker	1	1	--	--	1	<1
White Sucker	1	1	2	1	3	1
Hog Sucker	--	--	6	2	6	1
Golden Redhorse	--	--	1	<1	1	<1
Silver Redhorse	6	3	41	12	47	9
Shorthead Redhorse	10	5	62	19	72	14
Carp	101	53	114	34	215	41
Emerald Shiner	4	2	1	<1	5	1
Channel Catfish	1	1	--	--	1	<1
Northern Pike	3	2	2	1	5	1
American Eel	--	--	1	<1	1	<1
White Bass	--	--	1	<1	1	<1
Smallmouth Bass	50	26	75	23	125	24
Green Sunfish	2	1	3	1	5	1
Rock Bass	--	--	4	1	4	1
Black Crappie	--	--	4	1	4	1
Freshwater Drum	1	1	7	2	8	2
Burbot	--	--	1	<1	1	<1
Total	192	100%	331	100%	523	100%
Effort (min.)	100		180		280	
Fish/Min.	1.92		1.83		1.87	

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

St Paul Field Office, Ecological Services
538 Federal Building and U.S. Court House
316 North Robert Street
St. Paul, Minnesota 55101

March 3, 1981

Colonel William W. Badger
District Engineer, St. Paul District
U.S. Army Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Colonel Badger:

This responds to your January 30, 1981 notice requesting our comments on the preparation of a reconnaissance study for hydropower generation at lock and dam 2 and St. Anthony Falls on the Mississippi River in Minnesota. We offer the following comments to assist you in the preparation of this study.

Existing Fish and Wildlife Resources

Fish and wildlife populations are somewhat limited in the Minneapolis pools primarily because of the lack of shallow water habitat, the relatively small size of the pools, and industrial development along the river-banks. Occasional periods of poor water quality further reduce the value of fishery habitat. However, valuable habitat for upland species can be found on the wooded bluffs along Pool 1. Sport fishing is common in the pools despite the relative lack of quality fishery habitat. Firearm restrictions prohibit hunting in the urban areas.

Fishery habitat is limited but generally good in Pool 2 upstream of downtown St. Paul. However, the quality of fishing declines in the lower portions of the Minnesota River and downstream portions of Pool 2 because of poor water quality. Valuable wildlife habitat can be found in the areas of Crosby Lake, Pigs Eye Lake, and Grey Cloud Island and on the Minnesota River within the Minnesota Valley National Wildlife Refuge and Black Dog Lake. Pigs Eye Lake, located in Pool 2 downstream of downtown St. Paul, has a unique heron-egret rookery located at its border. This rookery is maintaining itself and contains black-crowned night herons, great blue herons, and common egrets.

Sport fishing is provided in the tailwater areas of locks and dam 1 and at the outfall of Black Dog Lake. Hunting is prohibited in the majority of Pool 2 and on the Minnesota River within the metropolitan area.

Pool 3 has a small but important commercial fishery in North and Sturgeon Lakes. Sport fishing is also good throughout much of Pool 3 and the St. Croix River, especially in some of the backwater lakes. Hunting is a popular sport around Pool 3. Bag checks by the Minnesota Department of Natural Resources indicate waterfowl harvests are comparable to the state average.

Several federally designated endangered or threatened species have been known to occur in this general area of the Upper Mississippi River. The bald eagle (Haliaeetus leucocephalus), a threatened species, winters on the Upper Mississippi River, concentrating below dams or near the mouths of tributaries where fish provide a ready food supply. Also, the endangered Higgin's eye pearly mussel (Lampsilis higginsi) inhabits portions of the Mississippi and Minnesota Rivers. Historically, the endangered peregrine falcon (Falco peregrinus) has also been known to occur in this general area.

These endangered species comments constitute informal consultation only. They do not fulfill the requirements of Section 7 of the Endangered Species Act, as amended. Enclosed is a discussion of federal agencies' major responsibilities under the act.

Concerns

Construction and operation of hydropower facilities at lock and dam 2 and lower St. Anthony Falls will impact fish and wildlife resources, the extent of which must eventually be documented should the projects appear feasible. A major concern involves potential effects to existing daily and seasonal water levels. A change in such levels could result in adverse impacts to wetlands, backwater areas, shoreline habitat, and associated fish and wildlife resources. Regardless of a change in water levels, the location of the generating facilities and their operation could alter existing flow patterns which are fairly uniform across the river. Concentrating a portion of this flow through the generating facilities could affect existing upstream and downstream flow patterns, terrestrial and aquatic habitats, possibly increase scouring and erosion, and affect the existing tailwater sport fisheries. We would be particularly concerned about this funneling effect during low flow periods.

We are also concerned with potential injury and mortality of aquatic organisms due to entrainment through the generating facilities. Impingement of organisms may also be an important factor if screening devices are used at the intakes. In addition to design, construction, and operation of the generating facilities, construction of required transmission lines, corridors, and other facilities could also result in adverse impacts to fish and wildlife resources.

The above concerns should be adequately addressed in future studies if the addition of generating facilities appears economically feasible. We also suggest the projects be closely coordinated with the Minnesota Department of Natural Resources. We appreciate the opportunity to offer our comments on these projects and look forward to our continued coordination on this matter.

Sincerely,

Richard A. Tollers

for Richard F. Berry
Field Office Supervisor

Attachment

cc: U.S. EPA, Chicago
Minn. DNR, St. Paul

FEDERAL AGENCIES'
MAJOR RESPONSIBILITIES UNDER
THE ENDANGERED SPECIES ACT OF 1973, AS AMENDED

1. All Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered or threatened species.

2. In accordance with Section 7(c) of the Endangered Species Act of 1973, as amended, the Federal agency responsible for actions authorized, funded, or carried out in furtherance of a construction project that significantly affects the quality of the human environment, is required to conduct a biological assessment. The purpose of the assessment is to identify listed or proposed species likely to be adversely affected by their action and to assist the Federal agency in making a decision as to whether they should initiate formal consultation.

3. The biological assessment is to be completed within 180 days of initiation and before contracts are entered into or construction begun.

4. When conducting a biological assessment, the following steps should be taken:

   a. Conduct an on-site inspection of the area affected by the proposed activity or program, which may include a detailed survey of the area to determine if species are present and whether suitable habitat exists for either expanding the existing population or potential reintroduction of populations.

   b. Interview recognized experts on the species at issue, including those within the Fish and Wildlife Service, State conservation departments, universities and others who may have data not yet found in the scientific literature.

   c. Review literature and other scientific data to determine the species' distribution, habitat needs and other biological requirements.

   d. Review and analyze the effects of the proposal on the species, in terms of individuals and populations, including consideration of the cumulative effects of the proposal on the species and its habitat.

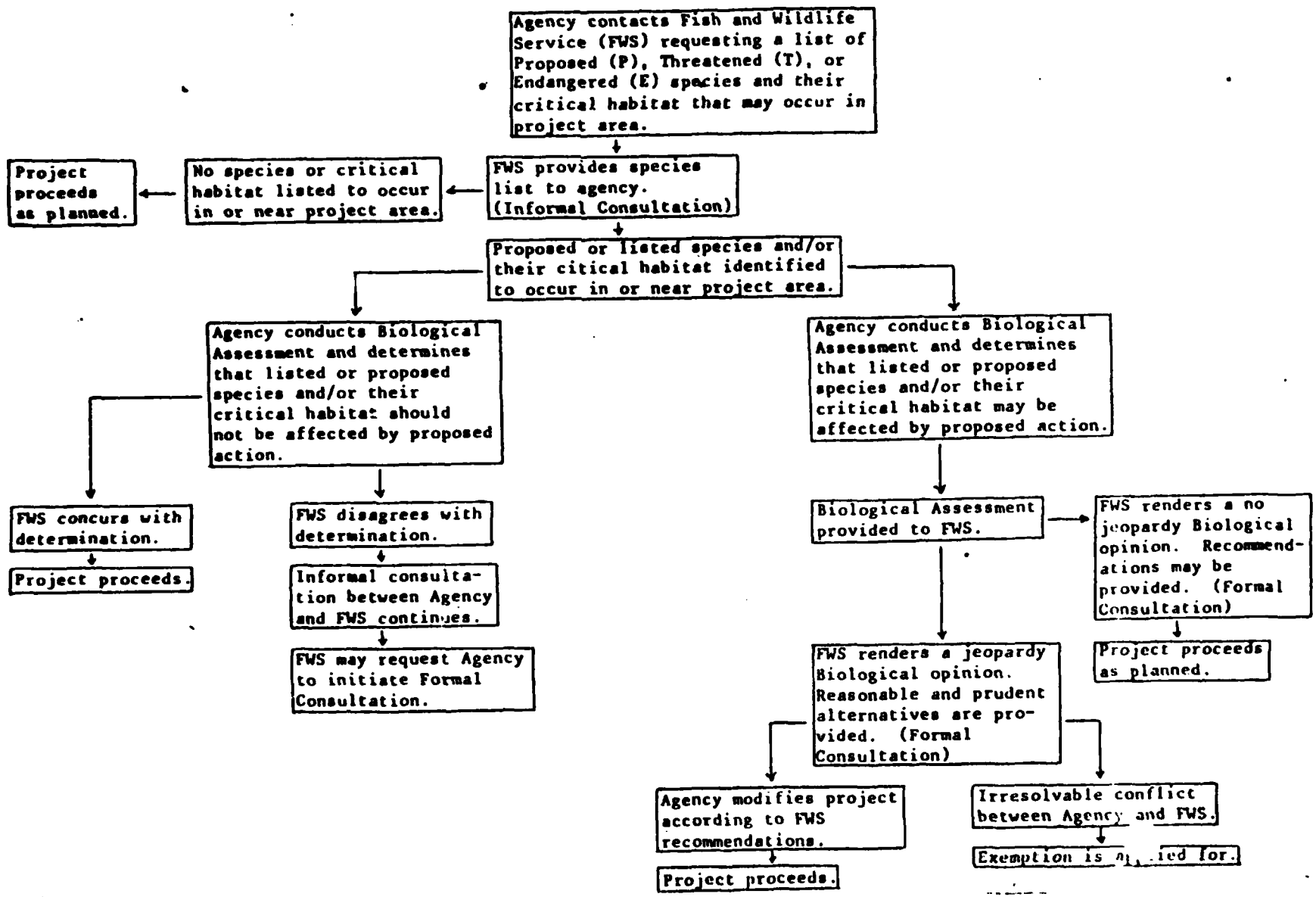
   e. Analyze alternative actions that may provide conservation measures.

5. Sections 7(a) and (b) require agencies to consult with the Fish and Wildlife Service when the Federal agency determines their action "may affect" listed species or Critical Habitat. Formal consultation may be initiated by submitting a writted request to the Field Supervisor, Fish and Wildlife Service, St. Paul Field Office, 570 Nalpak Building, 333 Sibley Street, St. Paul, Minnesota 55101. At this time, the agency should provide a copy of the biological assessment and other relevant information that assisted the in reaching their "may affect" decision.

6. Section 7(d) of the 1978 Amendments to the Endangered Species Act underscores the requirement that the Federal agency and the permit or license applicant shall not make any irreversible or irretrievable commitment of resources during the consultation period which in effect would deny the formulation or implementation of reasonable alternatives regarding their actions on any Endangered or Threatened species.

7. Federal agencies are advised to determine if State listed endangered or threatened species reside in the project area that may be adversely affected by the Federal action. The State Department of Natural Resources should be contacted to make this determination.

Overview of the
Section 7 Consultation Process
Endangered Species Act of 1973
FLOW CHART



6 JUN 1983

Environmental Resources Branch
Planning Division

Mr. Richard F. Berry
Field Office Supervisor
St. Paul Field Office, Ecological Services
U.S. Fish and Wildlife Service
570 Halpak Building
330 Sibley Street
St. Paul, Minnesota 55101

Dear Mr. Berry:

This letter responds to your planning aid letter dated March 25, 1983, for the possible construction of additional hydropower generating facilities at Upper and Lower St. Anthony Falls on the Upper Mississippi River in Minneapolis, Minnesota.

A technical report has been completed by the North Pacific Division of the Corps of Engineers. The report evaluated the feasibility of adding generating capacity at St. Anthony Falls and showed that three alternative sites could be used. Two vertical axis, fixed blade, propeller units could be installed at the upper falls, for an installed capacity of 21.0 megawatts. Each unit would discharge 3,100 cubic feet per second (cfs). A single unit could be added at the lower falls power plant to produce 5.4 megawatts using 3,600 cfs. This unit would be a horizontal axis Kaplan (adjustable blade) bulb unit. A combined falls power plant would utilize the combined head of both falls. This alternative would consist of two vertical axis, fixed blade, propeller units, generating 28.0 megawatts and using 5,500 cfs.

A tentative selection has been made which would recommend that the upper and lower falls alternatives be developed. A detailed description of the proposed plants is given in the technical report. A feasibility report and environmental assessment are scheduled for completion in July 1983.

Your recommendations have been reviewed and several meetings have been held with your staff and the Minnesota Department of Natural Resources to discuss how these recommendations might be implemented. Our responses to your recommendations are enclosed.

Sincerely,

Enclosures

Louis Kowalski
Chief, Planning Division

RECOMMENDATIONS AND RESPONSES CONCERNING
POSSIBLE CONSTRUCTION OF ADDITIONAL HYDROPOWER
GENERATING FACILITIES AT UPPER AND LOWER
ST. ANTHONY FALLS

RECOMMENDATIONS

1. Recommendation: "To assess potential impacts, information is needed from the St. Paul District concerning the anticipated diversion of flows presently going over the falls which will be used for additional hydropower generation. The information should include a comparison of normal flows and with-project flows. In general, we would recommend that such flows deviate as little as possible from existing conditions. If oxygen levels below SAF are depressed as a result of flow diversion, reaeration of flows passing through the turbines may be necessary."

Response: The information you requested is enclosed. Flow deviations would be limited to those necessary to supply the added turbines. The combined alternative would have substantially reduced the flow into the lower falls pool and will not be recommended, at least in part, because of the flow deviation. Oxygen levels meet water quality standards more than 93 percent of the time in the metropolitan area above lock and dam 1. It is not anticipated that dissolved oxygen levels would be significantly depressed as a result of diversion. Turbulent flow in the tailraces would offset some of the decrease resulting from diversion.

2. Recommendation: "As identified in the reconnaissance report, existing hydropower generation at SAF utilizes a limited storage-and-release mode of operation. To avoid and minimize additional adverse impacts to fish and wildlife resources, operation of the proposed hydropower facilities should be within these existing constraints with no additional storage-and-release of flows beyond existing conditions."

Response: It was recognized in the Reconnaissance Report for St. Anthony Falls that, because of potential adverse impacts resulting from pool fluctuations, operation of any additional hydropower must be confined to existing operating limits.

3. Recommendation: "Small trash racks or large screens should be placed in front of the intake area to prevent passage of larger fish. Screening devices should be considered to minimize entrainment losses. To minimize fishery impacts, the approach area should be devoid of lights and structural projections which would attract fish into the intake area. Recommended approach velocities for intakes at major power plants is 0.5 feet per second or less to allow fish to escape. Approach velocities at this site should be as low as possible. a. b.

"Although study results are variable, we would recommend use of horizontal Kaplan-type turbines with adjustable blades as proposed. To minimize fish mortality, turbines should be operated at maximum efficiency. Cavitation should be minimized and large clearances provided between the vanes of the runners and between runners and wicket gates. c.

"We recommend that studies be conducted by the Corps of Engineers to determine the potential for turbine-related impacts to fishery resources on the Upper Mississippi River, including hydropower proposed at St. Anthony Falls. In 1980, an ichthyoplankton study was conducted for the Northern States Power Riverside Plant upstream of St. Anthony Falls at River Mile 857 (Heberling et al. 1981). The study found a variety of species and larval stages in the drift including a sizeable number of channel catfish, an important sport fish. Projecting these data by simple proportion, an estimated 5.5 million channel catfish larvae may have drifted past this facility over the summer period. d.

"It is unfortunate that no information exists concerning an assessment of turbine-related mortality of fish from the existing hydropower facilities at SAF. To illustrate our concern at this location, flows are presently divided between the falls area and the Northern States Power Hydropower Plant. If turbine-related mortality is substantial in a worse-case situation, increasing the hydropower capacity at this site which will result in a greater diversion of flows through turbine units may have a significant adverse impact on fish populations in the SAF and downstream areas. This concern becomes even more important in future years as attempts are made to "clean up" the river and promote recreational uses including sport fishing.

"Although turbine mortality studies have been conducted at several locations, we do not feel their results are applicable to a large warm-water river like the Upper Mississippi River. Information concerning turbine-related mortality for important fishes of the Upper Mississippi River is vital to assess the probable impacts of hydropower development. We suggest these studies be conducted as soon as possible to provide this information for use in the early stages of planning. If a more suitable site does not exist, the Northern States Power Hydropower Plant contains both Francis and Kaplan turbines and may provide the opportunity for study."

Response:

a. Trash racks would be installed to prevent damage to the turbines and entrainment of large fish. It would not be cost effective to install small mesh screens with sufficient capacity to handle the flow to the turbines without clogging. Lighting would be held to a minimum in location, wattage and hours of use. However, a certain minimum would be required for safety in operation and maintenance of the units.

b. Approach velocities of 0.5 foot per second are not attainable. Hydropower installations use a proportionally greater flow than steam plants. Velocities are expected to be approximately 2 to 3 feet per second which, based on fish passage studies, should allow the majority of adult game fish to escape impingement on the trash screens.

c. The characteristics of the upper falls site dictate that a vertical type propeller turbine with fixed blades be installed. A horizontal, bulb turbine with a Kaplan (adjustable blade) runner would be installed at the lower falls site. Turbines at both sites would be set in place, relative to

the tailwater, to meet requirements for high efficiency and minimal cavitation, conditions which favor the survival of entrained fish. Clearances between various parts are determined by design considerations.

d. Considerable coordination has taken place between the Fish and Wildlife Service, Minnesota Department of Natural Resources, and Corps of Engineers with regard to the recommendation that studies be conducted to determine turbine-related impacts. It was agreed that an analysis of potential entrainment would be conducted by employing the ichthyoplankton drift data for the NSP Riverside Plant which was cited in your letter. The total drift was apportioned according to lock and power plants flows at the upper falls. A 10-percent reduction was made for upstream withdrawals but no reduction was made for natural mortality. For the purpose of analysis it was assumed that there would be total mortality of larval fish passing through the turbine. It is probable that this is an overly conservative estimate, which will be discussed further in later paragraphs. Since flows were low in 1980, the majority of the flow would have passed through turbines. Thus, this condition is considered to be a realistic "worst case" analysis of the impact of hydropower additions to the St. Anthony Falls area. In order to assess the value of the larval fish, their numbers were expressed in terms of the numbers of adults to which they would be equivalent. The Horst method of calculating equivalent adults, multiplying larva to adult survival rates by numbers of larvae, which was used in the Riverside Report, was also used for this analysis. The numbers of equivalent adult fish which would be entrained appeared to be low, especially most of the game fish. However, no population data for pool 1 were available to which the mortality estimates could be compared. Creel census data are available but tend to be biased because most of the data are from bank fishermen who are at a disadvantage compared to boat fishermen when fishing for certain species, such as walleye.

The initial mortality estimates indicated that the equivalent of no more than the creel limits of several fishermen per year would be eliminated. The Minnesota DNR suggested that the survival rates used for game fish tended to underestimate the potential mortality and that several adjustments might be made to improve the accuracy of estimation. While it is agreed that the estimation of equivalent adults could be improved, it should be noted that the method of estimating larval drift could be substantially improved as well.

Turbine mortality studies conducted at St. Anthony Falls could not be used to predict the impacts of new units because of the difference in hardware. The installed Francis units with multiple blades would tend to cause greater numbers of injuries from striking parts of the machinery than the new large diameter units with few blades and large clearances. Thus, information would not be transferable.

Prototype studies conducted on units similar to those proposed indicated that the survival rate of fish passing through a turbine is parallel and usually equal to the percent efficiency at which the unit is running. Mortality rates of 5 to 10 percent appear inevitable but may be the total caused by the unit. Head differentials are low and would not be a factor in mortality. The primary cause of mortality in the type of unit proposed would be pressure changes including cavitation. High efficiencies and deep turbine settings

(relative to the tailwater) prevent cavitation and these values are included in design criteria. It is reasonable that, if the proposed units were run in preference to the installed units, the impact of the St. Anthony Falls area on the fishery might actually decrease.

After reviewing the information discussed above, the biologists from the three agencies agreed that no significant impacts on the fishery could be predicted to result from the installation of additional hydropower. It was determined that sufficient information was developed in the analysis of larval drift data and that turbine mortality studies would not be required. It was also agreed that improved methods of determining larval drift, additional information on fish populations in the river, or improvements in fish habitat quality in the vicinity would be cause to acquire additional data on the fishery resources of the St. Anthony Falls area.

4. Recommendation: "Construction impacts should be minimized. If dredging is required, suitable upland disposal sites must be utilized for disposal especially if the dredged material is contaminated. Turbidity and impacts to benthic organisms should be minimized. Existing transmission lines and crossings should be utilized for electrical transmission."

Response: It is anticipated that dredging would not be required. Cofferdams would be placed to allow dry excavation but only a small area of river bottom would be disturbed. This technique would create less turbidity increases and benthic impacts than other construction methods although short-term impacts would be associated with placement and removal of cofferdams. Suitable upland disposal sites would be used to dispose of excavated material.

The generators would be connected by overhead line to the switch gear in the Main Street Hydro Plant. From there, existing substation transformers, transmission lines, and crossings would be utilized.

5. Recommendation: "Adverse impacts associated with a diversion of flows completely away from SAF and the lower pool are not known but would likely be more severe than the diversion likely to occur in Alternative A, where flows would be diverted only a short distance downstream of the falls. Adverse impacts to the wooded bluffs are not anticipated under Alternative A. We therefore recommend that Alternative B be dropped from further consideration and Alternative A selected as the final plan for hydropower development at SAF."

Response: The plan which you refer to as Alternative A has been selected as the recommended plan.

MITIGATION MEASURES

Under the heading of Mitigation Measures you have offered the following for consideration:

Item 1. "Consideration should be given to the installation of large riprap in the new tailrace areas to provide habitat for fish and benthic organisms. Riprap should also be used to protect any shoreline areas which may require

stabilization from erosion. Riprap should extend below the ordinary high water mark to provide habitat for aquatic organisms."

Response: Riprap would be placed to prevent scour of the shoreline and tailrace areas. Large riprap would be placed in tailrace areas and all riprap would extend below the normal pool elevation.

Item 2. "A supply of fresh water could be added to the backwater areas immediately below the Main Street Hydro Plant. These backwaters are the only such habitat in this area of the river. The addition of river water into the upper portions of these areas, via a culvert or similar means, would improve their habitat value for fish and wildlife. Since these backwaters are also part of the Father Hennepin Bluffs Park which receives substantial public use, improvements to water quality will also improve the aesthetic value of this area in general."

Response: A flow of fresh water into the abandoned tailrace areas on Hennepin Island would certainly be beneficial. This is evident where water from the Hennepin Island Hydro Station trash rack sluiceway flows into part of the tailrace area. Benthic life is common and diverse and the water is clear and aerated.

A 5-foot sluiceway connects a portion of the tailrace to the upper pool via the Main Street Station. Northern States Power Company officials have indicated that they would be willing to consider the opening of this sluiceway which is presently closed by stoplogs. It is estimated that the flow would be greater than the Hennepin Island Sluice and, on that basis, would appear to be sufficient to improve the water quality in a portion of the tailrace area. The Minneapolis Park Board should be consulted before action is taken on this item. It does not depend on the hydro project for implementation.

Item 3. "Public access to the Upper Mississippi River is quite limited in the St. Anthony Falls area. There are presently no public boat launching facilities between Lower St. Anthony Falls and Lock and Dam 1. Although not a mitigative measure as such, we request that consideration be given to providing public boating access and facilities for shoreline and pier fishing. Tureson (1978) found that bank fishing accounted for approximately 75% of the angling effort in the SAF area while pier fishing comprised only 5%. Improvements might also include facilities for the handicapped and elderly."

Response: High banks, commercial barge traffic, lack of public land, and significant safety considerations are some of the reasons for the lack of public boat access and shore fishing facilities near the St. Anthony Falls hydro plants. Pool 1 also has high banks but less commercial congestion and fewer safety hazards. However, the city of Minneapolis is not encouraging the addition of boat launching or improved fishing access.

INFORMATION NEEDED

The items listed under the category of Information Needed have been discussed in previous paragraphs but are reiterated here.

1. No water level changes are planned.

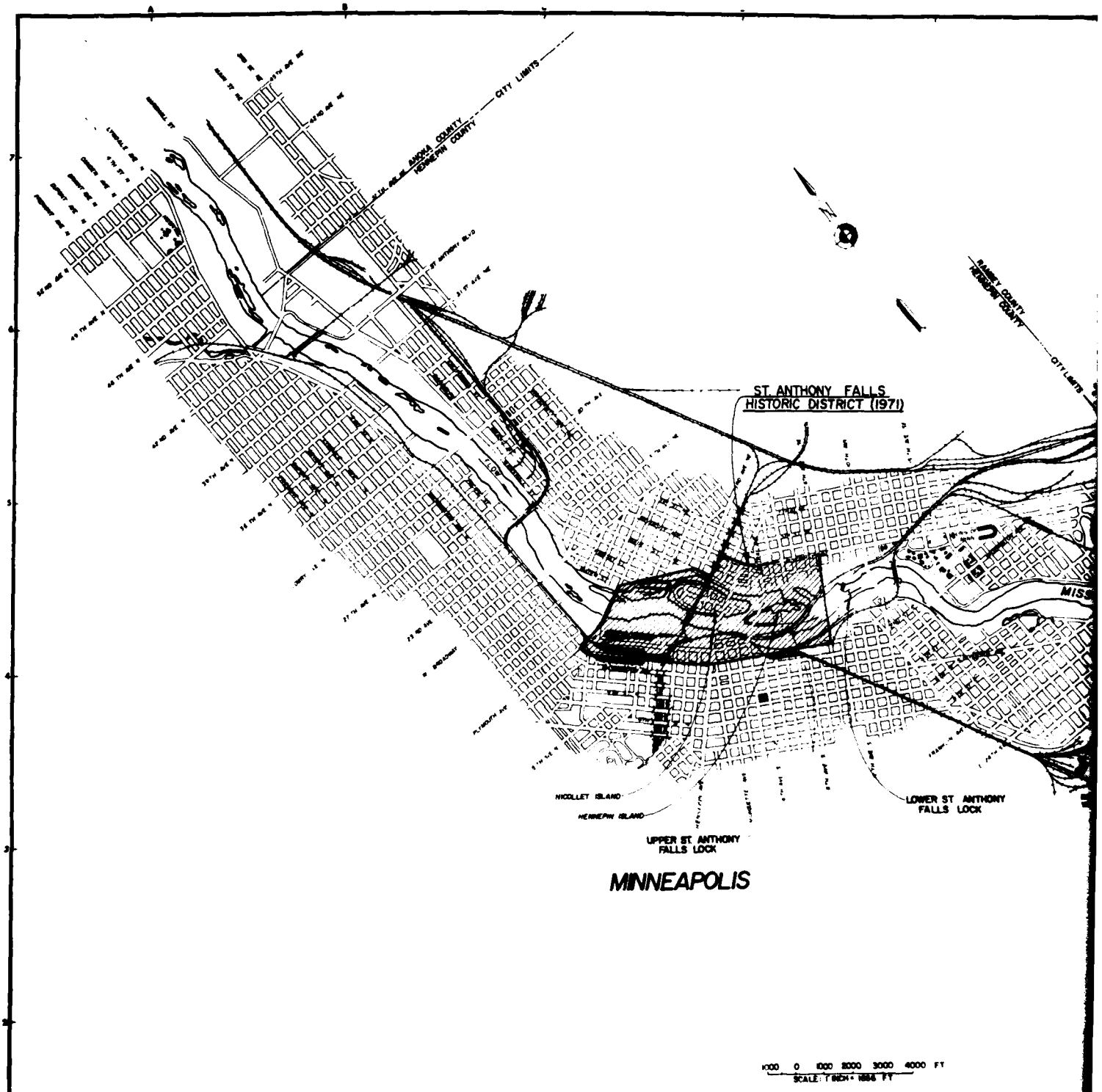
2. Information on potential diversion of flows is included.

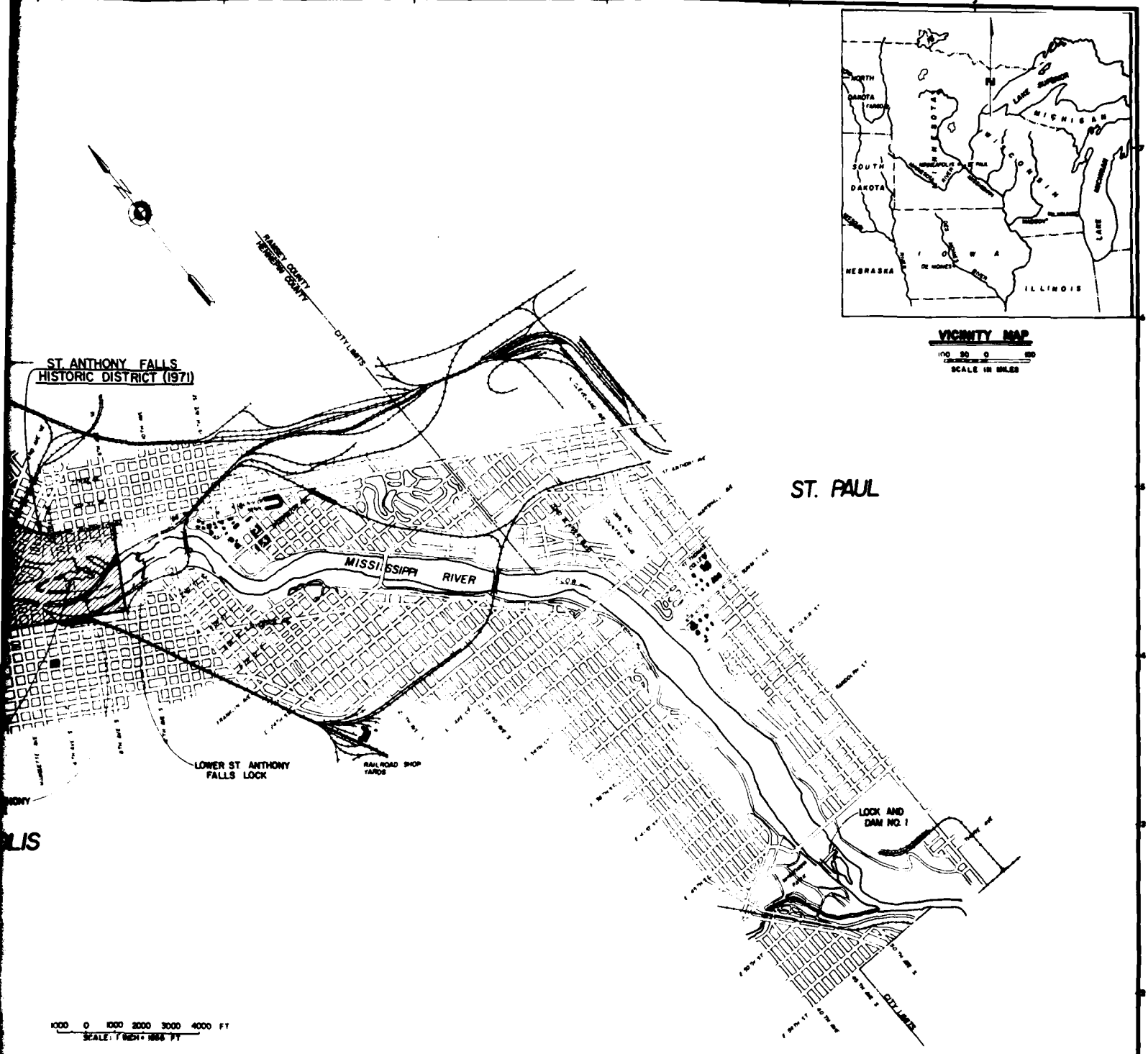
3. It was determined that turbine mortality studies would not be conducted.

4. Engineering plans and the technical report are included.

5. Dredging would not be required.

6. Mitigation features are discussed.


ST. ANTHONY FALLS
HISTORIC DISTRICT (1971)
NICOLLET ISLAND
HENNEPIN ISLAND
UPPER ST ANTHONY
FALLS LOCK
LOWER ST ANTHONY
FALLS LOCK
MINNEAPOLIS
1000 0 1000 2000 3000 4000 FT
SCALE: 1 INCH = 1854 FT



VICINITY MAP

100 50 0 100
SCALE IN MILES

Note Source: cg Dwg STA-O/1

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
APPROVED:

MISSISSIPPI RIVER
ST. ANTHONY FALLS

LOCATION MAP

HYDROPOWER FEASIBILITY STUDY

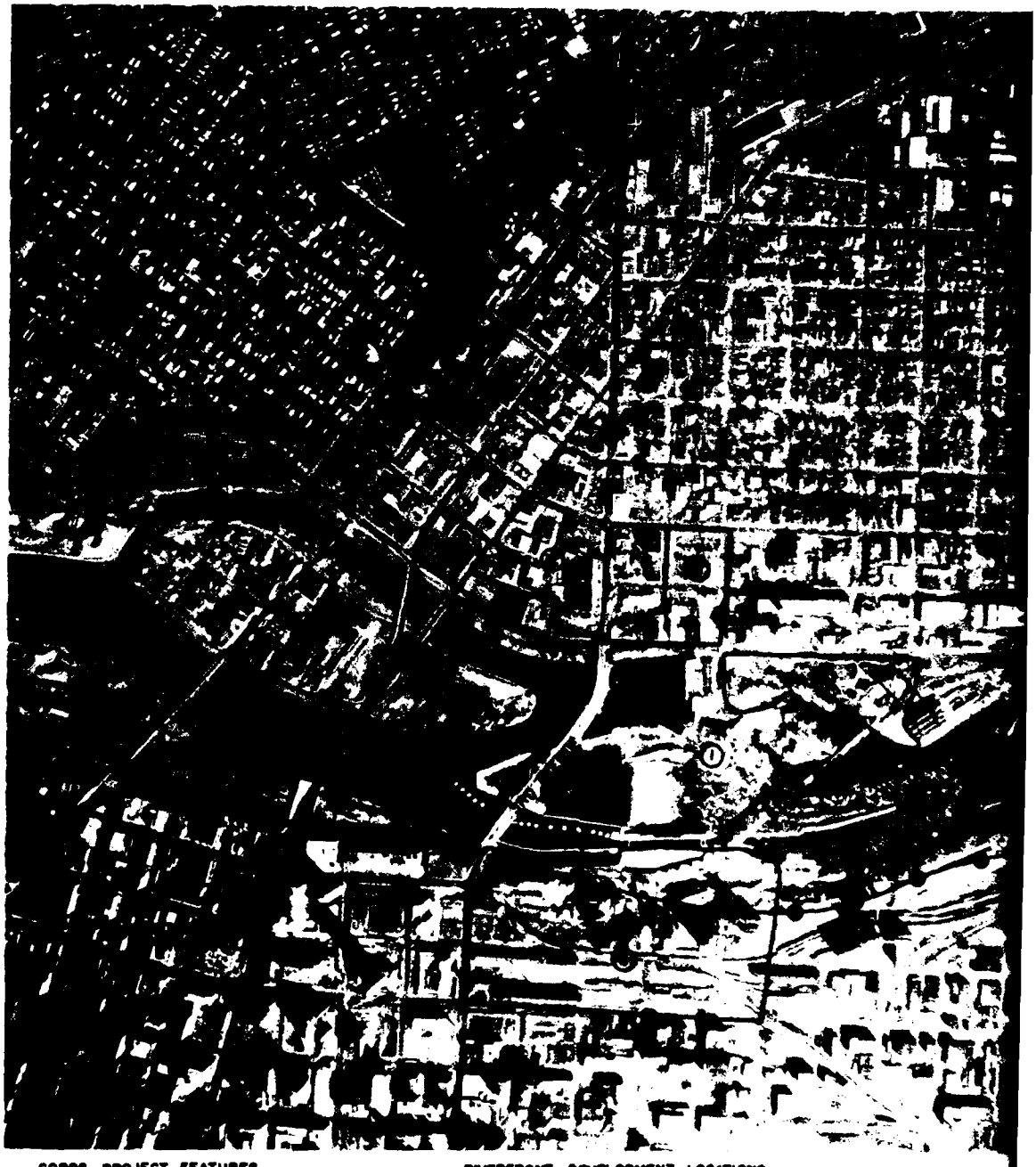
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SHEET OF

PLATE 1

2



CORPS PROJECT FEATURES

1. UPPER FALLS POWER SITE (PROPOSED)
2. LOWER FALLS POWER SITE (PROPOSED)
3. HORSESHOE DAM (EXISTING)
4. LOWER ROLL DAM (EXISTING)

RIVERFRONT DEVELOPMENT LOCATIONS

5. RIVERPLACE
6. MILLS DISTRICT
7. HERITAGE LANDING
8. CENTRAL RIVERFRONT DEVELOPMENT "OPEN SPACES"
9. NICOLLET ISLAND INN
10. GEORGE STREET FLATS AND THE LOFTS
11. ST. ANTHONY MAIN
12. MARQUETTE AND COKE SITES
13. FATHER HENNEPIN BLUFFS PARK



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VELOPMENT LOCATIONS

IE
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LANDING
RIVERFRONT DEVELOPMENT "OPEN SPACES"
ISLAND INN
ITREET FLATS AND THE LOFTS
DNY MAIN
'E AND COKE SITES
ENNEPIN BLUFFS PARK

GREAT RIVER ROAD (PROPOSED)

PHOTOGRAPH TAKEN 17 NOV 1978
BY OWEN AYRES & ASSOCIATES
INC., MADISON, WISCONSIN

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

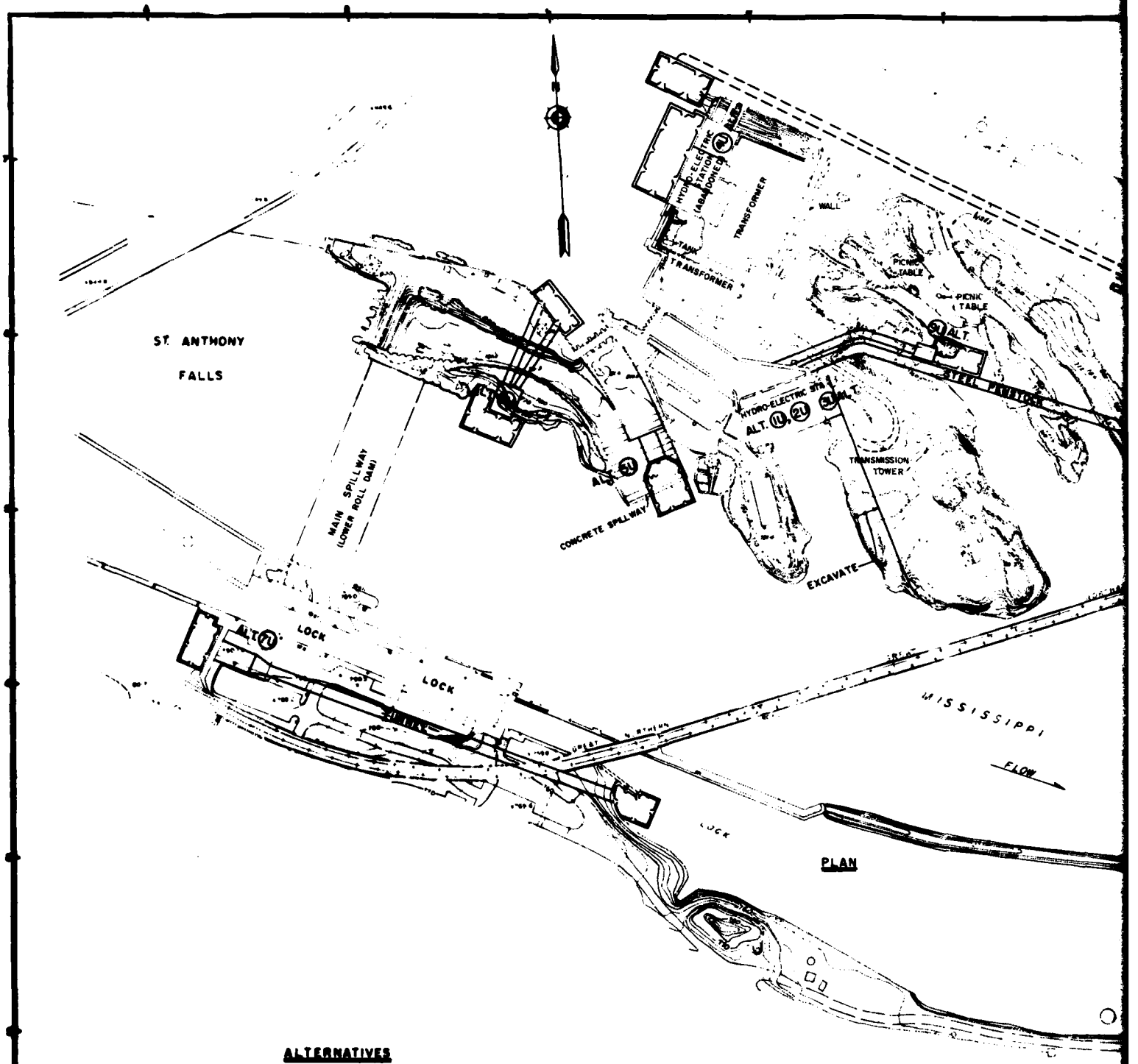
MISSISSIPPI RIVER
ST. ANTHONY FALLS
AERIAL VIEW
HYDROPOWER FEASIBILITY STUDY

SUBMITTED BY:
APPROVED:
DATE:

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SHEET OF

PLATE 2

2



ALTERNATIVES

1. REPLACE EXISTING UNITS WITH NEW LARGER UNITS.
2. REHABILITATE EXISTING UNITS. REHABILITATION MAY BE DONE IN COMBINATION WITH OTHER ALTERNATIVES.
3. ADD NEW UNIT (S) TO EXISTING HYDRO-ELECTRIC STATION.
4. INSTALL NEW UNIT (S) IN ABANDONED HYDRO-ELECTRIC STATION.
5. INSTALL NEW UNIT (S) IN WASTEWAY.
6. INSTALL NEW UNIT(S) WITH CROSS ISLAND FEED.
7. INSTALL NEW UNIT (S) PARALLEL TO LOCK.
8. a. INSTALL PENSTOCK AND NEW POWERHOUSE TO REPLACE EXISTING POWERHOUSE AT UPPER AND LOWER.
   b. INSTALL PENSTOCK TO FEED NEW UNITS LOCATED AT L.S.A.F. HYDRO-ELECTRIC STATION (POWERHOUSE).
   c. INSTALL CANAL AND NEW POWERHOUSE TO REPLACE EXISTING POWERHOUSE AT UPPER AND LOWER.
   d. INSTALL CANAL TO FEED NEW UNITS LOCATED AT L.S.A.F. HYDRO-ELECTRIC STATION (POWERHOUSE).
9. INSTALL NEW UNIT (S) IN ABANDONED CHANNEL.
10. REPLACE EXISTING UNITS.
11. ADD NEW UNIT (S) TO EXISTING HYDRO-ELECTRIC STATION.
12. INSTALL NEW UNITS IN AUXILIARY LOCK.
13. REPLACE UNITS AS NECESSARY TO FIT ADDITIONAL UNIT AT SOUTH END OF EXISTING L.S.A.F. HYDRO-ELECTRIC STATION.
14. REHABILITATE EXISTING UNITS. REHABILITATION MAY BE DONE IN COMBINATION WITH OTHER ALTERNATIVES.

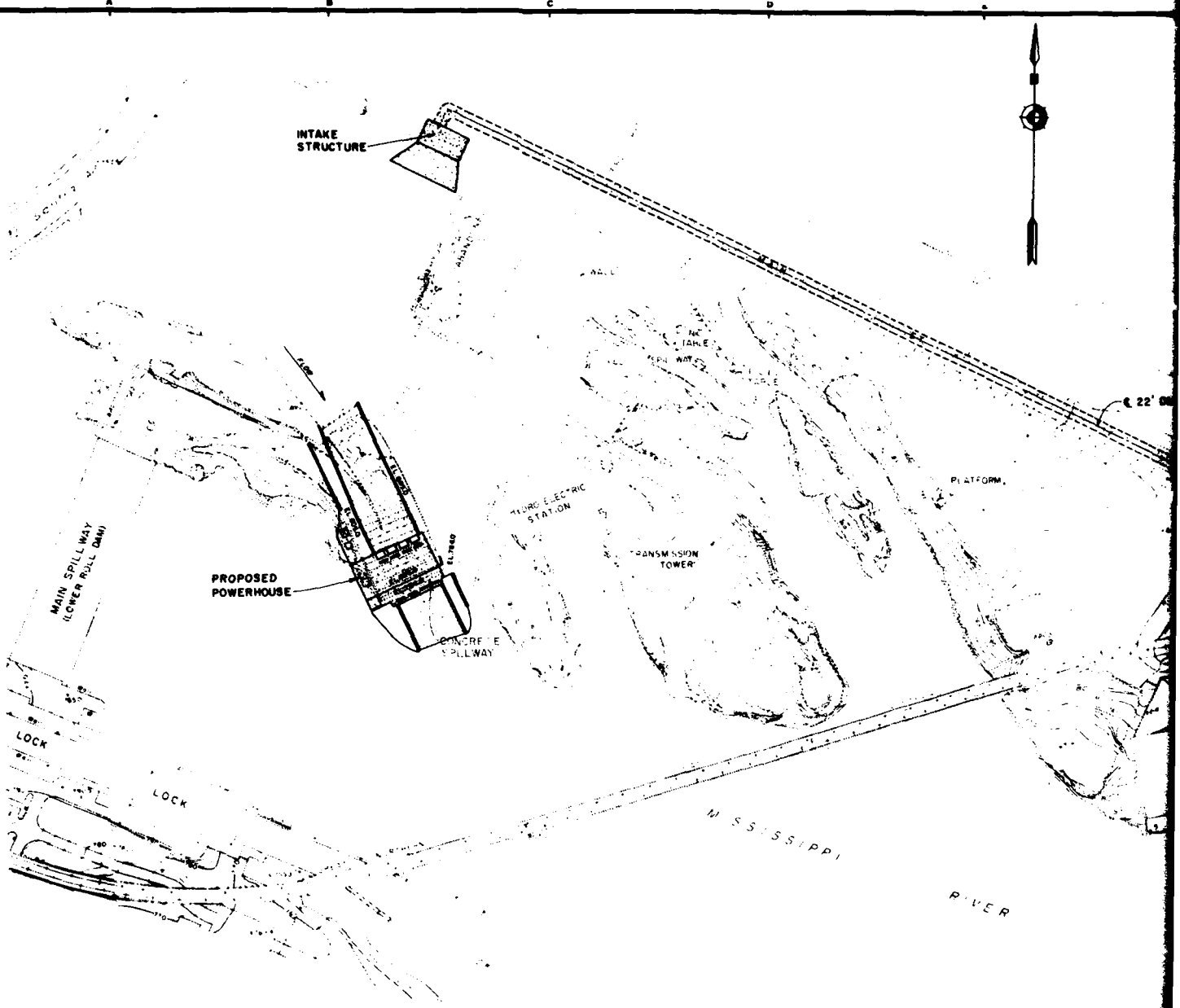
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DRO-ELECTRIC STATION.
NATIVES.

PLATE 3

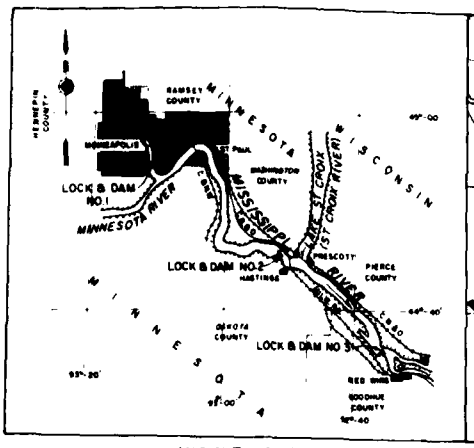
CORPS OF ENGINEERS



PLAN

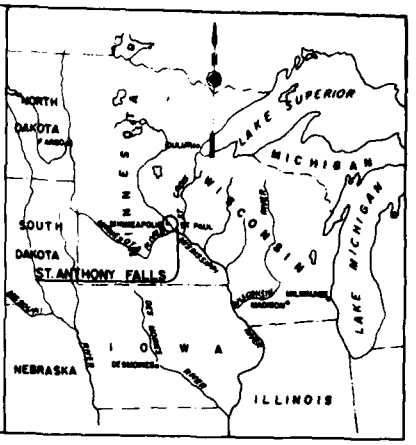
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SCALE IN FEET



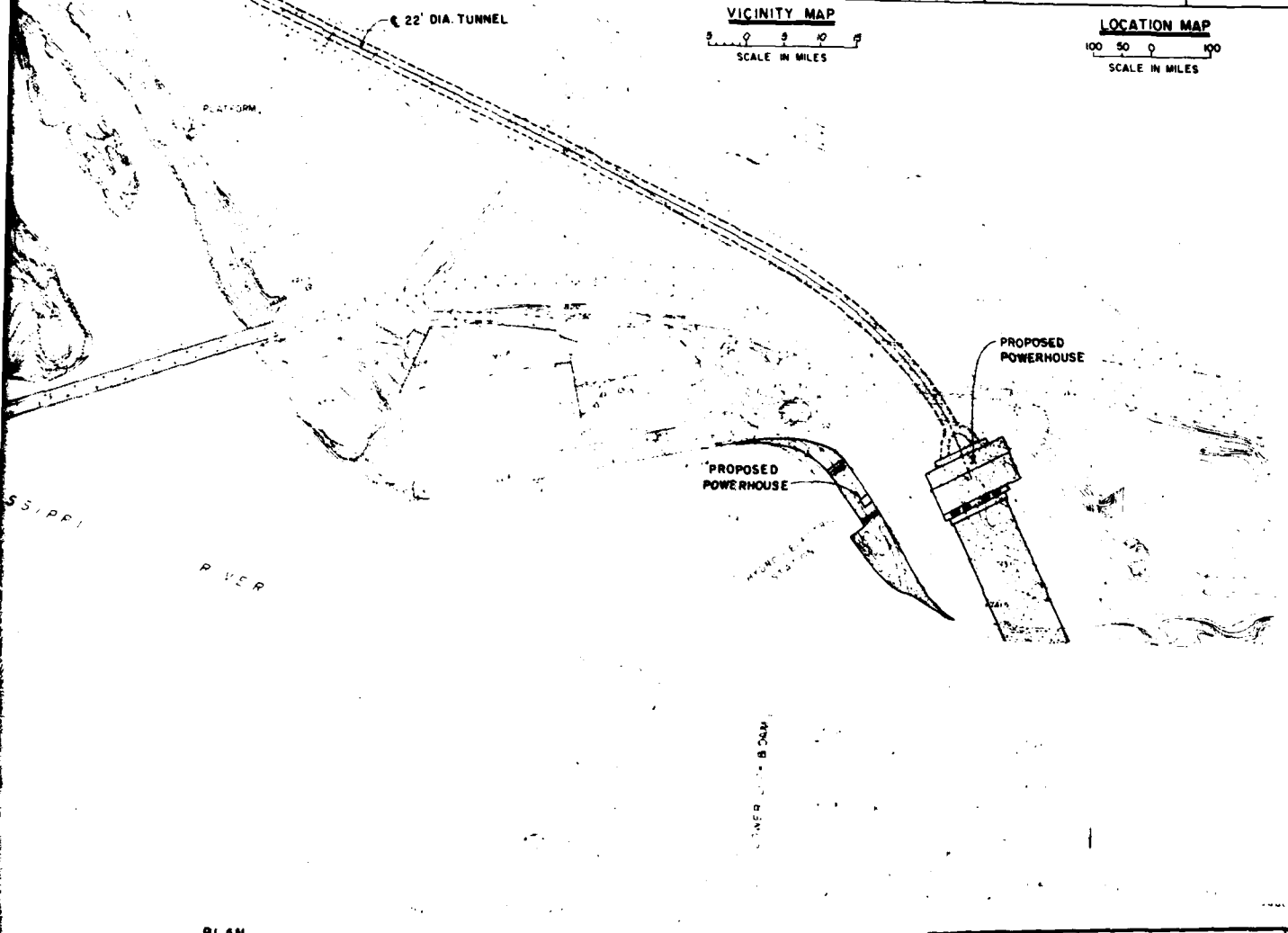
VICINITY MAP

SCALE IN MILES



LOCATION MAP

SCALE IN MILES



PLAN

SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

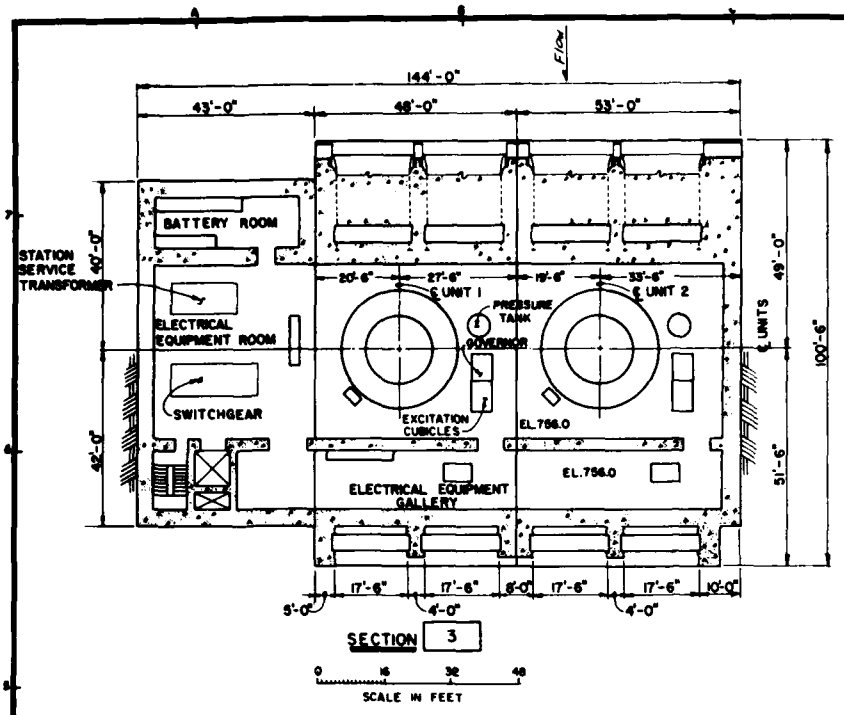
MISSISSIPPI RIVER
ST. ANTHONY FALLS
PRINCIPAL POWERHOUSE PLANS
HYDROPOWER FEASIBILITY STUDY

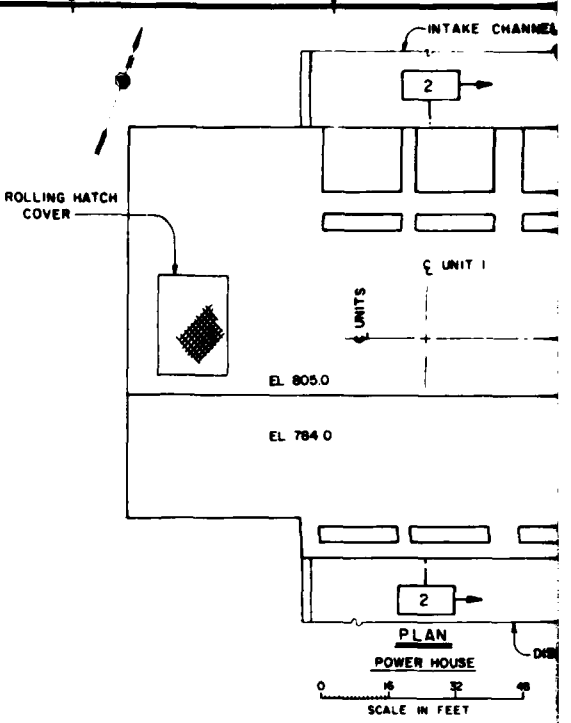
SUBMITTED BY:
APPROVED:
DATE: MAY 1983
AS SHOWN

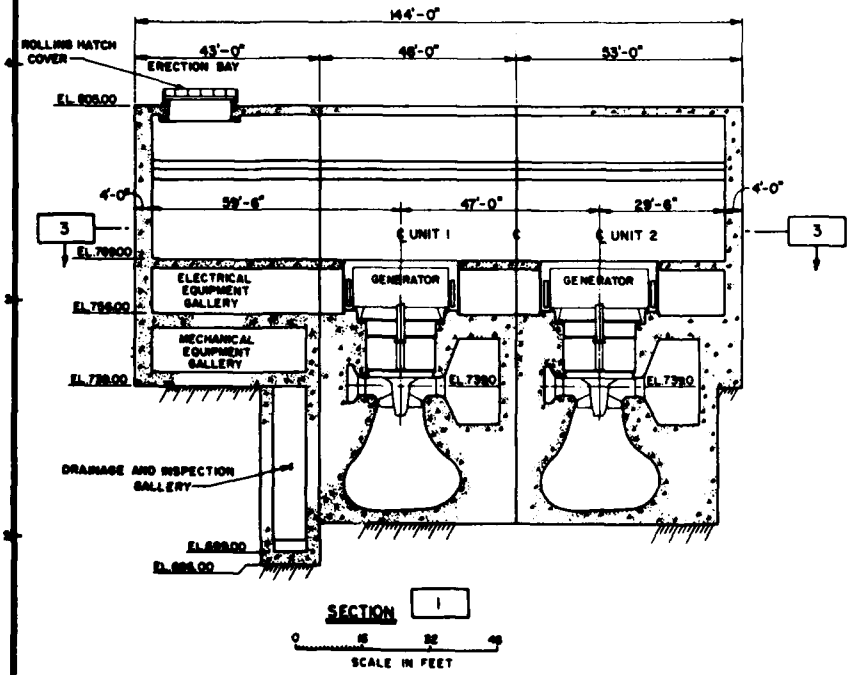
SAFETY PAYS

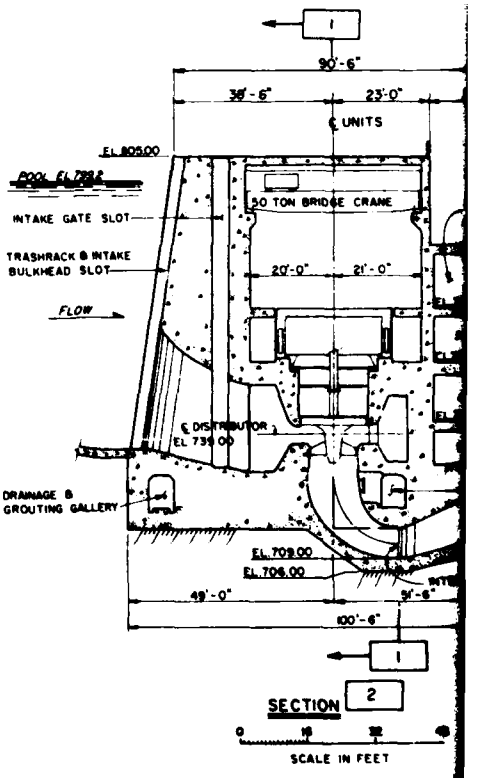
PLATE 4

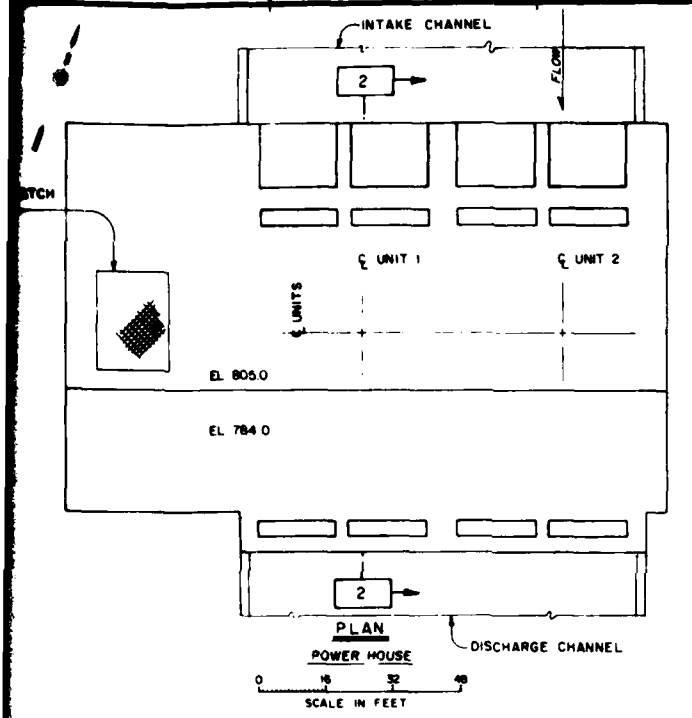
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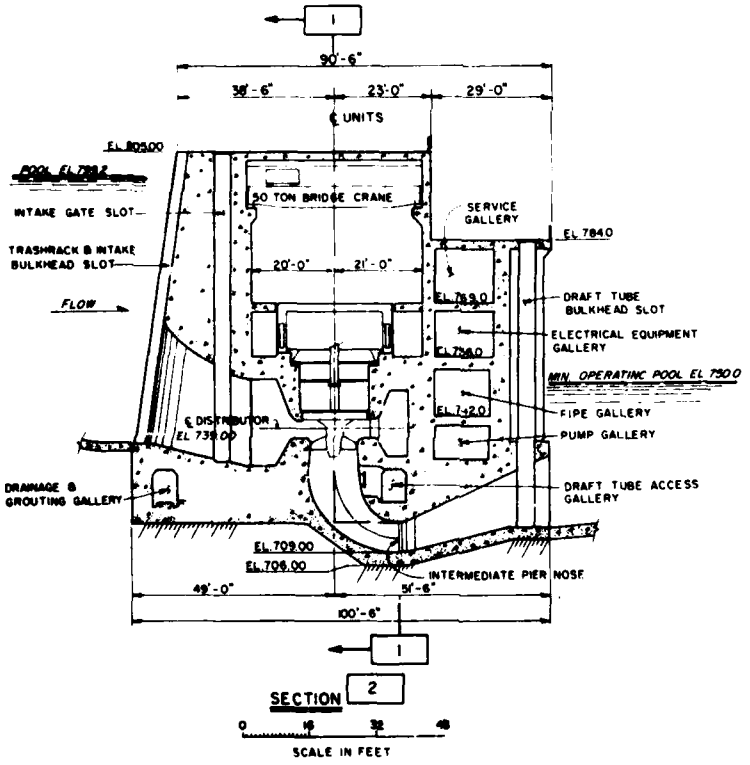

144'-0"
43'-0"
48'-0"
53'-0"
FLOW
BATTERY ROOM
STATION SERVICE TRANSFORMER
40'-0"
ELECTRICAL EQUIPMENT ROOM
SWITCHGEAR
42'-0"
20'-6"
27'-6"
19'-6"
33'-6"
℄ UNIT 1
℄ UNIT 2
PRESSURE TANK
GOVERNOR
EXCITATION CUBICLES
EL. 756.0
EL. 756.0
ELECTRICAL EQUIPMENT GALLERY
℄ UNITS
49'-0"
100'-6"
51'-6"
17'-6"
17'-6"
5'-0"
17'-6"
17'-6"
10'-0"
5'-0"
4'-0"
4'-0"
SECTION 3
0 16 32 48
SCALE IN FEET


INTAKE CHANNEL
2
ROLLING HATCH COVER
℄ UNIT 1
℄ UNITS
EL 805.0
EL 784.0
2
PLAN
POWER HOUSE
0 16 32 48
SCALE IN FEET


144'-0"
ROLLING HATCH COVER
43'-0"
ERECTION BAY
48'-0"
53'-0"
EL. 805.00
4'-0"
59'-6"
47'-0"
29'-6"
4'-0"
3
3
EL. 799.00
℄ UNIT 1
℄ UNIT 2
ELECTRICAL EQUIPMENT GALLERY
GENERATOR
GENERATOR
EL. 756.00
MECHANICAL EQUIPMENT GALLERY
EL. 739.00
EL. 739.0
EL. 739.0
DRAINAGE AND INSPECTION GALLERY
EL. 686.00
EL. 686.00
SECTION 1
0 16 32 48
SCALE IN FEET


1
90'-6"
36'-6"
23'-0"
℄ UNITS
EL. 805.00
POOL EL. 799.4
50 TON BRIDGE CRANE
INTAKE GATE SLOT
TRASHRACK & INTAKE BULKHEAD SLOT
20'-0"
21'-0"
FLOW
℄ DISTRIBUTOR EL. 739.00
DRAINAGE & GROUTING GALLERY
EL. 709.00
EL. 706.00
49'-0"
100'-6"
1
SECTION 2
0 16 32 48
SCALE IN FEET





SYMBOL	DESCRIPTION	DATE	APPROVED

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

DESIGNED BY:	
DRAWN BY:	TLB
CHECKED BY:	
SUBMITTED BY:	
SUPV. ENGR.	
APPROVED:	
CHIEF, ENGR. DIV.	

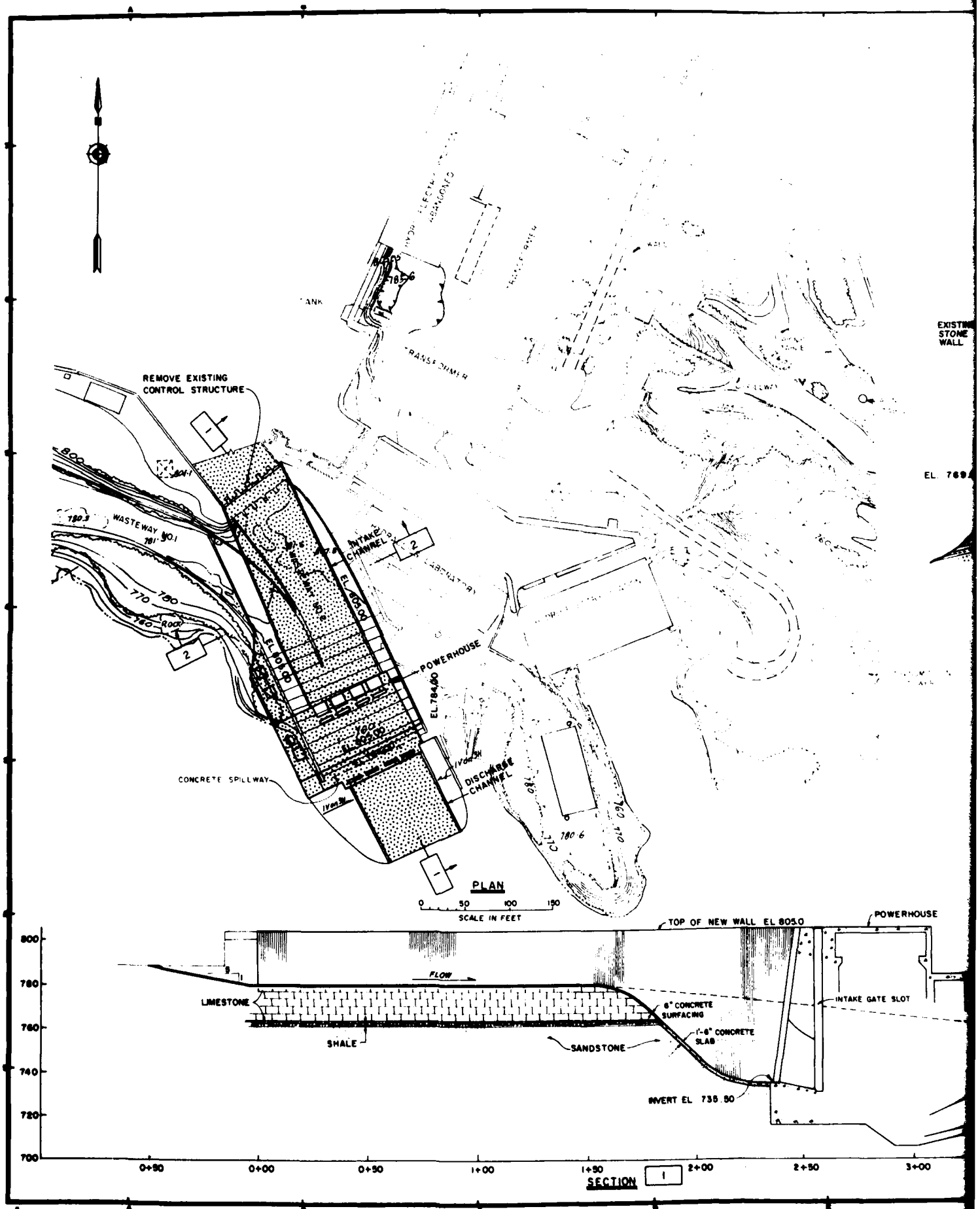
MISSISSIPPI RIVER
UPPER ST. ANTHONY FALLS
POWER HOUSE
PLAN & SECTIONS

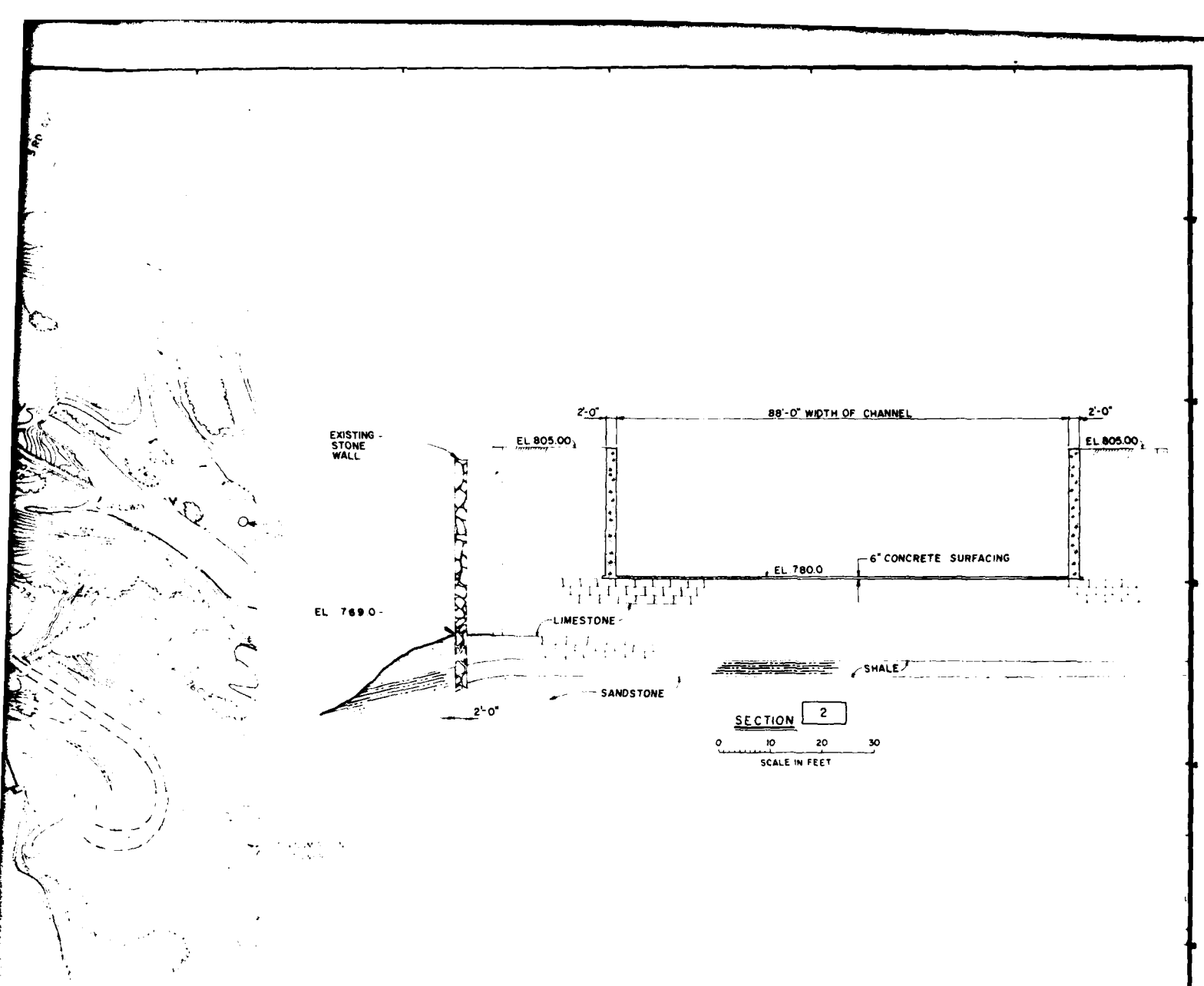
DATE: MAY 1983

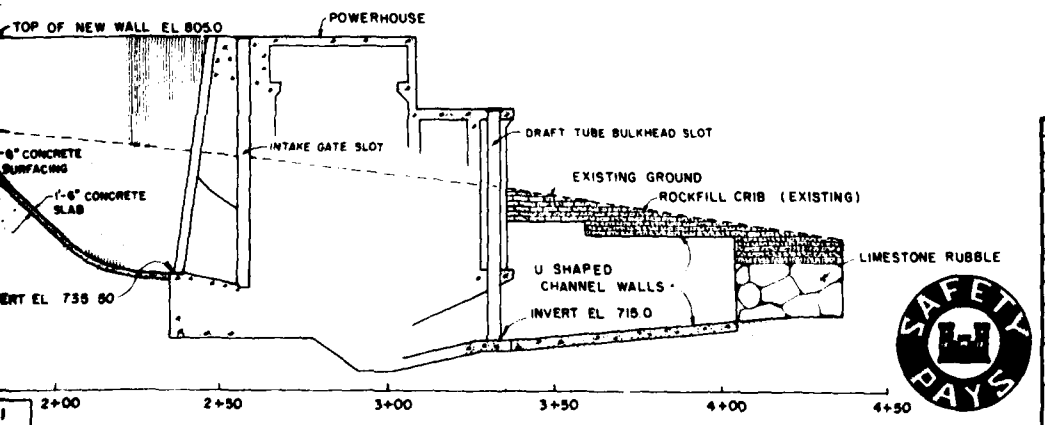
SCALE: AS SHOWN
CONT. NO.
DRAWING NUMBER
SHEET 6F

SAFETY PAYS

PLATE 5


REMOVE EXISTING CONTROL STRUCTURE
WASTEWAY
INTAKE CHANNEL
POWERHOUSE
EL. 784.00
CONCRETE SPILLWAY
DISCHARGE CHANNEL
EXISTING STONE WALL
PLAN
0 50 100 150
SCALE IN FEET
TOP OF NEW WALL EL 805.0
POWERHOUSE
FLOW
LIMESTONE
SHALE
SANDSTONE
6" CONCRETE SURFACING
1'-6" CONCRETE SLAB
INTAKE GATE SLOT
INVERT EL 738.50
800
780
760
740
720
700
0+50
0+00
0+50
1+00
1+50
2+00
2+50
3+00
SECTION 1





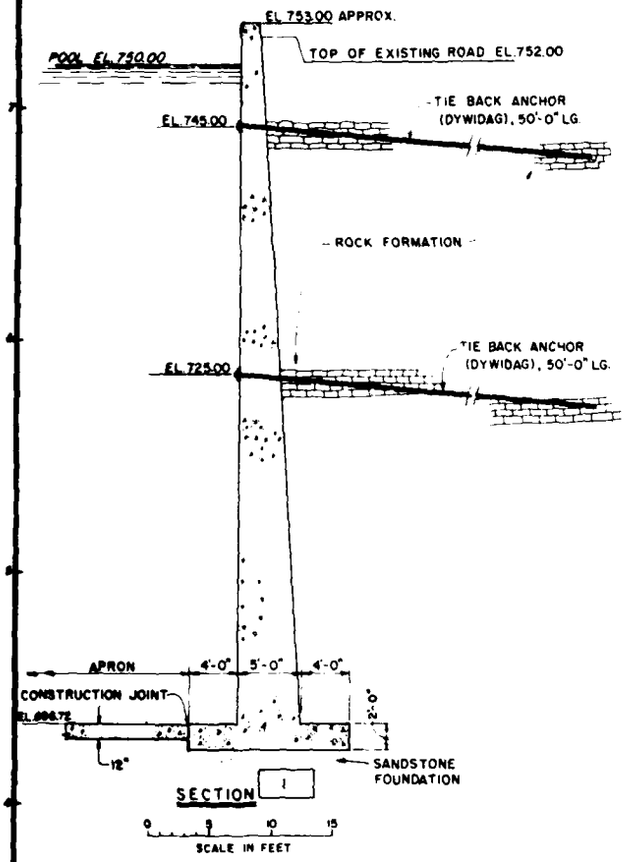
SAFETY PAYS

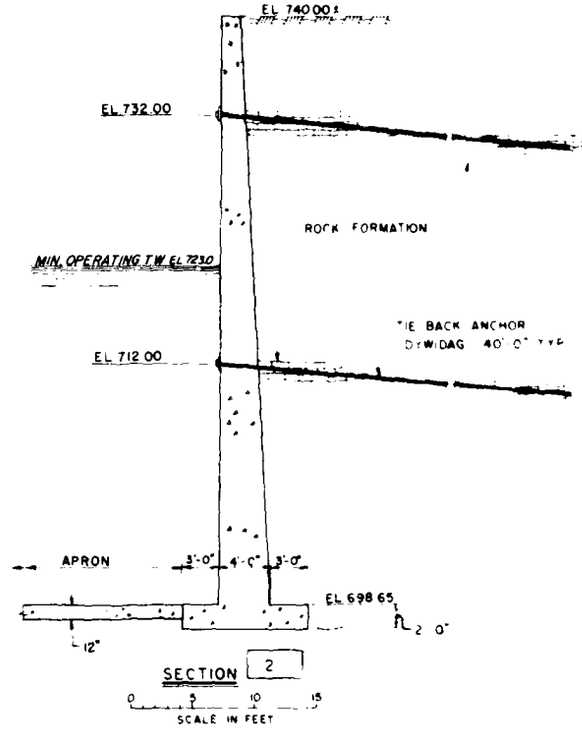
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

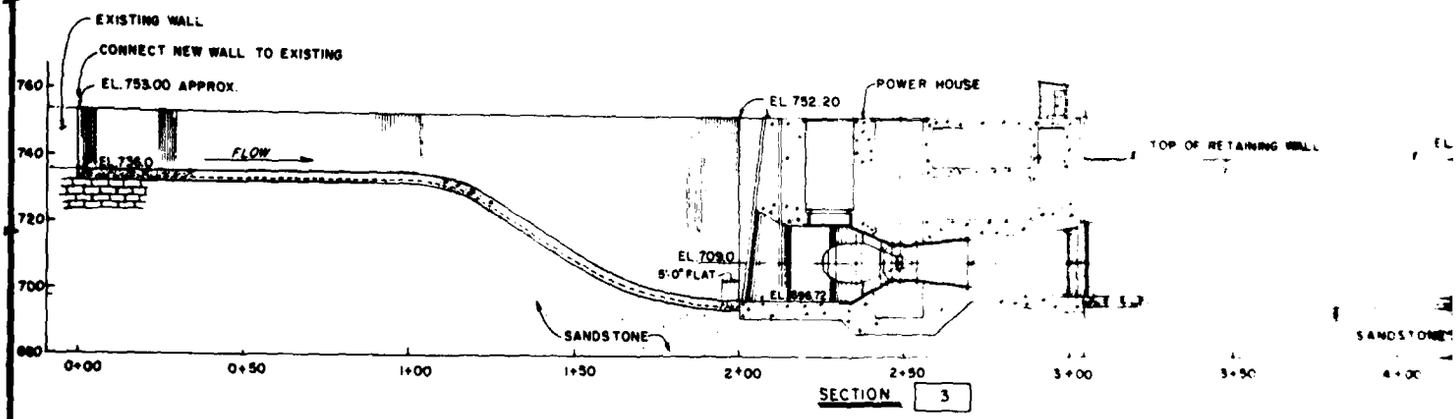
MISSISSIPPI RIVER
UPPER ST. ANTHONY FALLS
POWERHOUSE SITE PLAN
PROFILE & CHANNEL SECTIONS

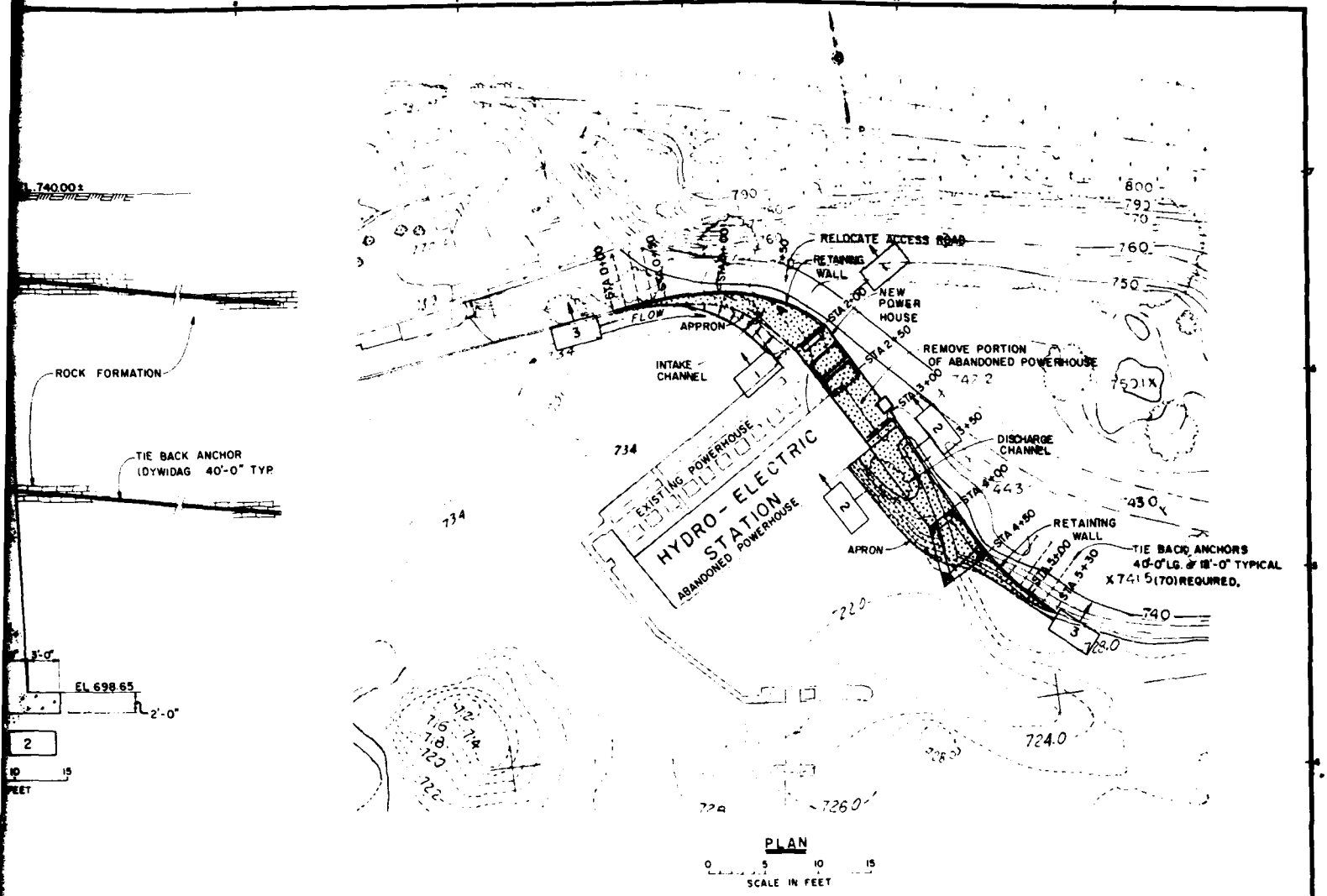
DESIGNED BY:
DRAWN BY: KM
TRACED BY:
SUBMITTED BY:
APPROVED:
DATE: JUNE 1983
SCALE: AS SHOWN

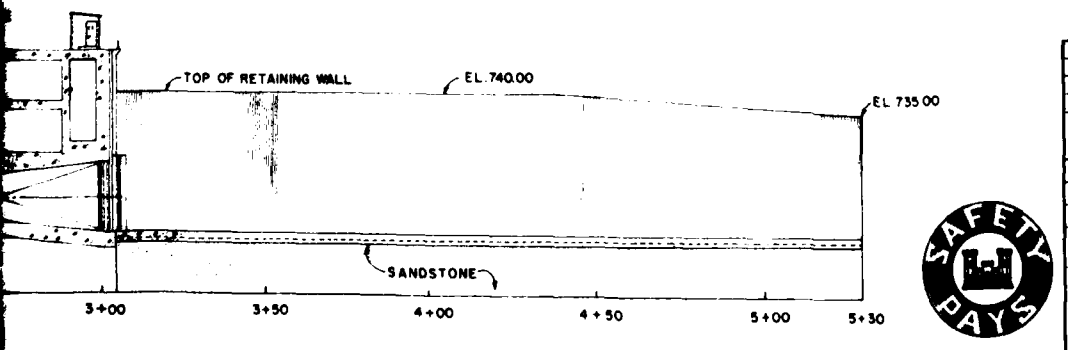
PLATE 6


EL 753.00 APPROX.
POOL EL 750.00
TOP OF EXISTING ROAD EL 752.00
TIE BACK ANCHOR (DYWIDAG), 50'-0" LG.
EL 745.00
ROCK FORMATION
TIE BACK ANCHOR (DYWIDAG), 50'-0" LG.
EL 725.00
APRON
4'-0"
5'-0"
4'-0"
CONSTRUCTION JOINT
EL 696.72
2'-0"
12"
SANDSTONE FOUNDATION
SECTION 1
0
5
10
15
SCALE IN FEET


EL 740.00±
EL 732.00
ROCK FORMATION
MIN. OPERATING T.W. EL 723.0
TIE BACK ANCHOR
DYWIDAG 40'-0" TYP.
EL 712.00
APRON
3'-0"
4'-0"
3'-0"
EL 698.65
2'-0"
12"
SECTION 2
0
5
10
15
SCALE IN FEET


EXISTING WALL
CONNECT NEW WALL TO EXISTING
EL. 753.00 APPROX.
760
740
720
700
680
EL 736.0
FLOW
EL 752.20
POWER HOUSE
TOP OF RETAINING WALL
EL 709.0
5'-0" FLAT
EL 696.72
SANDSTONE
SANDSTONE
0+00
0+50
1+00
1+50
2+00
2+50
3+00
3+50
4+00
SECTION 3





SAFETY PAYS

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

MISSISSIPPI RIVER
LOWER ST.ANTHONY FALLS
POWERHOUSE SITE PLAN
PROFILE CHANNEL, SECTIONS

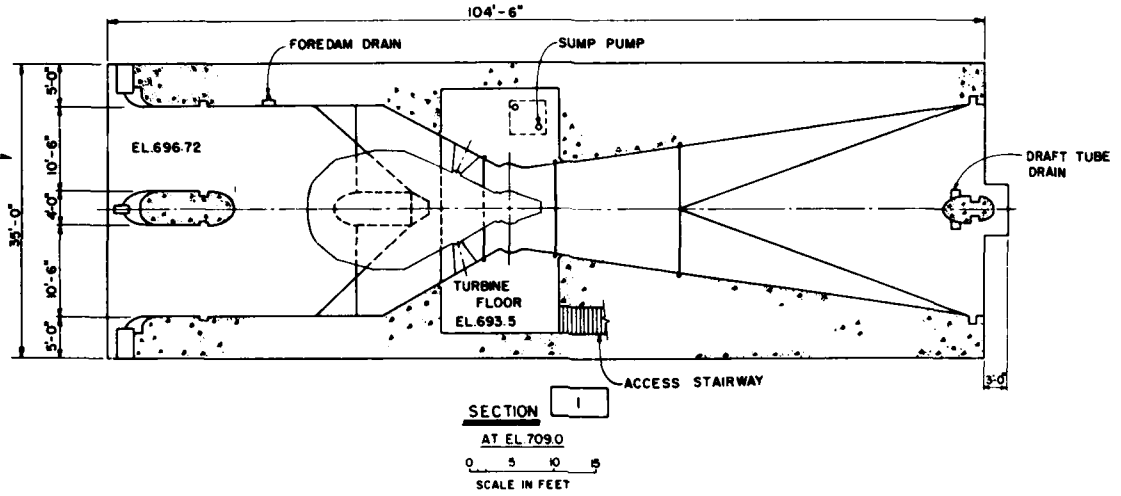
DATE:
JUNE 1983

AS SHOWN

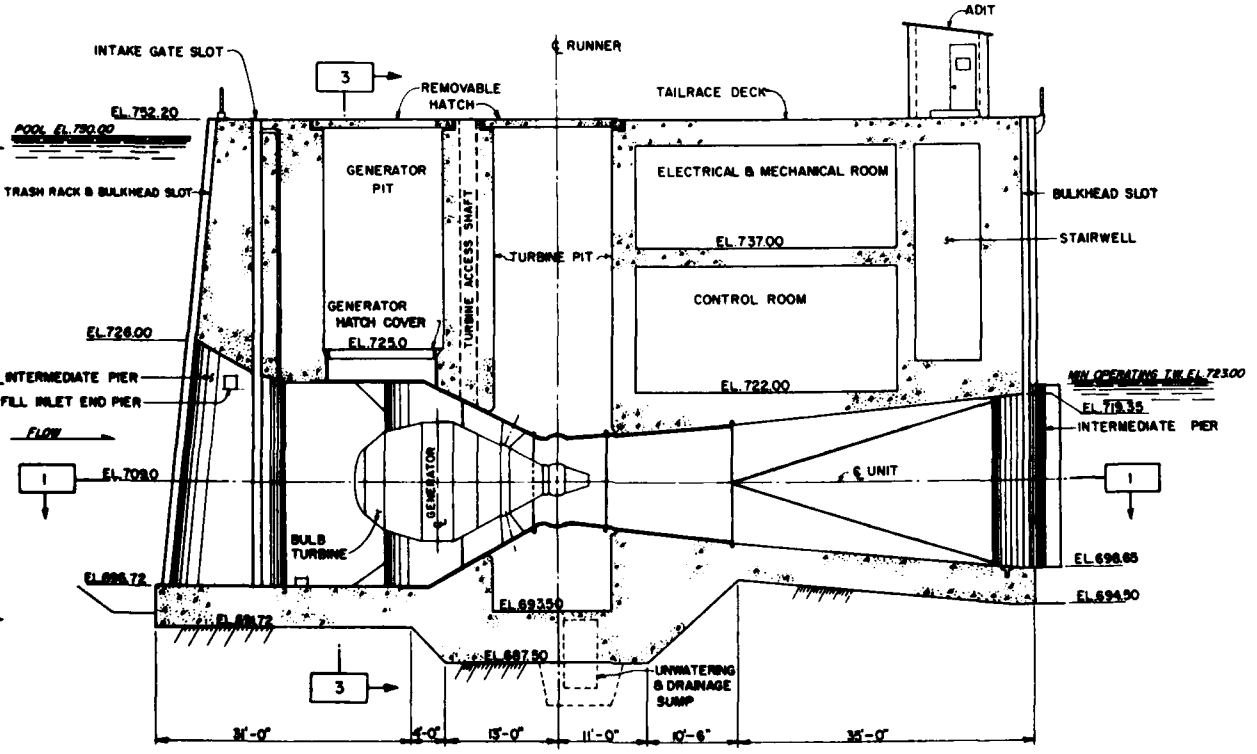
DRAWING NUMBER

SHEET OF

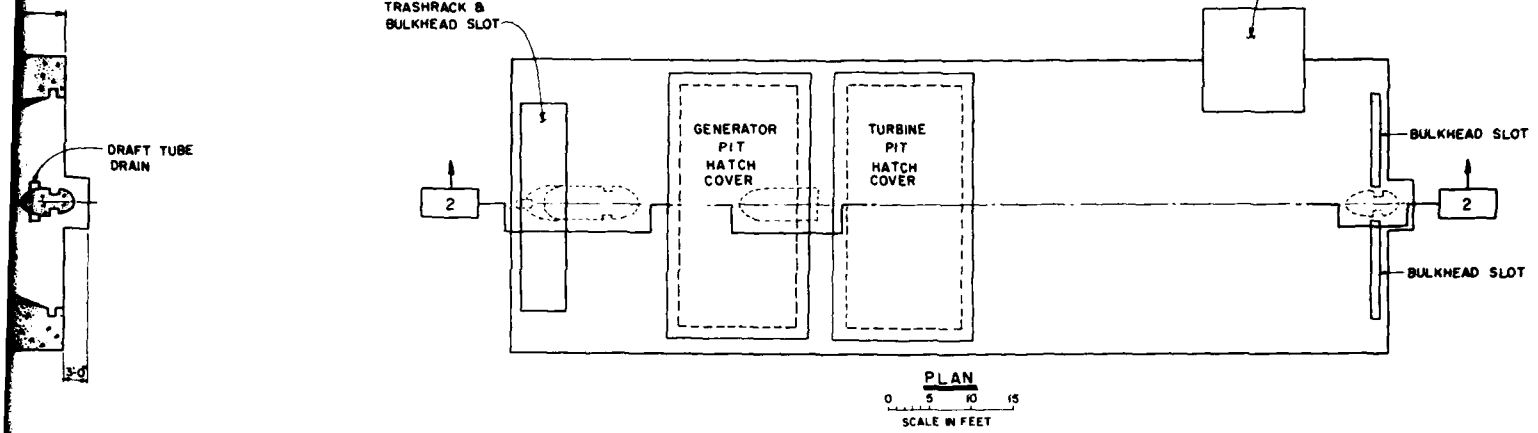
PLATE 7

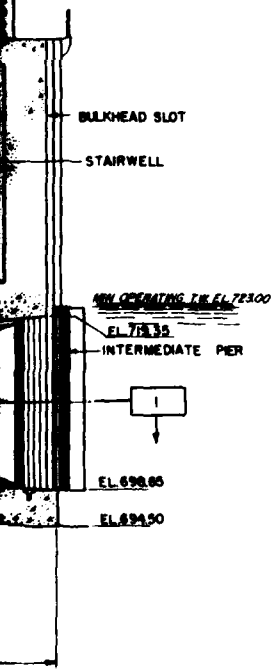


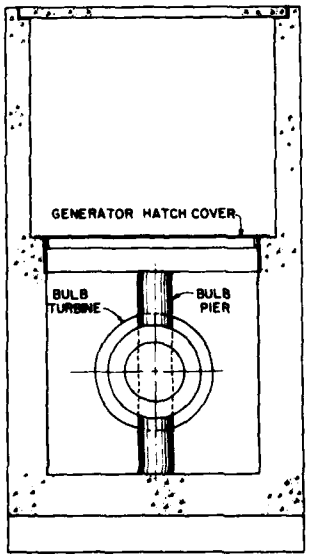
SECTION 1
AT EL.709.0
0 5 10 15
SCALE IN FEET



SECTION 2
0 5 10 15
SCALE IN FEET







SECTION 3

0 5 10 15

SCALE IN FEET

SAFETY PAYS

DEPARTMENT OF THE ARMY

ST PAUL DISTRICT, CORPS OF ENGINEERS

ST PAUL, MINNESOTA

MISSISSIPPI RIVER

LOWER ST. ANTHONY FALLS

POWER HOUSE

PLAN & SECTIONS

APPROVED:

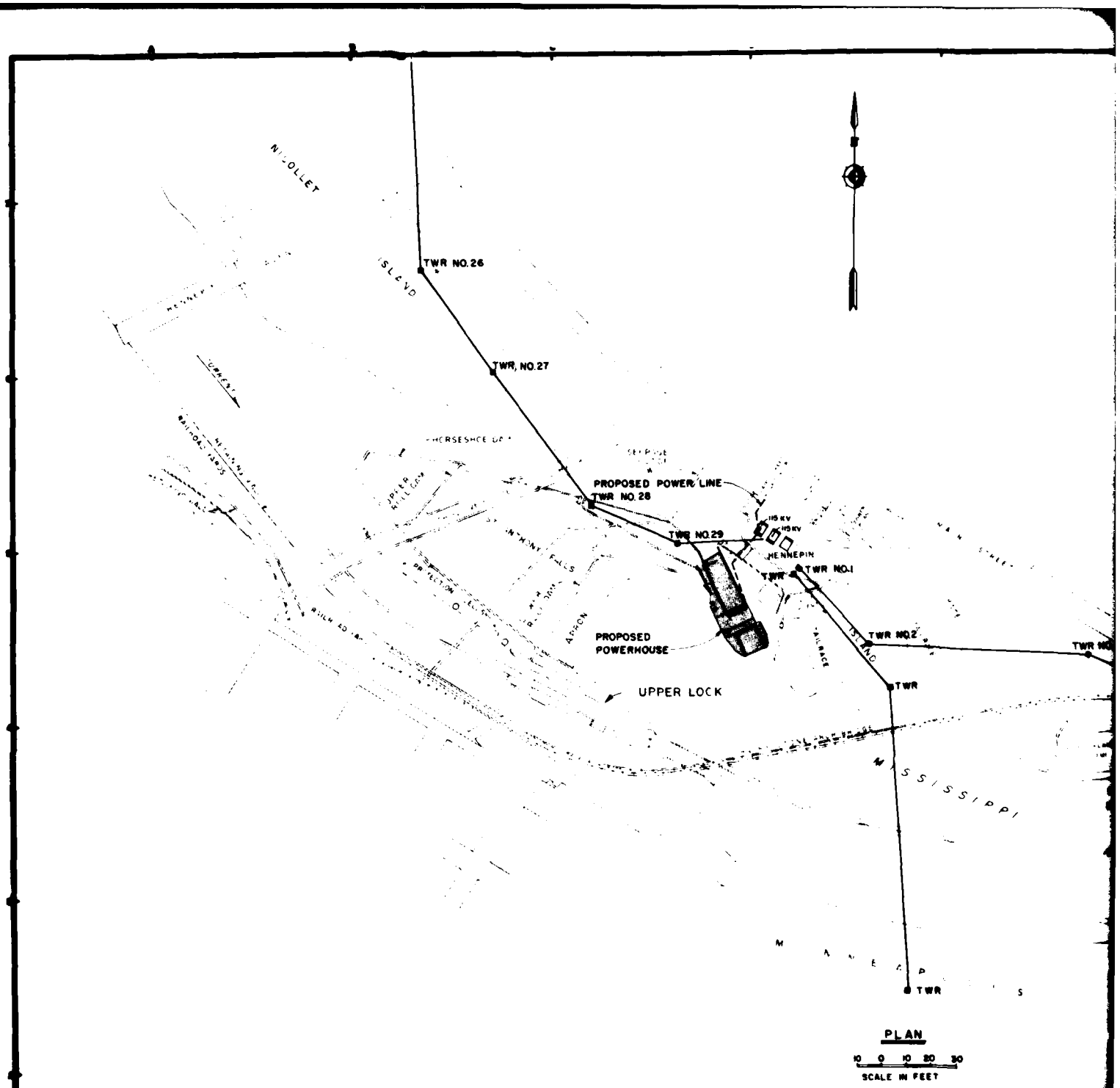
DATE: MAY 1963

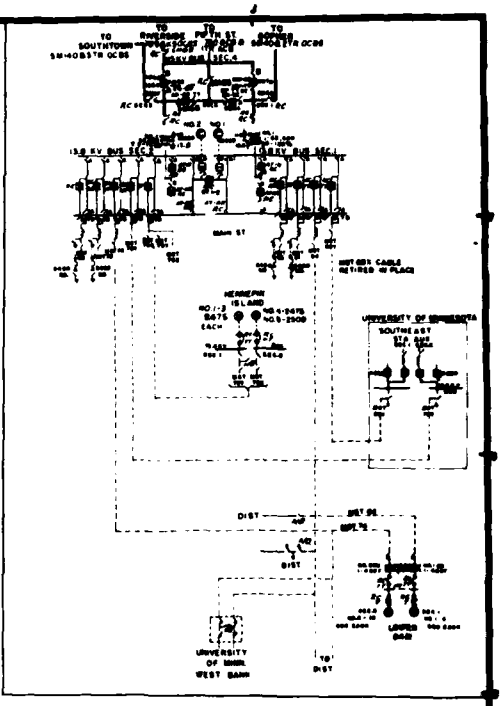
SCALE: AS SHOWN

DRAWING NUMBER

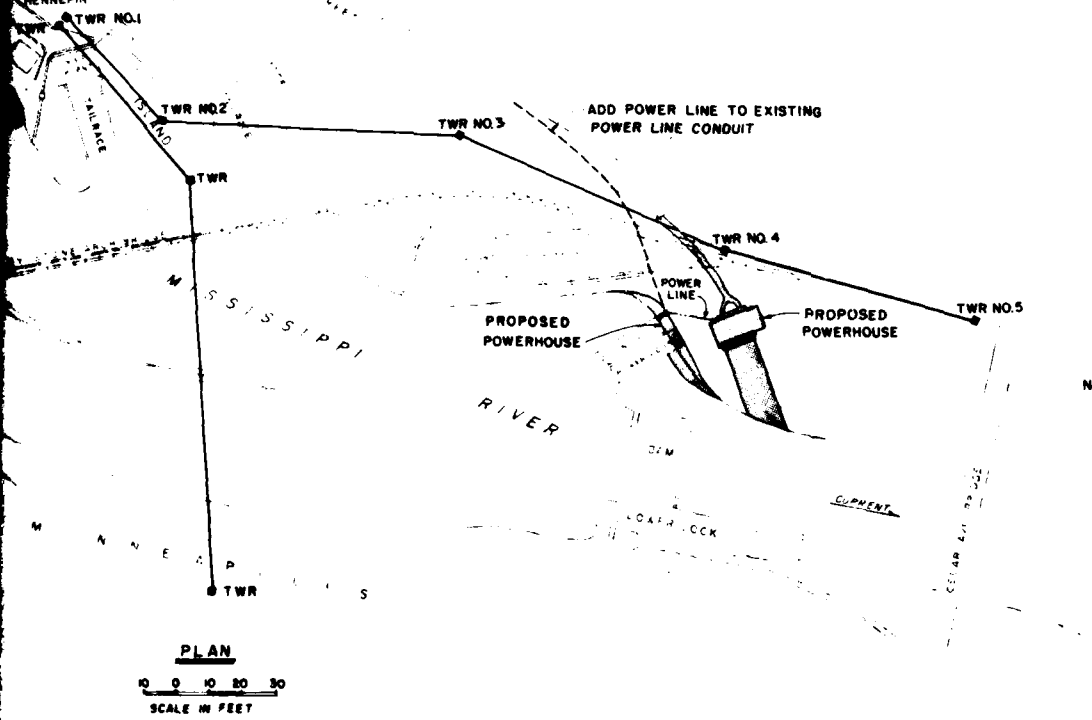
SHEET OF

PLATE 8


TWR NO. 26
TWR, NO. 27
PROPOSED POWER LINE
TWR NO. 28
TWR NO. 29
115 KV
115 KV
HENNEPIN
TWR
TWR NO. 1
TWR NO. 2
TWR
PROPOSED
POWERHOUSE
UPPER LOCK
TWR
TWR
PLAN
10 0 10 20 30
SCALE IN FEET



OPERATING DIAGRAM



PLAN

10 0 10 20 30
SCALE IN FEET

LEGEND

- PROPOSED CONSTRUCTION
- EXISTING CONSTRUCTION
- PROPOSED POWER LINE
- EXISTING POWER LINNES

NOTES:
1. ALL PROPOSED POWER LINE WILL BE UNDERGROUND.
2. ALL EXISTING POWER LINES ARE OVERHEAD LINES.

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

DESIGNED BY:
DRAWN BY: KAB
CHECKED BY:
SUBMITTED BY:
RECOMMENDED:
APPROVED:

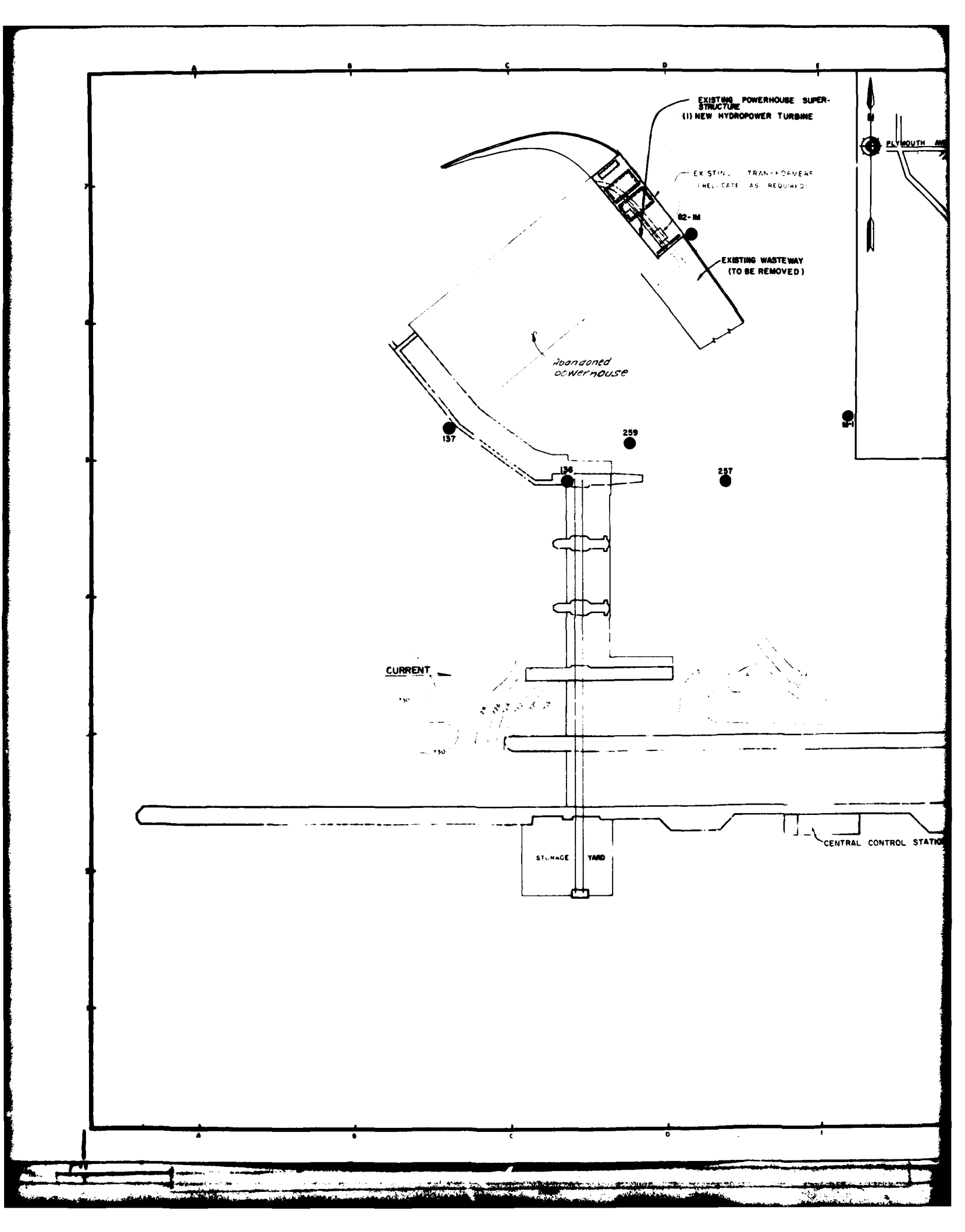
MISSISSIPPI RIVER
ST. ANTHONY FALLS

TRANSMISSION LINE LOCATIONS

DATE
JUNE 1983

SCALE: AS SHOWN
DRAWING NUMBER:
SHEET OF

PLATE 9

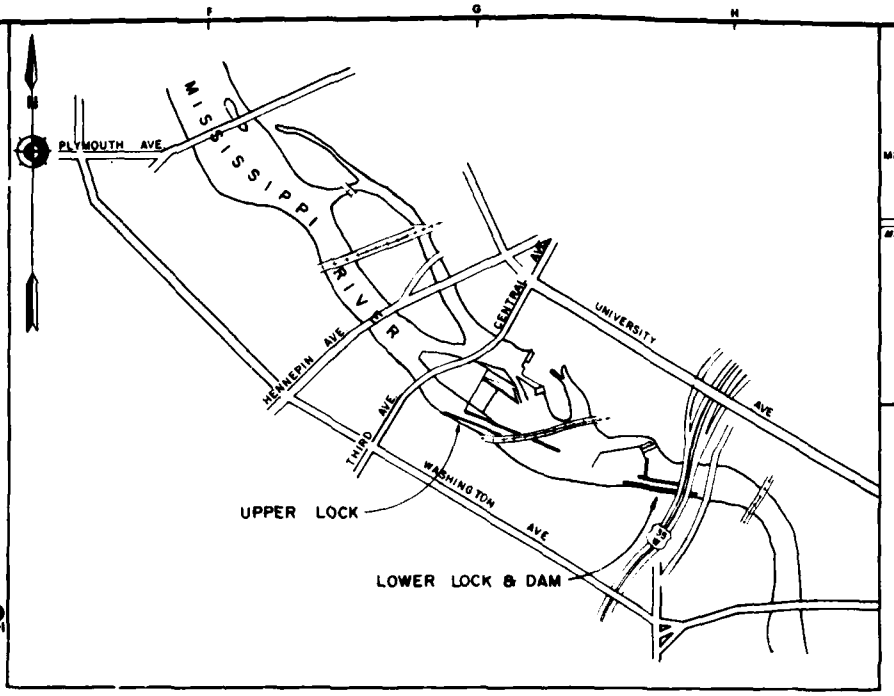

EXISTING POWERHOUSE SUPER-STRUCTURE
(1) NEW HYDROPOWER TURBINE
EXISTING TRANSFORMERS
(RELOCATE AS REQUIRED)
82-M
EXISTING WASTEWAY
(TO BE REMOVED)
Abandoned powerhouse
137
259
136
257
CURRENT
730
730
STORAGE YARD
CENTRAL CONTROL STATION
PLYMOUTH

EXISTING POWERHOUSE SUPER-STRUCTURE

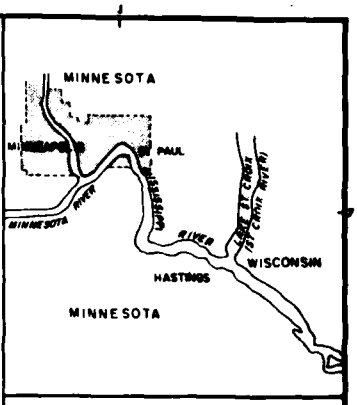
(I) NEW HYDROPOWER TURBINE

EXISTING TRANSFORMER RELOCATE AS REQUIRED

EXISTING WASTEWAY (TO BE REMOVED)



VICINITY MAP



LOCATION MAP

257

CENTRAL CONTROL STATION

LEGEND

● INDICATES BORING LOCATION

0 40 80 120

SCALE IN FEET

SAFETY PAYS

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

MISSISSIPPI RIVER
LOWER ST. ANTHONY FALLS
POWERHOUSE SITE PLAN
BORING LOGS LOCATIONS

DESIGNED BY
DRAWN BY
CHECKED BY
SUBMITTED BY
APPROVED

DATE
JUNE 1983

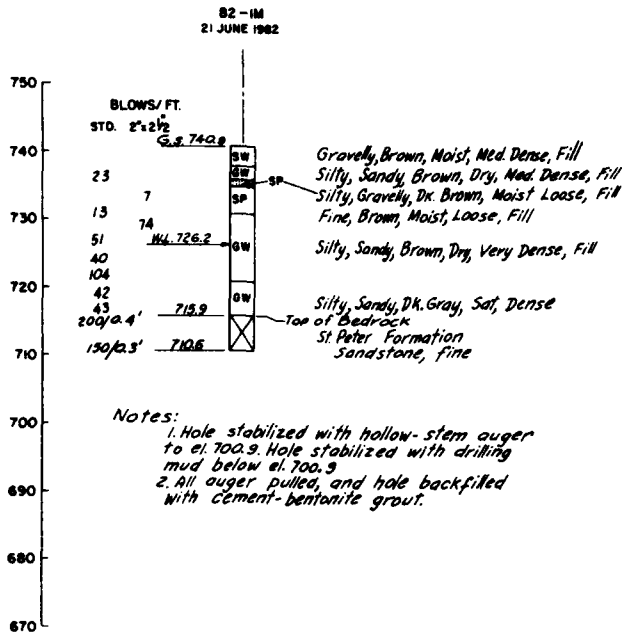
SCALE AS SHOWN

DRAWING NUMBER

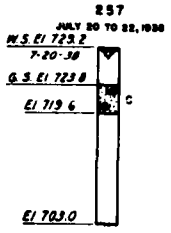
SHEET OF

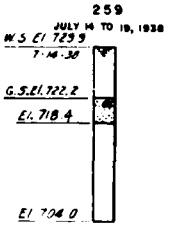
PLATE 10

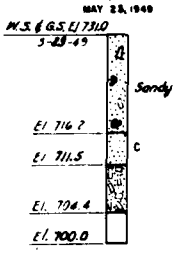
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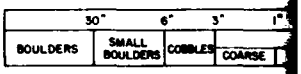


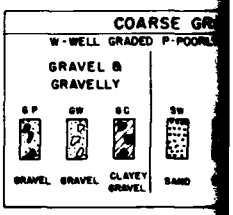
Notes:
1. Hole stabilized with hollow-stem auger to el. 700.9. Hole stabilized with drilling mud below el. 700.9
2. All auger pulled, and hole backfilled with cement-bentonite grout.











Note

The legend represents a
phrases are added to th
gravels or fine and coar
For fine grained soils the
D_{10} (mm) = Effective size.

Samples are classifie
Washington, D.C. dated
G.S. - indicates gr
W.S. - indicates

B2 - IM
JUNE 1982

SW
SW
SP
SP
GW
GW

Gravelly, Brown, Moist, Med Dense, Fill
Silty, Sandy, Brown, Dry, Med Dense, Fill
Silty, Gravelly, Dk Brown, Moist Loose, Fill
Fine, Brown, Moist, Loose, Fill
Silty, Sandy, Brown, Dry, Very Dense, Fill
Silty, Sandy, Dk. Gray, Sat, Dense
Top of Bedrock
St Peter Formation
Sandstone, fine

...le stabilized with hollow-stem auger
...t. 700.9. Hole stabilized with drilling
... below el. 700.9
... auger pulled, and hole backfilled
... cement-bentonite grout.

136
DEC 1 & 2, 1938
W.S.E. 72[illegible]
12[illegible]-38
G.S.El. 722.7
E. 716.8
El. 670.0

137
NOV 28 TO 30, 1938
G.S.El 732.3
El. 723.5
El. 720.5
El. 670.0

M-1
MAY 23, 1949
...2.7±1.0
...49
...2
...5
...4.4
...2.0
Sandy
C

SOILS LEGEND

50"	6"	3"	1"	4	10	40	200
BOULDERS	SMALL BOULDERS	COBBLES	GRAVEL COARSE	GRAVEL MEDIUM	GRAVEL FINE	SAND COARSE	SAND FINE	FINES SILT OR CLAY

GRAIN SIZE SCALE

COARSE GRAINED							OTHER SYMBOLS				
W - WELL GRADED P - POORLY GRADED											
GRAVEL & GRAVELLY			SAND & SANDY								
GP	GW	GC	SW	SP	SM	SC					
GRAVEL	GRAVEL	CLAYEY GRAVEL	SAND	SAND	SILTY SAND	CLAYEY SAND	CONTAINS NUMEROUS LIMESTONE SLABS	CONTAINS A FEW LIMESTONE SLABS	FILL	SAND-STONE	SILT STONE

Note

The legend represents only basic soils. A complete ... is obtained when descriptive phrases are added to the right of the boring staff. Fine, medium and coarse gravels or fine and coarse sands are designated by the letters f, m or c. For fine grained soils the maximum grain sizes are noted in inches. D_{10} (mm) = Effective size.

Samples are classified in accordance with letter from Office Chief of Engineers, Washington, D.C. dated 9 February, 1949.

G.S. = indicates ground surface
W.S. = indicates water surface

NOTE
BORING LOCATIONS ARE SHOWN ON PLATE.

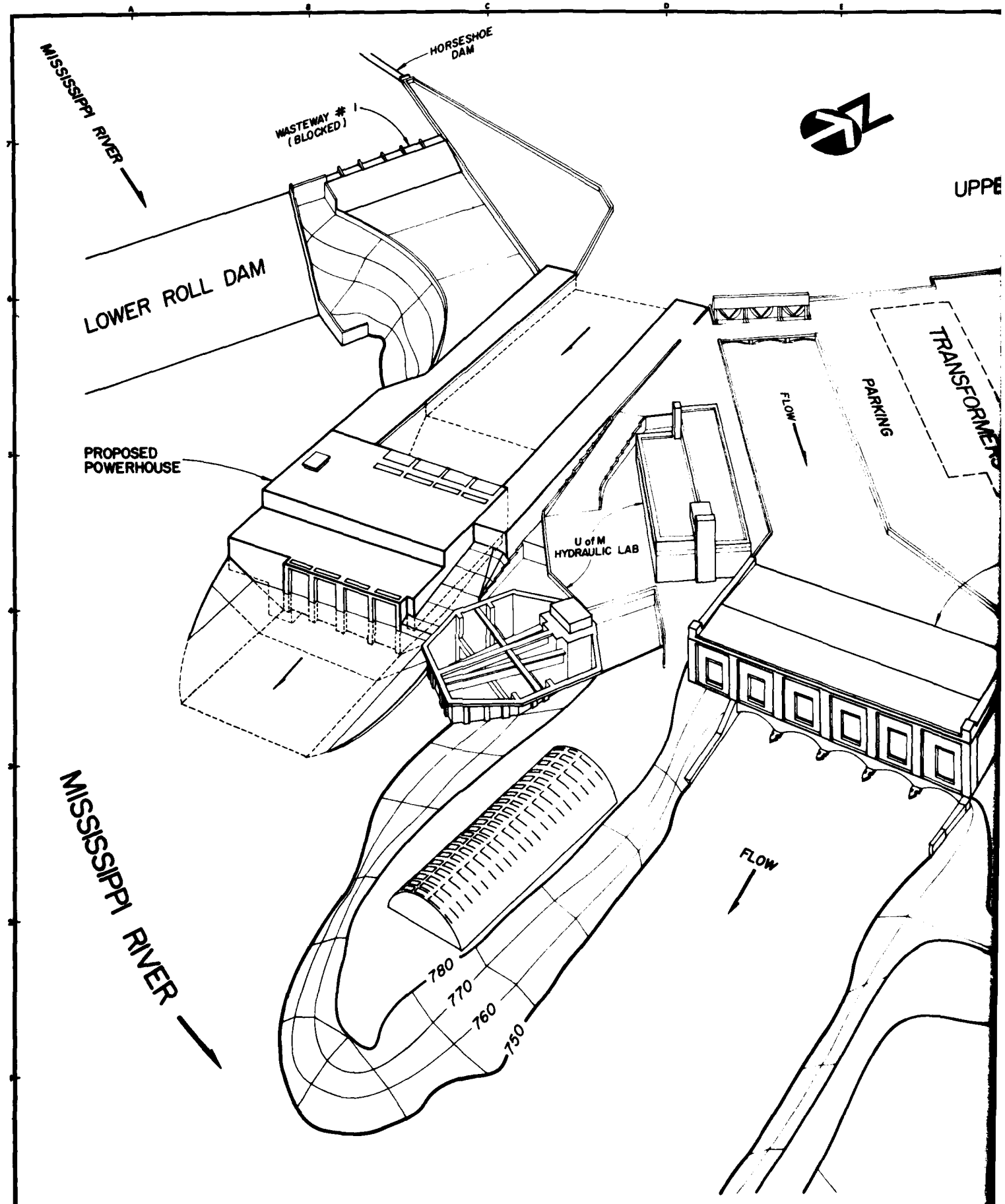
10 5 0 10 20
SCALE 1 INCH = 10 FEET

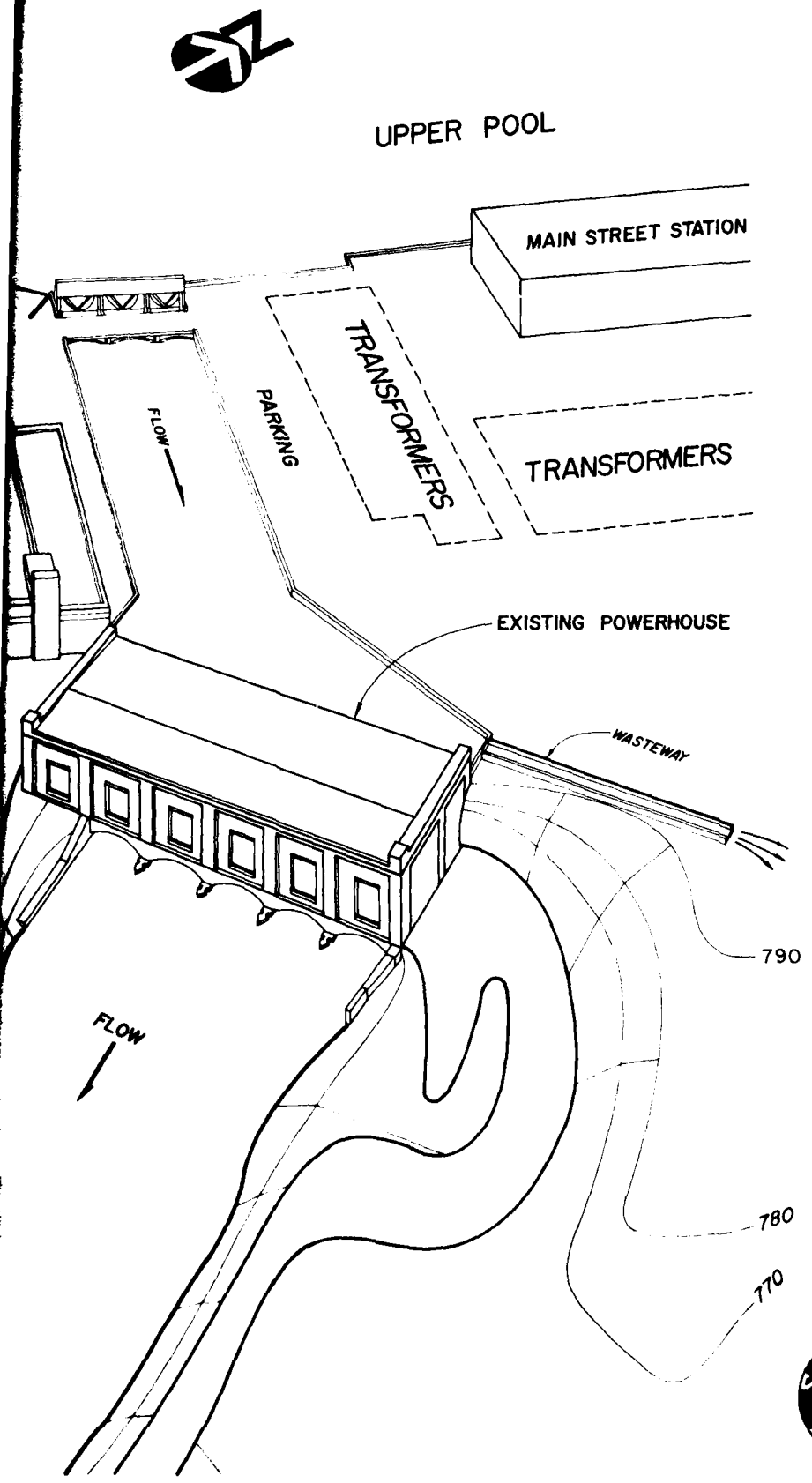
SAFETY PAYS

SYMBOL	DESCRIPTION	DATE
	U. S. ARMY ENGINEER DISTRICT, ST. PAUL CORPS OF ENGINEERS ST. PAUL, MINNESOTA	
DESIGNED BY	MISSISSIPPI RIVER ST ANTHONY FALLS LOWER LOCK AND DAM	
DRAWN BY (R)	BORING LOGS	
CHECKED BY	HYDROPOWER FEASIBILITY STUDY	
SUBMITTED BY		
APPROVED:		
	SCALE AS SHOWN	DWG NO
	DRAWING NUMBER	

PLATE 11

2


MISSISSIPPI RIVER
HORSESHOE DAM
WASTEWAY # 1 (BLOCKED)
LOWER ROLL DAM
PROPOSED POWERHOUSE
U of M HYDRAULIC LAB
PARKING
FLOW
FLOW
MISSISSIPPI RIVER
780
770
760
750



SAFETY PAYS

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

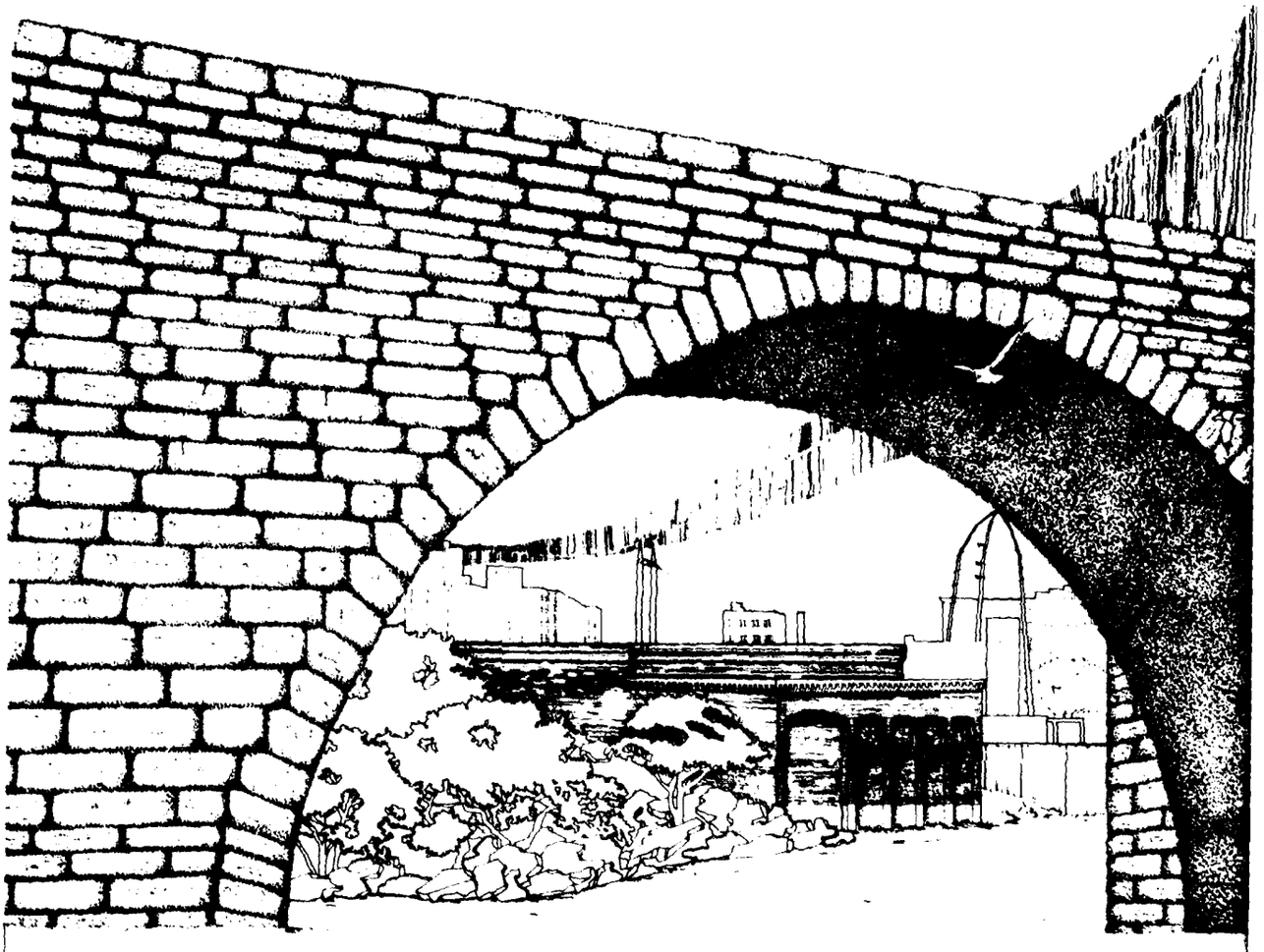
MISSISSIPPI RIVER
ST ANTHONY FALLS

CONCEPTUAL VIEW
UPPER ST ANTHONY FALLS

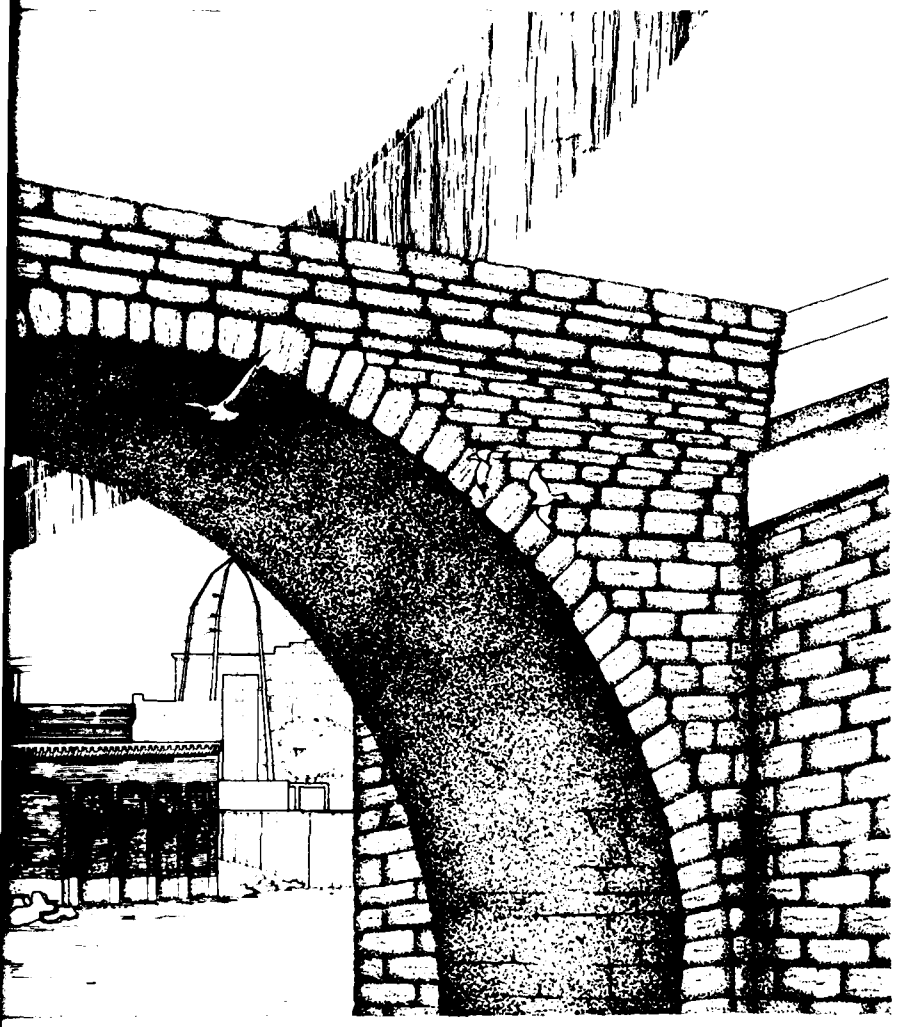
HYDROPOWER FEASIBILITY STUDY

DATE: AUGUST 1983

PLATE 12



UPPER ST. ANTHONY



ITHONY FALLS

SAFETY PAYS

SYMBOL	DESCRIPTION	DATE	APPROVAL

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

DESIGNED BY:
DRAWN BY: BAT
CHECKED BY:
SUBMITTED BY:

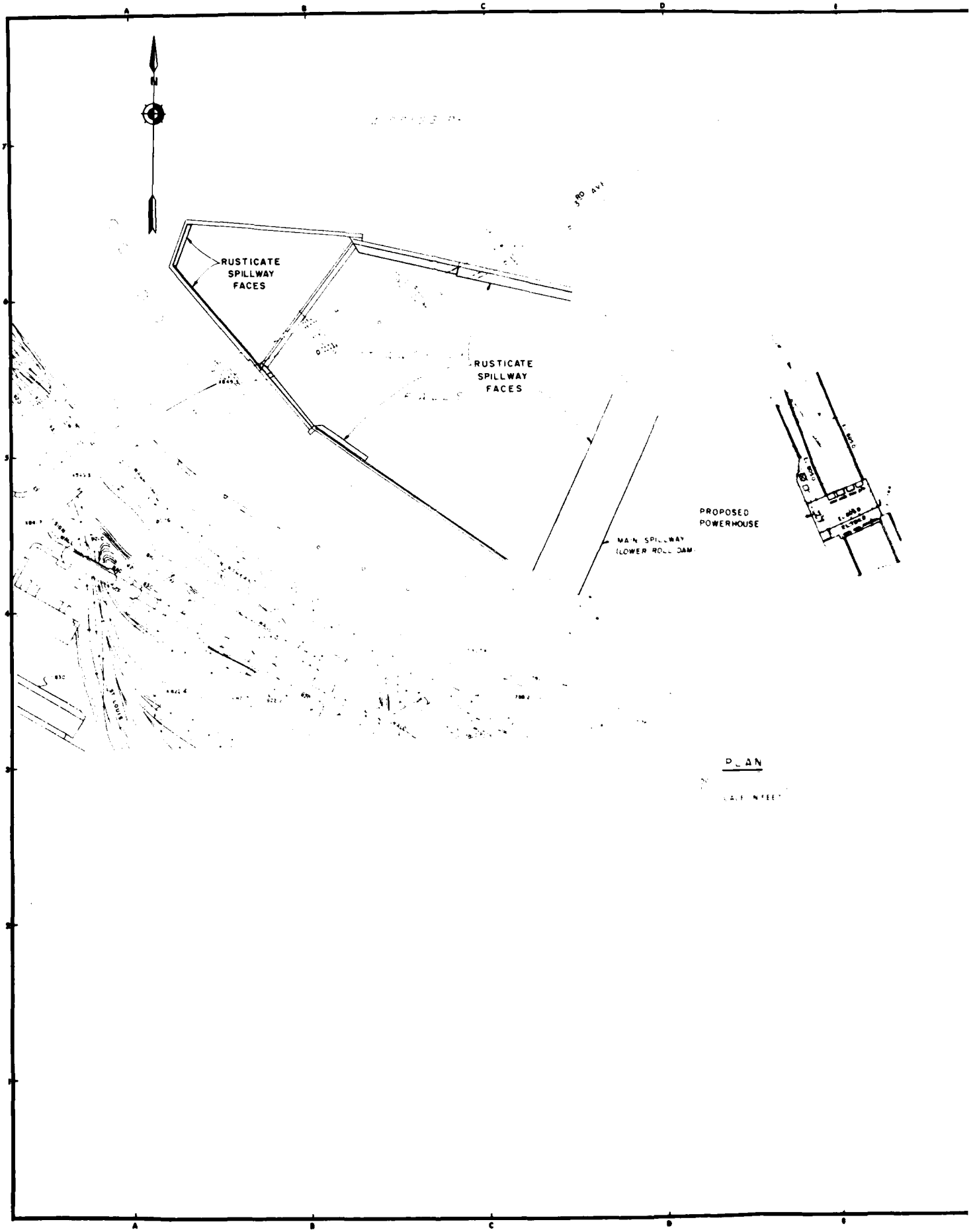
MISSISSIPPI RIVER
ST ANTHONY FALLS
PROPOSED POWER PLANT
HYDROPOWER FEASIBILITY STUDY

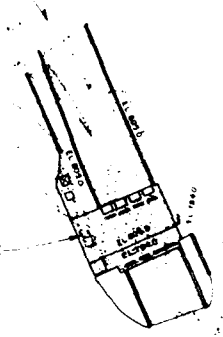
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PLATE 13

2


A
B
C
D
E
N
RUSTICATE SPILLWAY FACES
RUSTICATE SPILLWAY FACES
3RD AVE
PROPOSED POWERHOUSE
MAIN SPILLWAY (LOWER ROCK DAM)
PLAN



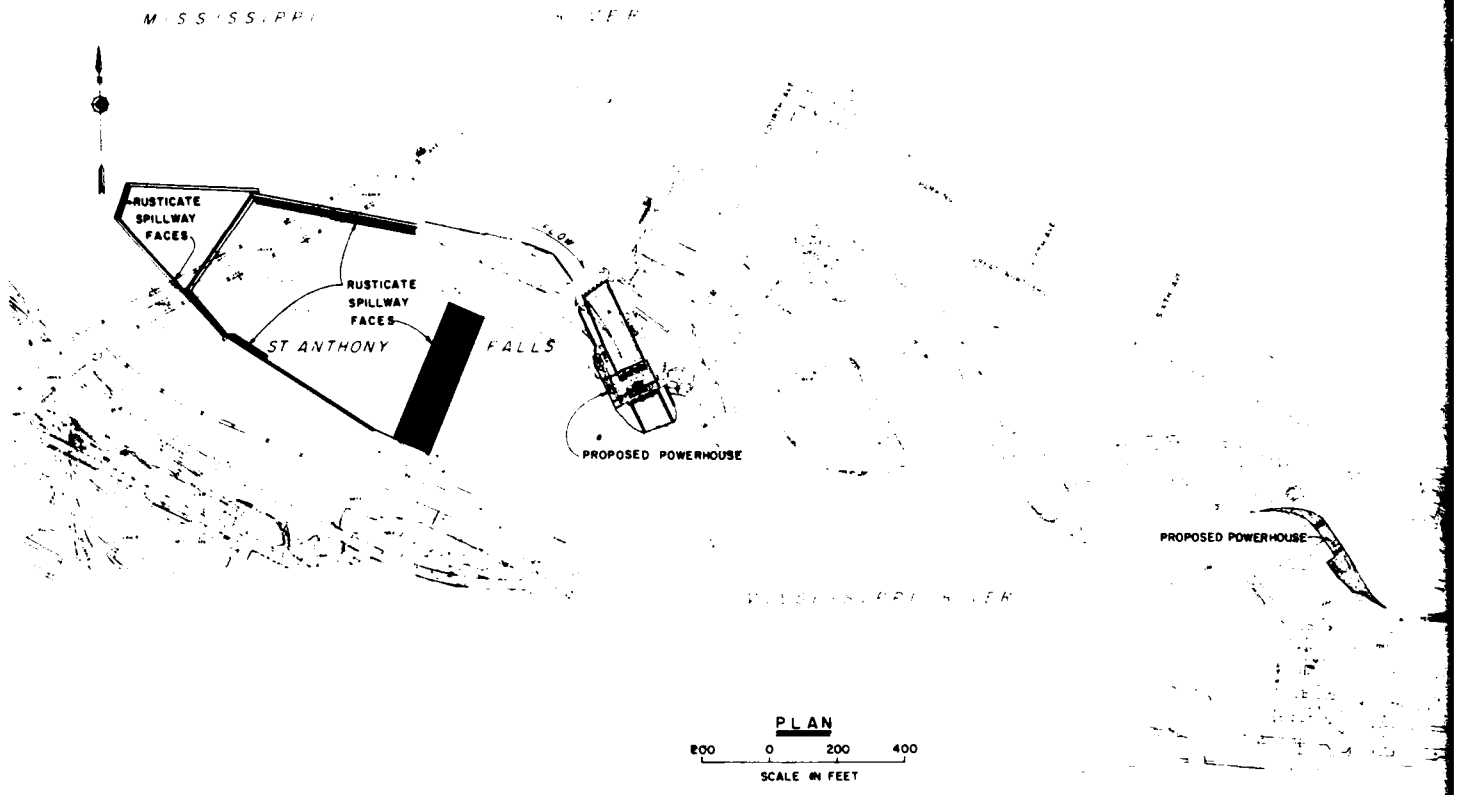
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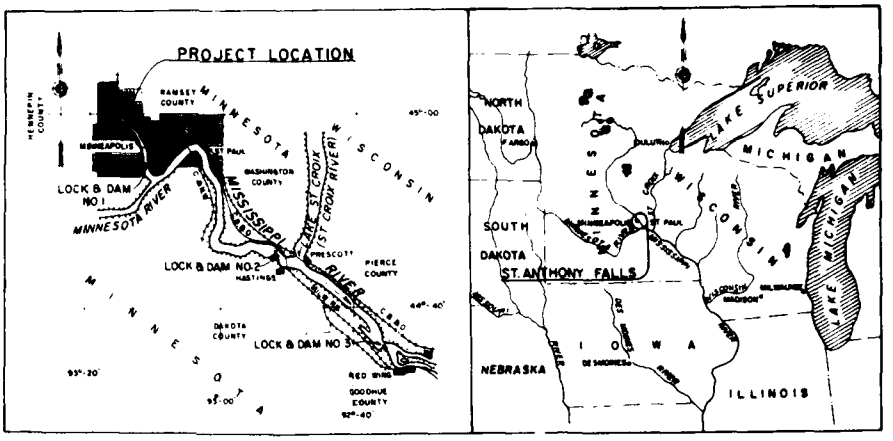
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SCALE IN FEET

SAFETY PAYS

PLATE 14


RUSTICATE SPILLWAY FACES
RUSTICATE SPILLWAY FACES
ST ANTHONY FALLS
PROPOSED POWERHOUSE
PROPOSED POWERHOUSE
PLAN
200 0 200 400
SCALE IN FEET



VICINITY MAP

5 0 5 10 15

SCALE IN MILES

LOCATION MAP

100 50 0 100

SCALE IN MILES

PROPOSED POWERHOUSE

R I V E R

SAFETY PAYS

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT, CORPS OF ENGINEERS
ST PAUL, MINNESOTA

MISSISSIPPI RIVER
ST ANTHONY FALLS
OVERALL SITE PLAN
HYDROPOWER FEASIBILITY STUDY

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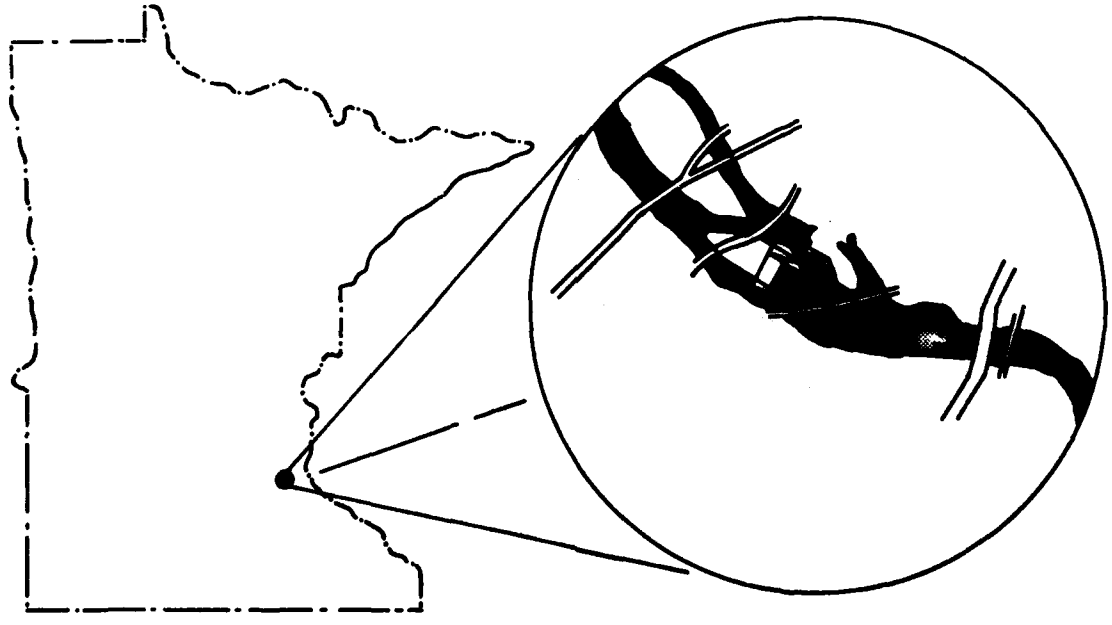
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PLATE 15

US Army Corps
of Engineers
North Pacific Division

ST. ANTHONY FALLS HYDROPOWER STUDY

Mississippi River at Minneapolis, Minn.



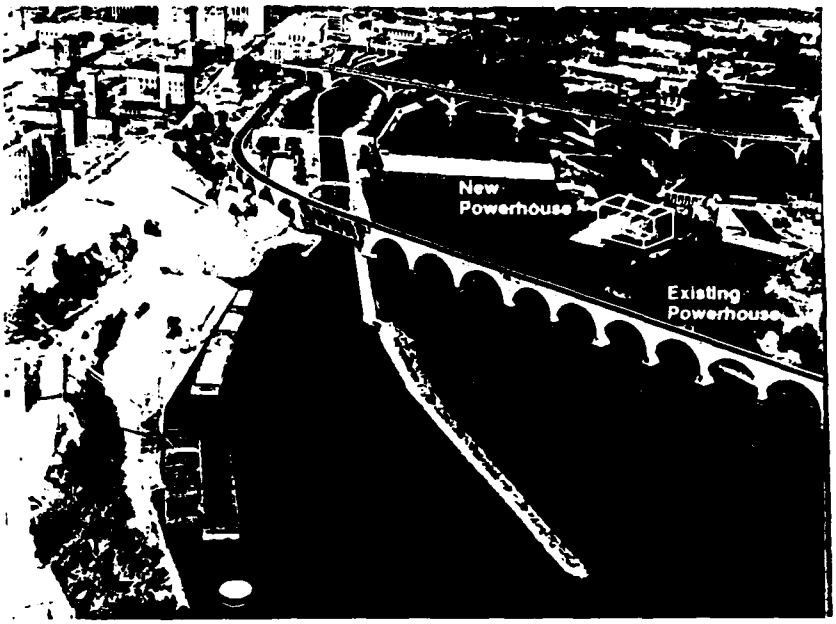
Technical Report • November 1983
Feasibility Level

TECHNICAL APPENDIX

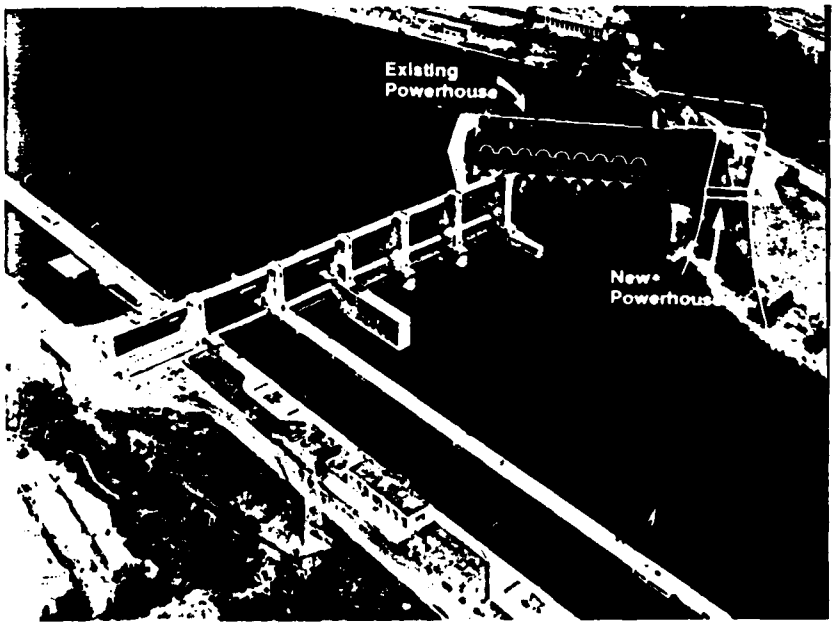
TECHNICAL REPORT BY
NORTH PACIFIC DIVISION

ST ANTHONY FALLS HYDROPOWER

MINNEAPOLLIS/ST. PAUL , MINNESOTA



site of Upstream Powerplant



site of Downstream Powerplant

HYDROPOWER STUDIES
ST. ANTHONY FALLS
MINNEAPOLIS/ST. PAUL, MINNESOTA

Technical Report
for
Feasibility Level

Prepared for the St. Paul District
Corps of Engineers as an Element
of their Feasibility Study by

North Pacific Division
Corps of Engineers
Portland, Oregon

November 1983

ST. ANTHONY FALLS HYDROPOWER ADDITIONS

BASIC PROJECT DATA

	Upper Falls Site	Lower Falls Site	Combined Falls Site
General Data			
Installed Capacity	21.0 MW	5.4 MW	28.0 MW
Number of Units	2	1	2
Plant Hydraulic Capacity	6200 cfs	3100 cfs	5500 cfs
Type of Turbines	Vertical axis propeller	Horizontal bulb Kaplan	Vertical axis propeller
Type of Generators	Synchronous	Synchronous	Synchronous
Rated Net Head	49 ft	22 ft	70 ft
Annual Plant Factor (Incremental)	41%	40%	34%
Estimated Constr. Time	3 years	3 years	3 years
Economic Data			
Total NED Inv. Cost	$23,860,000	$ 9,937,000	$37,310,000
Power Production Cost	28 mills/kwh	48 mills/kwh	38 mills/kwh
Annual Net Benefit	$ 2,283,000	$ 226,000	$ 1,670,000
B/C Ratio	2.1	1.2	1.5

SUMMARY

This report, prepared by North Pacific Division, Corps of Engineers, determines the feasibility of adding hydropower generation to the St. Anthony Falls project, located on the Mississippi River in Minneapolis, Minnesota.

The project consists of an existing upper and lower falls, located about one half mile apart. The Corps owns and operates navigation locks at the project. Powerplants are located at each falls and are owned and operated by the Northern States Power Company, a private utility. These existing, relatively old, powerplants were refurbished in the 1950's, but their generating capacity does not fully utilize the capability of the river and additional generation appears warranted.

This study shows that additional generating plants could be built at the project. Three alternative site locations were evaluated:

(1) An Upper Falls powerplant, consisting of two units with an install ed capacity of 21.0 megawatts, could produce some 74 million kwh of annual generation. The total investment cost would be 23.9 million dollars and the production cost would be 28 mills per kwh. The benefit-to-cost ratio for the Upper Falls plant would be 2.1.

(2) A single unit Lower Falls powerplant could be developed at 5.4 megawatts that would produce some 18.9 million kwh of annual generation. The total investment cost would be 9.9 million dollars and the production cost would be 48 mills per kwh. The benefit-to-cost ratio for the Lower Falls plant would be 1.2.

(3) A Combined Falls powerplant could be constructed that would utilize the combined generating heads of both falls. This alternative consists of a two-unit, 28.0 megawatt plant that could develop some 83.7 million kwh of annual generation. The total investment cost would be 37.3 million dollars and the production cost would be 38 mills per kwh. The benefit-to-cost ratio would be 1.5. The Combined Falls development would preclude the development of the Upper and Lower Falls site.

The generation will be needed in the power marketing area. Construction of these hydroelectric facilities would preclude construction of an increment of thermal generation in the system.

Development of this additional hydropower potential at St. Anthony Falls provides the immediate opportunity to develop a clean, renewable resource at a reasonable cost. As a comparison, the annual power production from the upper falls site (21.0 MW) would be equal to the residential requirement for about 11,000 homes in the area.

HYDROPOWER STUDY
FEASIBILITY LEVEL
St. Anthony Falls
Minneapolis/St. Paul, Minnesota

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Appendix A	Detailed Cost Estimates for Items Exclusive of Powerplant Equipment
Appendix B	Monthly Power Duration Curves
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SECTION 1 - GENERAL

1.01 Purpose and Authority. This report presents the results of an investigation into the economic feasibility of developing additional hydroelectric power at St. Anthony Falls on the Mississippi River at Minneapolis, Minnesota.

The St. Paul District, Corps of Engineers, is conducting the study under the authority contained in the House Committee on Public Works resolution dated 11 December 1969. Funds were made available by the District to the Corps' North Pacific Division for preparation of this feasibility level technical report on hydropower.

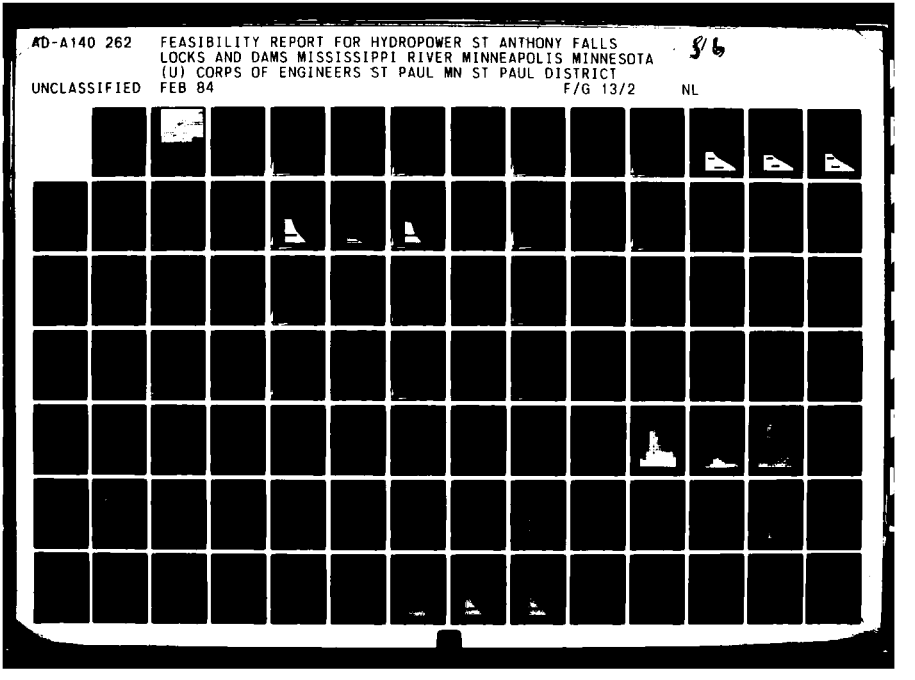
1.02 Scope of Study. The St. Anthony Falls region contains two "falls" in close proximity (see Figure 1-1). This report assesses the power potential of both the upper and the lower falls. Hydropower facilities exist and are currently operating at both sites, but each powerplant utilizes only a portion of the total available stream flows in the river. This study was conducted on the basis of expanding the existing plants for additional hydropower generation and, therefore, was limited to assessing the available flow beyond that now utilized by the existing plants. This increment of flow was analyzed to determine the size and power output of added generating units at each site. Powerplant costs were developed from manufacturers' information for the turbine-generators and from current cost experience for related equipment and structures. Each site was optimized by preparing a series of annual project costs and comparing them with corresponding annual benefits. The selected plant size

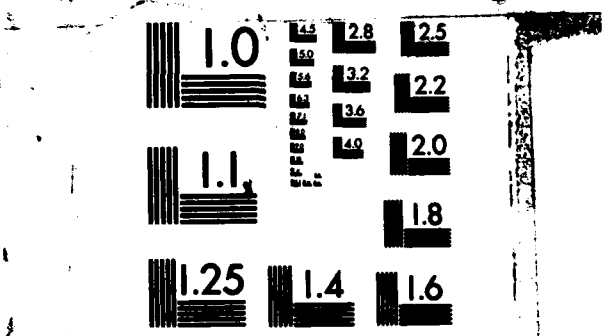
in each case was based on a net benefit analysis.

Future studies should consider alternative operating patterns to allow for a more efficient use of available flows and coordinated operation between the old and new plants.

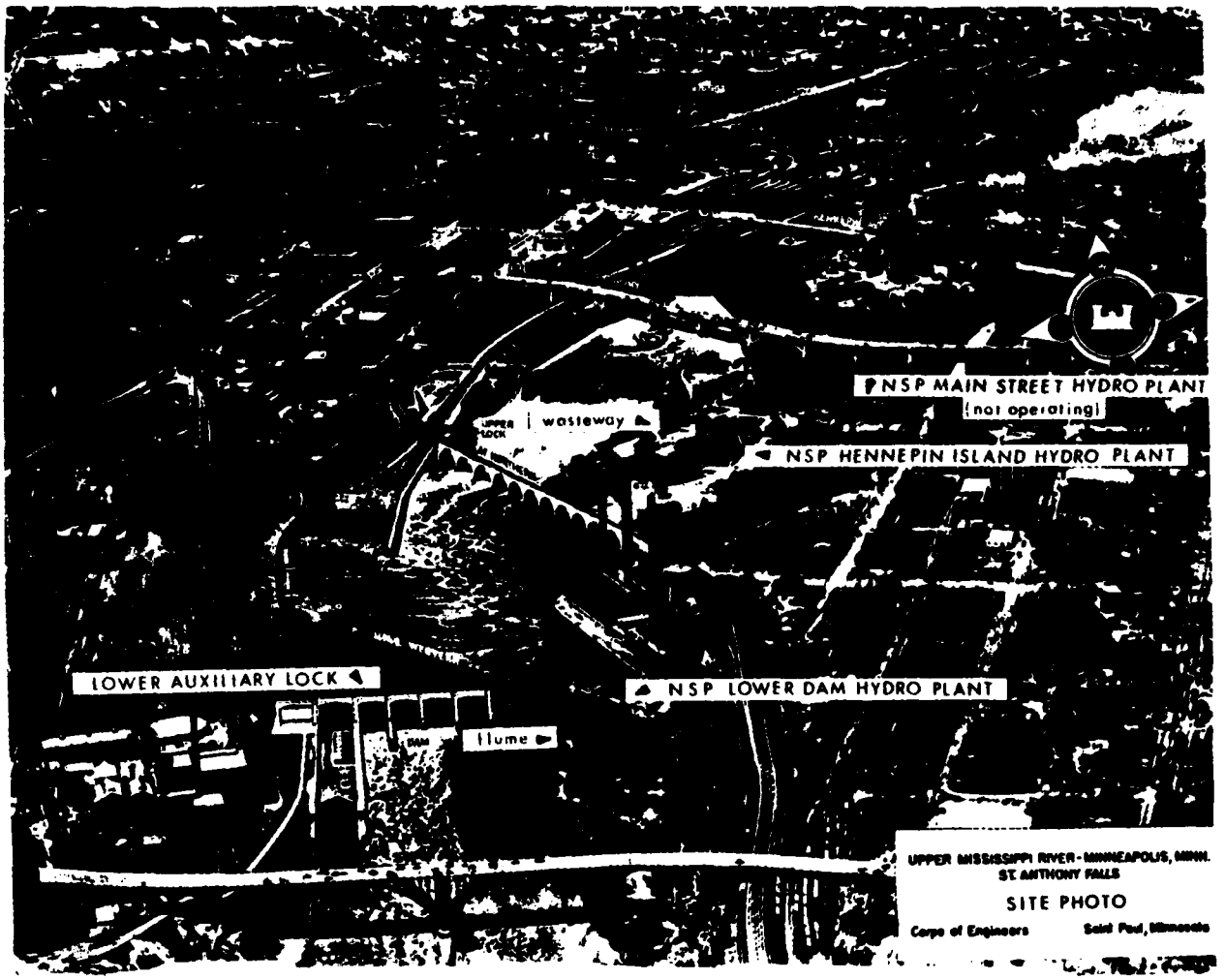
AD-A140 262 FEASIBILITY REPORT FOR HYDROPOWER ST ANTHONY FALLS LOCKS AND DAMS MISSISSIPPI RIVER MINNEAPOLIS MINNESOTA (U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT

UNCLASSIFIED FEB 84 F/G 13/2 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A


NSP MAIN STREET HYDRO PLANT
(not operating)
wasteway
NSP HENNEPIN ISLAND HYDRO PLANT
LOWER AUXILIARY LOCK
NSP LOWER DAM HYDRO PLANT
flume
UPPER MISSISSIPPI RIVER - MINNEAPOLIS, MINN.
ST. ANTHONY FALLS
SITE PHOTO
Corps of Engineers
Saint Paul, Minnesota

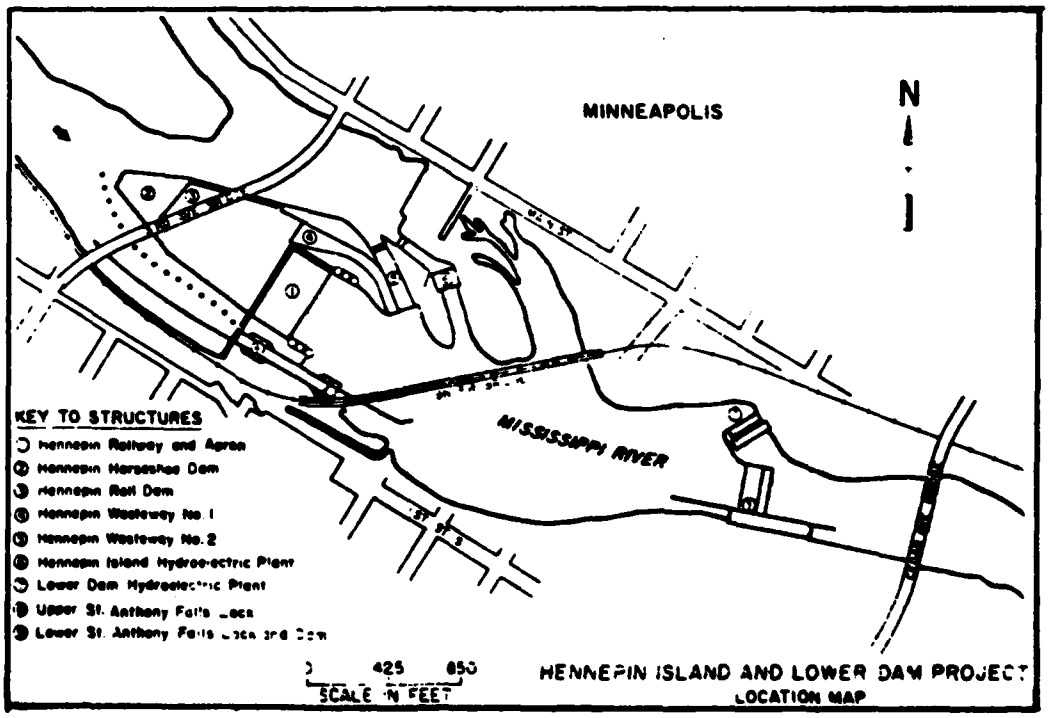

MINNEAPOLIS
N
MISSISSIPPI RIVER
KEY TO STRUCTURES
1 Hennepin Railway and Apron
2 Hennepin Horseshoe Dam
3 Hennepin Roll Dam
4 Hennepin Wasteway No. 1
5 Hennepin Wasteway No. 2
6 Hennepin Island Hydro-electric Plant
7 Lower Dam Hydroelectric Plant
8 Upper St. Anthony Falls Lock
9 Lower St. Anthony Falls Lock and Dam
0 425 850
SCALE IN FEET
HENNEPIN ISLAND AND LOWER DAM PROJECT
LOCATION MAP

Figure 1-1

SECTION 2 - EXISTING FACILITIES

2.01 General. The upper and lower St. Anthony Falls area has a combined water surface elevation drop of about 74 feet. The upper falls development consists of a Corps of Engineers lock, a horseshoe-shaped dam and concrete spillway, a limestone and concrete dam, and two utility owned hydropower plants, only one of which is operating; the second plant discontinued operation in the 1960's. The lower falls development contains a Corps lower lock and dam on the right riverbank, an intermediate dam, and a hydroelectric plant on the left bank.

The power plants at both sites are owned and operated by the Northern States Power Company (NSP) and are licensed by the FERC as Project No. 2056. The upper falls development utilizes 49 feet of river fall and the powerplant uses a 300-foot-long intake canal with head gates and a bridge, and a 250-foot-long discharge canal. The lower hydroelectric works is located approximately one-half mile downstream from the upper falls. It consists of a powerplant, dam, and spillway that utilizes about 22 feet of head.

2.02 Project Operation. The operating powerhouse at the upper falls contains four horizontal, fixed blade turbines and one vertical Kaplan unit and the total installed capacity is 12.4 MW. It produces an average annual generation of about 87.3 million kilowatt-hours. While the operation is considered a run-of-river plant, it may draw its pool down one foot for peaking. By providing this one foot of daily pondage, the flow immediately downstream at the lower dam hydroelectric plant is also increased during

the peaking period. Streamflow at the project is also affected by six Federal headwater reservoirs and the various upstream lakes and recreation reservoirs.

The lower falls powerhouse contains 10 vertical fixed-blade turbines coupled to outdoor type 60 cycle generators, each rated at 800 kw. The average annual generation of the plant is about 51.3 million kwh. While the operation is considered run-of-river, the lower project may draw its pool down 0.4 feet for peaking.

SECTION 3 - HYDROLOGY AND POWER CAPABILITY

3.01 Hydrologic Analysis. The flow available for hydropower at St. Anthony Falls is estimated from 50 years of data from the gage at Anoka, Minnesota (USGS 05-2885). The gage is 11.8 miles upstream of the project and there are no major tributaries between the two. The total drainage area upstream of the project is 3.1 percent greater than the area upstream of the gage and this difference was accounted for in analyzing the average daily flow data. There have been no major diversons or additions to the streamflow at the project and none are anticipated. For this reason the 50 years of historical data was considered appropriate for the estimation of the future operation of the powerplants.

3.02 Existing Power. Since the existing plants already utilize part of the available streamflow, a basic assumption of this study was that any additional generation would come from flow in excess of the existing plants' hydraulic capacity. Thus, the new generating units would operate only after the existing generating units were operating at full capability. Close operating coordination between the existing NSP plants and the new Corps plants will be needed. This coordination will be especially important in the transition phase from low streamflows, when only the old plant will operate, to higher flows when both old and new plants will operate. This situation is discussed further in Section 6.07.

The hydraulic capacity of the existing plants was derived from known generation output and actual daily flows. By simulating the existing conditions, the hydraulic capacities were established after trying several

estimated overall plant efficiencies. NPD's Power Duration Plot Program (described in the following paragraphs) was used to estimate the energy output of the two plants.

EXISTING PLANT DATA

	Overall Efficiency	Annual Energy	Annual Plant Factor	Hydraulic Capacity
Upper Falls	81%	87,200 MWH	85%	3300 cfs
Lower Falls	81%	51,000 MWH	76%	4500 cfs

Figures 3-1, 3-2, and 3-3 show graphically the annual flow-duration curves for each site configuration. The existing plant flows are shown on the graph along with the plant flows of the selected plant (see Section 6.06 for scoping of selected plants). Once the hydraulic capacities were established for the existing plants, that flow was deducted from the total streamflows in all successive analyses.

3.03 Additional Power Potential. Several powerhouse sizes were investigated for each of three sites. In addition, different combinations of generating units were studied. The number of units selected at each site was based on requirements for coordinated operation with the existing powerplants (also see section 6.06).

Power development was investigated for separate installations at both the upper and lower falls, as well as a third alternative which utilized the combined head of the two falls. In the latter case, water from the

upper falls would be routed through a penstock to a powerhouse below the lower falls. The power potential at each site was determined using NPD's Power Duration Plot Program (DURAPLOT). This computer program analyzes daily average flow, forebay and tailwater elevation data, and constraints associated with various sized power installations. For the flow and generating head ranges associated with specific turbine generator sizes, the program produces annual and monthly flow-duration curves and the corresponding power duration curves. Power is developed using the following equation:

$$\text{Average Power (kw)} = \frac{Q \times H \times e}{11.8}$$

where Q = average flow in cfs.
H = average net generating head in feet.
e = efficiency, assumed constant at 85%.

In this equation, daily project flows were computed by deducting flows equal to the existing plants' hydraulic capacity from the total flows as described earlier.

In applying the power equation to the upper falls and the combined falls site, forebay elevations were developed from daily historical data. At the upper dam, the forebay elevations reflect the effect of flashboards, which are in place except during periods of high streamflow. Tailwater for the upper falls and forebay for the lower site were considered constant at 750 feet m.s.l. A rating curve was used to establish tailwater for the lower falls and the combined falls configuration. This curve is shown in Figure 3-4. Net generating heads were determined by subtracting the daily tailwater elevations from the forebay elevations, then deducting an estimated head loss. A 2-foot head loss was assumed for the Upper and

Lower Falls sites, while 5 feet of head loss was estimated for the Combined Falls site. Head-duration curves were prepared and are shown in Figures 3-5, 3-6, and 3-7. These curves were useful in establishing preliminary turbine operating limits for initial project scoping.

Table 3-1 summarizes the different generating plant sizes and their respective annual energy outputs and dependable capacities. This data was used to scope the project (see Section 6.06) and to determine the project benefits listed in Tables 6-5, 6-6, and 6-7.

Power duration curves were developed for all cases. Annual power duration curves for the selected plants are shown in Figures 3-8, 3-9, and 3-10. Monthly curves showing generation for the new plants are shown in Appendix B. The shaded area under the curve represents the total flow or energy generation that can be developed with the selected plant size; the unshaded area represents the potential not feasible for development.

3.04 Dependable Capacity. The dependable capacity of a hydropower project is usually defined as the amount of capacity available in a month or period of time that is considered most critical from the standpoint of both loads and hydrologic conditions. As such it is intended to reflect hydrologic availability. Dependable capacity is frequently less than installed capacity because the amount available when needed may be reduced because of low flows or reduced heads due to reservoir drawdown or tailwater encroachment. Various techniques have been used to measure

dependable capacity, but it is widely agreed that for large predominately thermal power systems, traditional procedures frequently understate the true value of hydroelectric capacity to the system. Procedures have been recommended by IWR[1/] and these have been used in this report.

For a small run-of-river hydro project operating in a large, predominantly thermal power system, hydrologic availability is simply the average plant factor during the period of peak power demand. Thus,

Dependable Capacity = Installed Capacity x Hydrologic Availablility.

The power system in which the St. Anthony Falls projects would operate, experiences both a winter and a summer peak load period. The summer load for July and August was used for establishing peak load in this study. Also see Section 6.09 which compares summertime and wintertime peak load periods.

In Section 6, the capacity benefit for each of the sites investigated is determined using the above definition of dependable capacity.

1/ US Water Resources Council, Water and Energy Task Force, Evaluating Hydropower Benefits, December 1981. Section 6.1.

TABLE 3-1

SUMMARY OF PLANT SIZES AND GENERATION 1/

(used for project scoping)

Hydraulic Capacity (cfs)	Installed Capacity (MW)	Annual Energy (MWH)	Annual Plant Factor	Jul-Aug Energy (MWH)	Hydrologic Availability 2/	Dependable Capacity (MW) 3/
UPPER FALLS - TWO UNITS						
2700	9.9	45950	53%	7980	55%	5.4
3700	13.6	57250	48%	10000	50%	6.8
4700	17.3	66710	44%	11570	45%	7.8
5700	21.0	74880	41%	12870	42%	8.8
6800	25.1	81240	37%	13520	38%	9.5
LOWER FALLS - ONE UNIT						
1500	2.6	10270	44%	1770	50%	1.3
2500	4.4	15450	40%	2650	43%	1.9
3100	5.4	18900	40%	3360	41%	2.3
4000	7.0	21640	35%	3600	37%	2.6
5000	8.8	25070	33%	4110	34%	3.0
COMBINED FALLS - TWO UNITS						
3000	15.0	54860	42%	9640	43%	6.3
4500	22.7	73020	37%	12500	37%	8.4
5500	28.0	83710	34%	14120	34%	9.5
6000	30.3	87770	33%	14720	33%	10.0
7200	36.2	98080	31%	16230	30%	10.9

1/ Figures shown represent additions to existing generating facilities

2/ Based on the July-August energy and the achievable capacity for those months.

3/ (Installed Capacity) x (Hydrologic Availability)

ST. ANTHONY - UPPER FALLS
ANNUAL FLOW DURATION CURVE
USING DAILY DATA

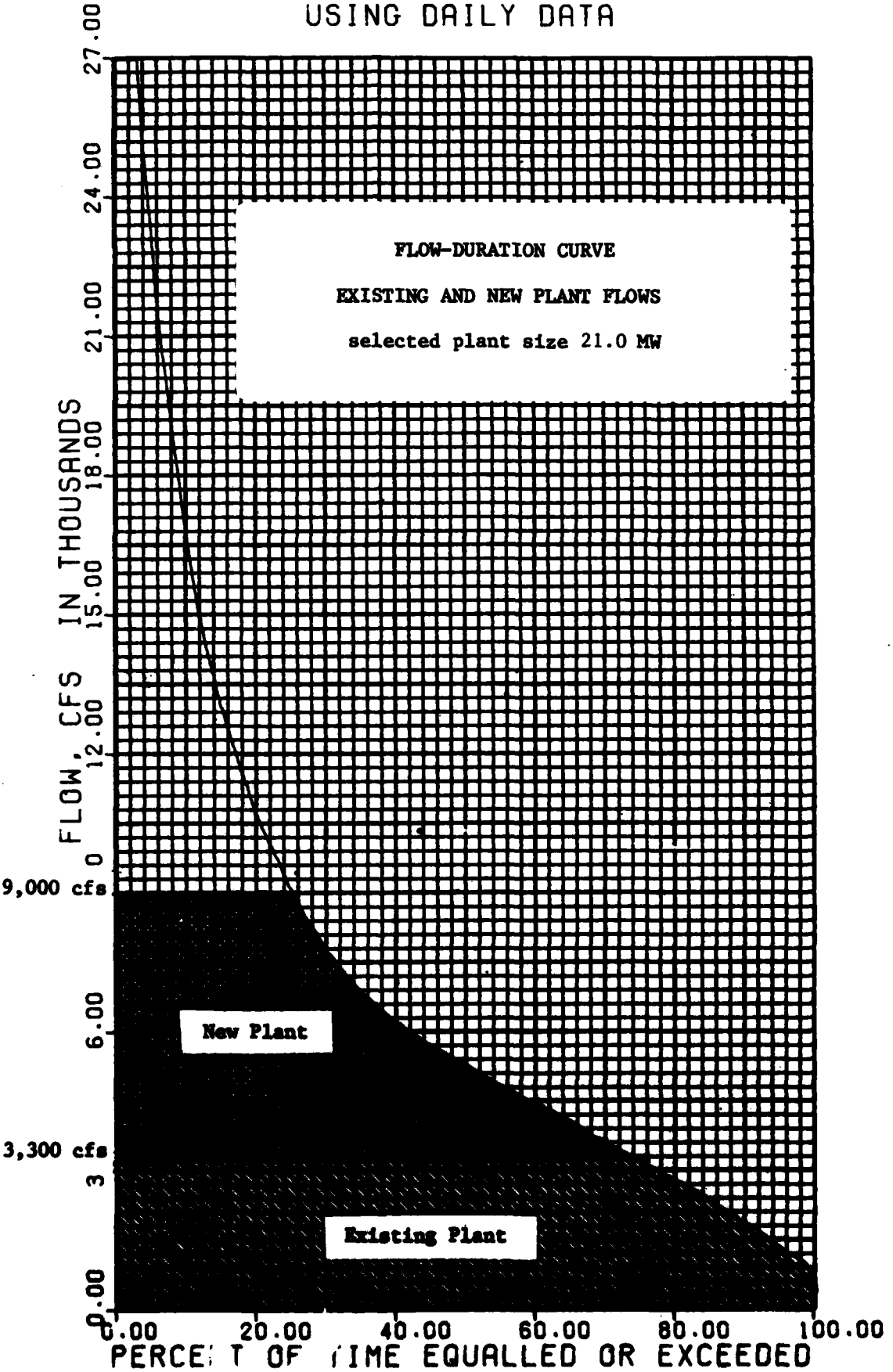


Figure 3-1

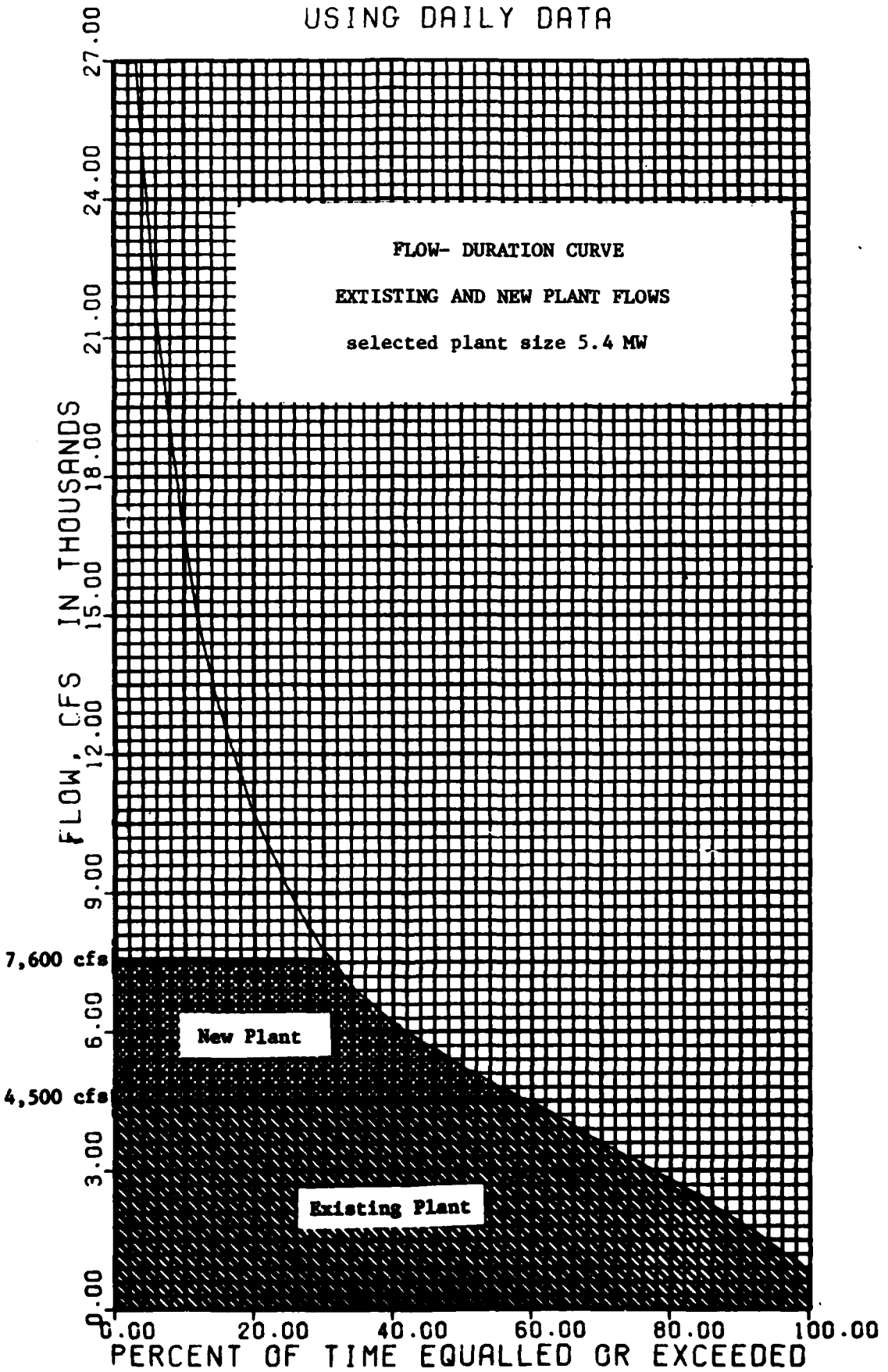

ST. ANTHONY - LOWER FALLS
ANNUAL FLOW DURATION CURVE
USING DAILY DATA
FLOW- DURATION CURVE
EXISTING AND NEW PLANT FLOWS
selected plant size 5.4 MW
FLOW, CFS IN THOUSANDS
27.00
24.00
21.00
18.00
15.00
12.00
9.00
7,600 cfs
6.00
4,500 cfs
3.00
0.00
New Plant
Existing Plant
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

Figure 3-2

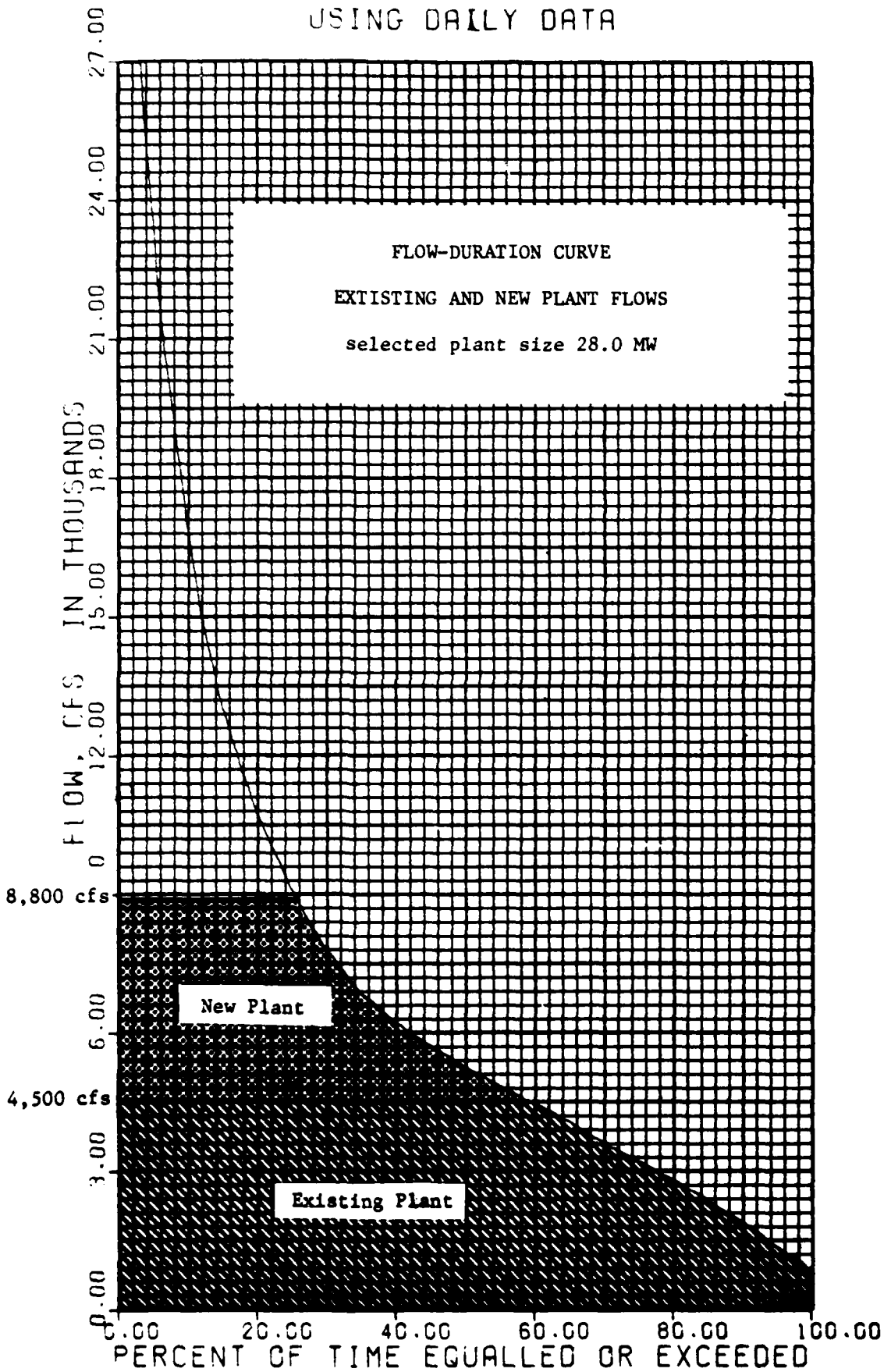

ST. ANTHONY - COMBINED FALLS
ANNUAL FLOW DURATION CURVE
USING DAILY DATA
FLOW-DURATION CURVE
EXISTING AND NEW PLANT FLOWS
selected plant size 28.0 MW
FLOW, CFS IN THOUSANDS
27.00
24.00
21.00
18.00
15.00
12.00
6.00
3.00
0.00
8,800 cfs
4,500 cfs
New Plant
Existing Plant
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

Figure 3-3

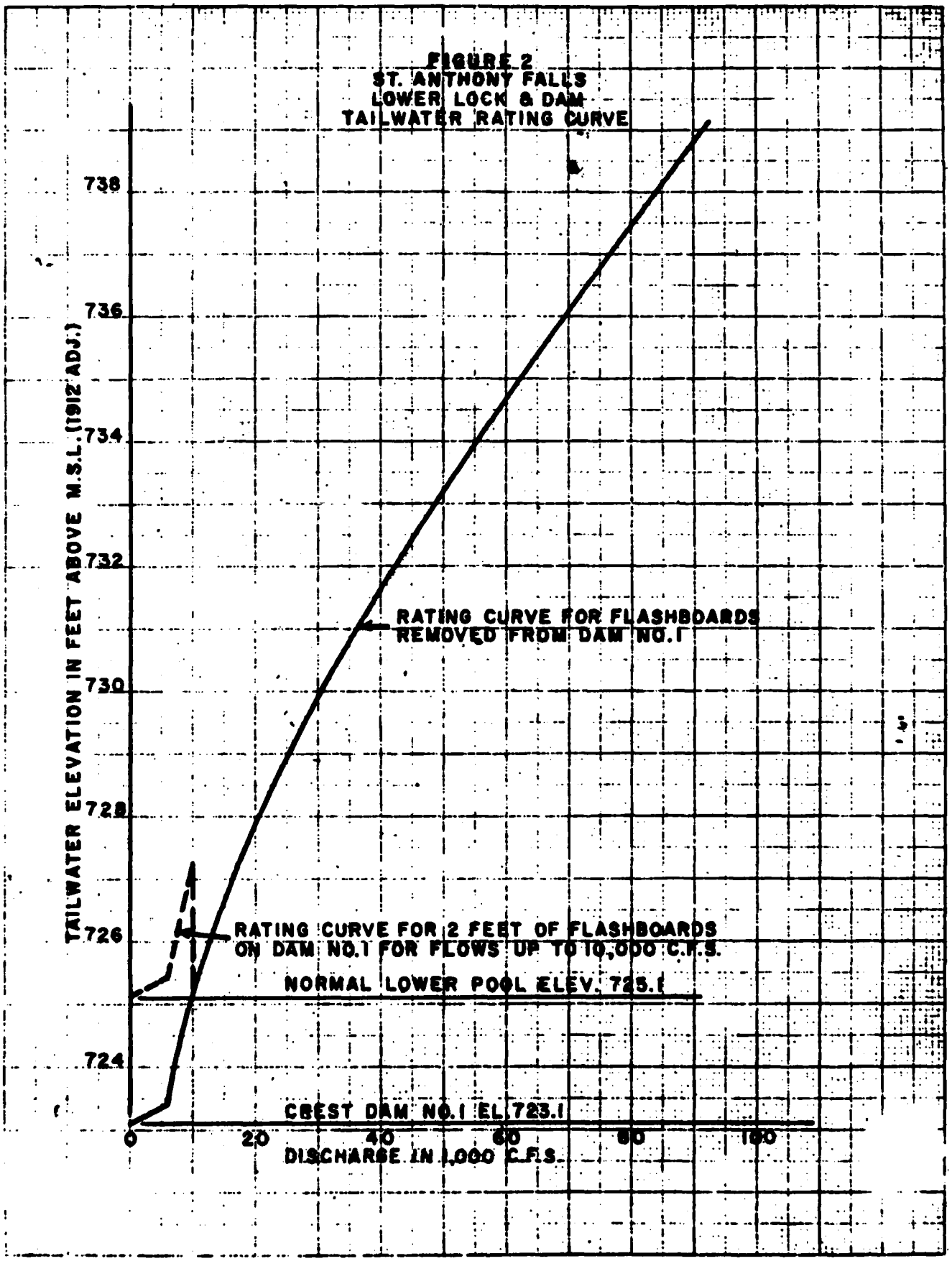

FIGURE 2
ST. ANTHONY FALLS
LOWER LOCK & DAM
TAILWATER RATING CURVE
TAILWATER ELEVATION IN FEET ABOVE M.S.L. (1912 ADJ.)
738
736
734
732
730
728
726
724
RATING CURVE FOR FLASHBOARDS REMOVED FROM DAM NO. 1
RATING CURVE FOR 2 FEET OF FLASHBOARDS ON DAM NO. 1 FOR FLOWS UP TO 10,000 C.F.S.
NORMAL LOWER POOL ELEV. 725.1
CREST DAM NO. 1 EL. 723.1
0
20
40
60
80
100
DISCHARGE IN 1,000 C.F.S.

Figure 3-4

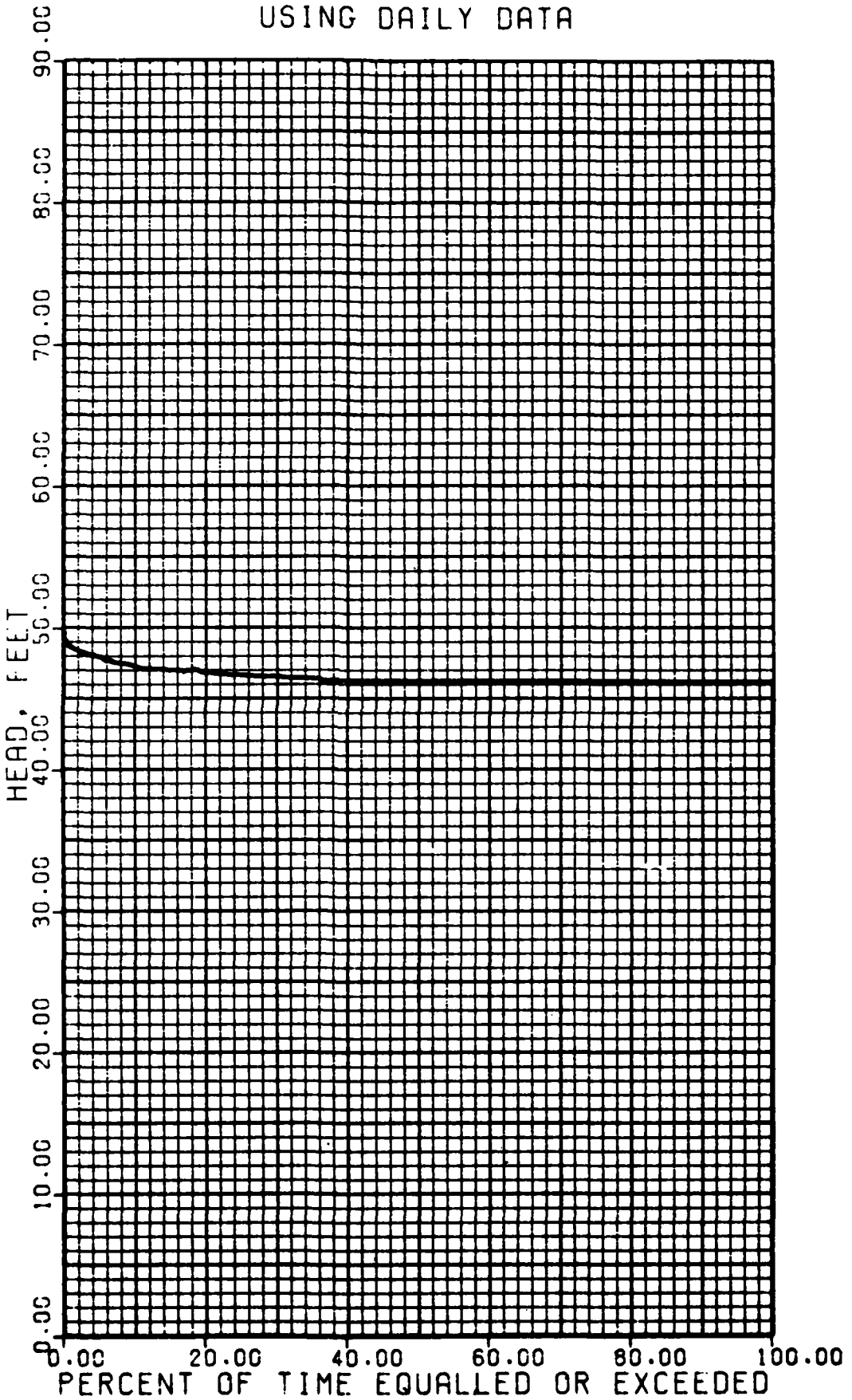

ST. ANTHONY - UPPER FALLS
ANNUAL HEAD DURATION CURVE
USING DAILY DATA
HEAD, FEET
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

Figure 3-5

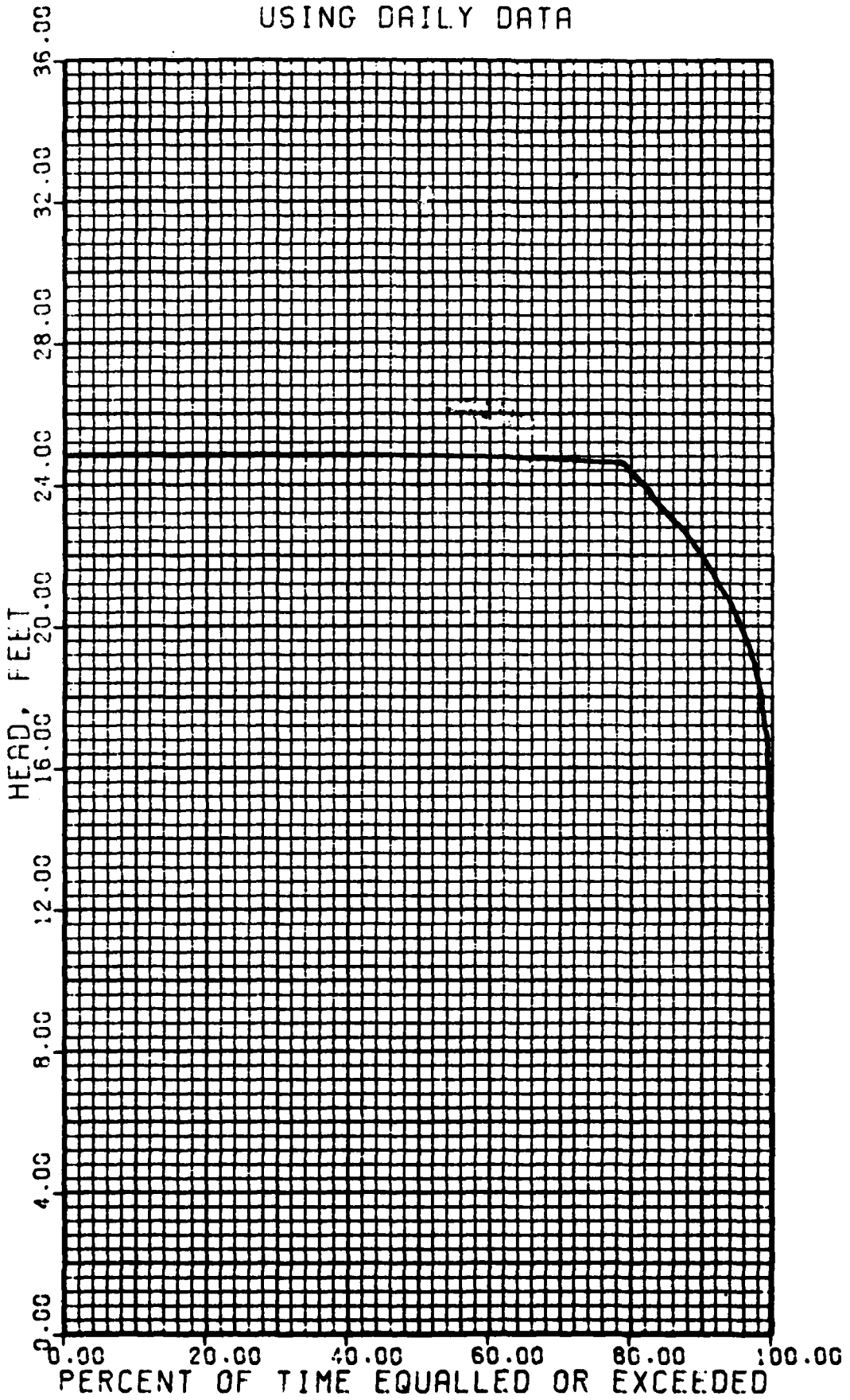

ST. ANTHONY - LOWER FALLS
ANNUAL HEAD DURATION CURVE
USING DAILY DATA
HEAD, FEET
36.00
32.00
28.00
24.00
20.00
16.00
12.00
8.00
4.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

Figure 3-6

ST. ANTHONY - COMBINED FALLS
ANNUAL HEAD DURATION CURVE
USING DAILY DATA

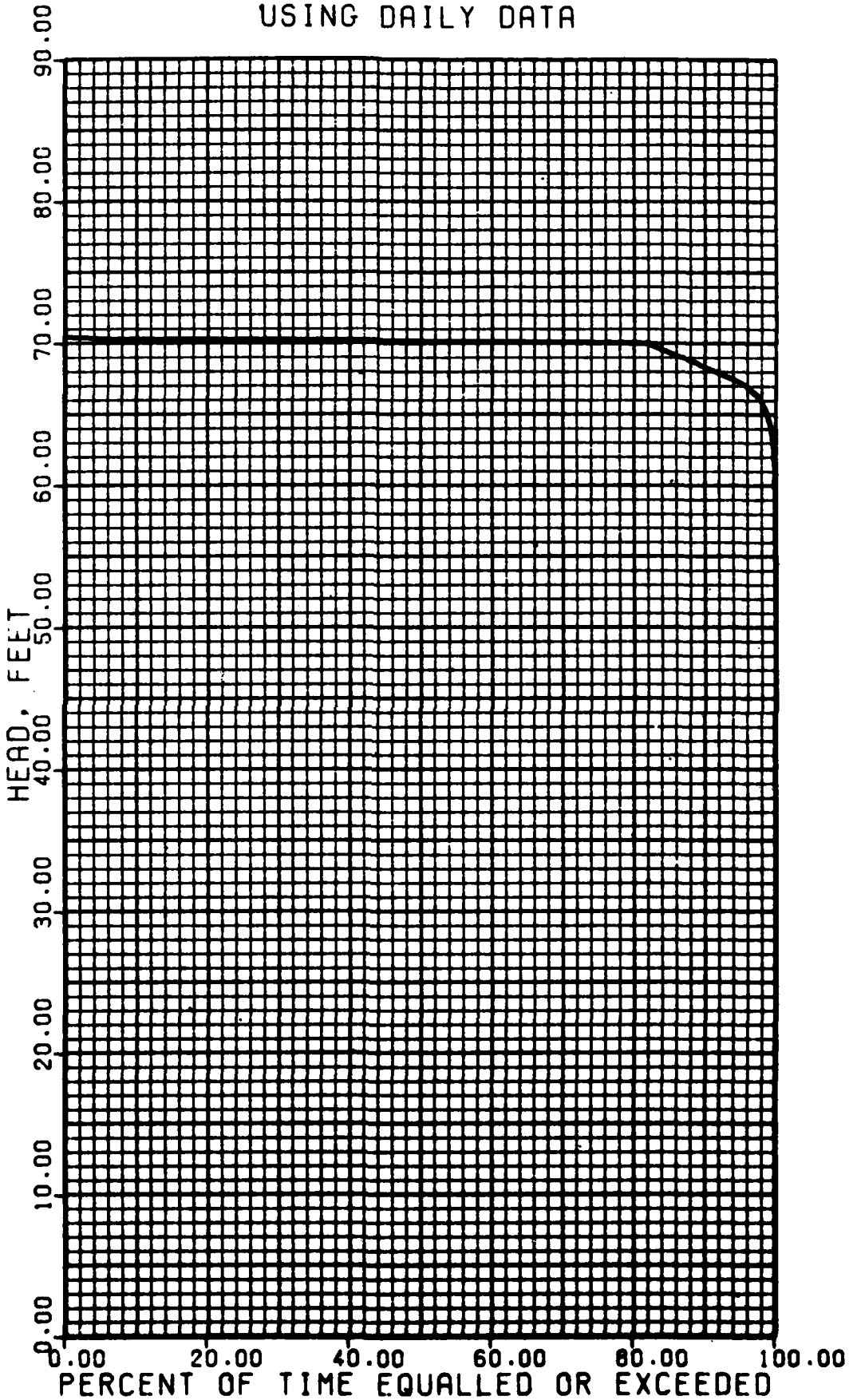


Figure 3-7

ST. ANTHONY - UPPER FALLS
ANNUAL POWER DURATION CURVE
USING DAILY DATA

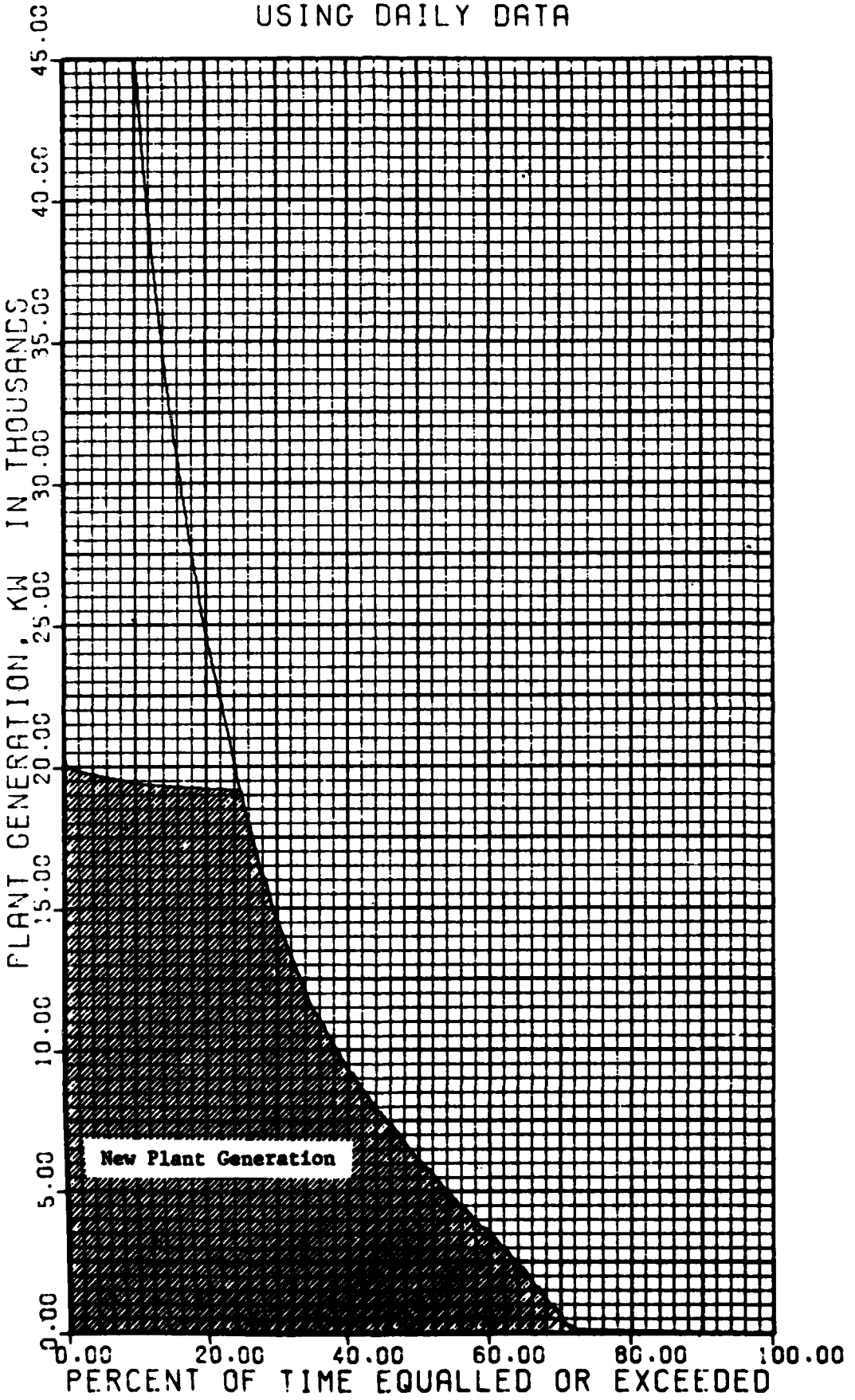


Figure 3-8

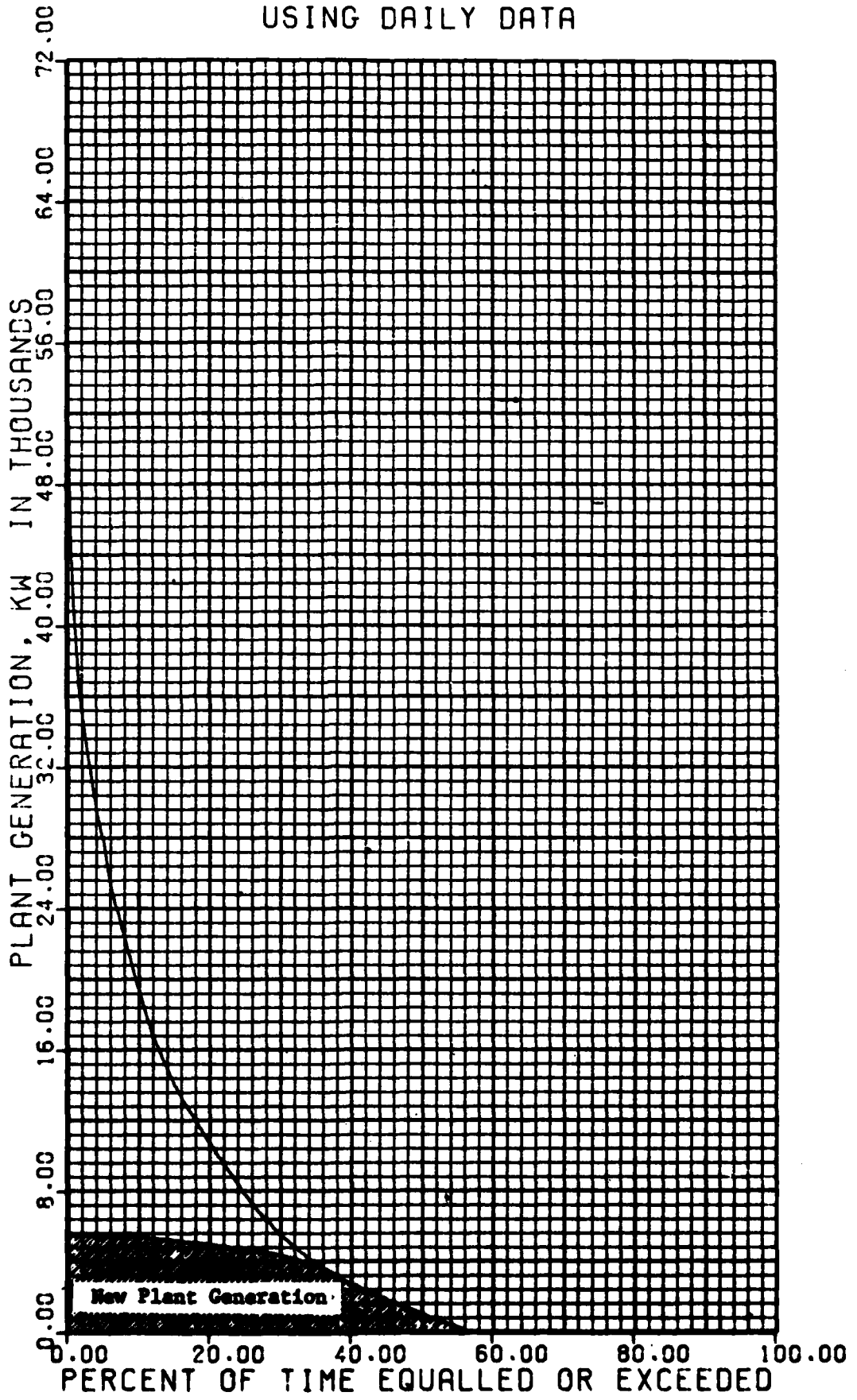

ST. ANTHONY - LOWER FALLS
ANNUAL POWER DURATION CURVE
USING DAILY DATA
PLANT GENERATION, KW IN THOUSANDS
72.00
64.00
56.00
48.00
40.00
32.00
24.00
16.00
8.00
0.00
New Plant Generation
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

Figure 3-9

ST. ANTHONY - COMBINED FALLS
ANNUAL POWER DURATION CURVE
USING DAILY DATA

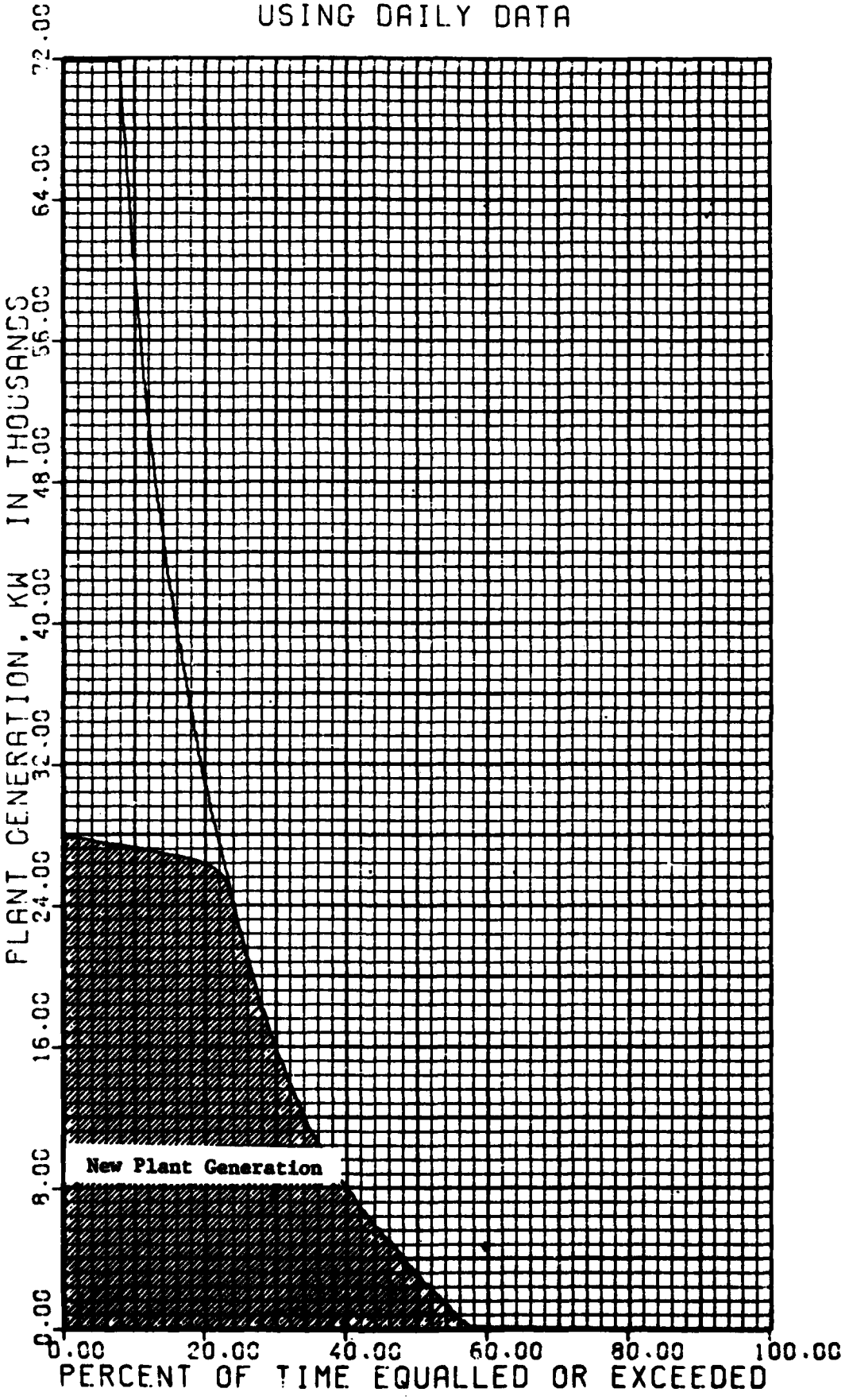


Figure 3-10

SECTION 4 - POWERHOUSE DESIGN

4.01 Powerhouse Layout.

a) General. There are three sites studied in this report. The names of the sites, followed by their original designations in the March 1982 Hydropower Feasibility Study, are as follows: the Upper Falls Site (Alternative 5U), the Lower Falls Site (Alternative 2L), and the Combined Falls Site (Alternative 8U). Each site is further explained in the following paragraphs. Plate 1 shows the location of these sites in relation to the entire complex at St. Anthony Falls.

b) Upper Falls. This powerhouse will be located in the abandoned wasteway adjacent to the University of Minnesota Hydraulics Lab. It will have two vertical axis, propeller (fixed blade) units. Equipment access into the Erection Bay will be through a movable hatch in the El 805 deck. A 50 ton bridge crane will be used to move the equipment within the powerhouse. The generator floor will be at El 769.0, and the auxiliary electrical equipment, switchgear, station service transformer, controls, and mechanical equipment will be located in galleries at the El 769.0, 756.0, and 742.0 levels. A drainage and grouting gallery will be provided in the U/S portion of the powerhouse. The intake bulkhead slot will also be used for the trashrack slot. The main power transformer will be located just upstream of the powerhouse. Take-off towers will route the power to the switchyard located adjacent to the existing Northern States Power (NSP) switchyard. Plates 2 and 3 show details of this powerhouse.

c) Lower Falls. This powerhouse will be located alongside the existing downstream hydroelectric plant, as shown on Plate 4. It will have one horizontal axis, Kaplan (adjustable blade) bulb unit. All of the powerhouse equipment will be installed and serviced through hatches in the El 752.20 deck by a mobile crane. A mobile crane will also handle and service the trashracks, intake bulkhead, intake gate, and draft tube bulkhead. The switchgear, auxiliary electrical equipment, controls, station service transformer, and mechanical equipment will be located on the El 737.0 and 722.0 levels. The main power transformer will be located adjacent to the powerhouse.

d) Combined Falls. This powerhouse will be located in the same area as the Lower Falls plant. However, the intake for this plant will be in the upper pool, next to the site of an inoperable NSP hydroelectric plant. A penstock will connect the intake and powerhouse as shown on Plate 5. This powerhouse will have two vertical axis, propeller (fixed blade) units. Equipment access into the Erection Bay at El 752.0 will be through a large, roll-up door. A 60 ton bridge crane will move and install equipment within the powerhouse. The main powerhouse floor will be at El 714.0. The switchgear, auxiliary electrical equipment, controls, station service transformer, and mechanical equipment will be located in galleries at the El 740.0, El 729.0, and El 714.0 levels. The draft tube bulkheads will be put into place, as needed, by a mobile crane. Butterfly valves, fifteen feet in diameter, will be located in a separate vault and also be serviced by a mobile crane. The main power transformer will be located adjacent to the powerhouse.

4.02 Foundation.

The proposed structures will be founded on sandstone of the St. Peter Formation. The sandstone above elevation 665 is fine-grained, very poorly cemented and easily eroded. Below elevation 665 the sandstone is moderately well cemented, interbedded with siltstone and frequently contains water under artesian pressure. All foundations, as proposed, will be in the upper friable portion of the sandstone. Careful control of water during construction and protection of the sandstone from running water after construction are, therefore, important design considerations. The sandstone is sufficiently friable to allow removal by machine excavation but exhibits more than adequate strength and bearing capacity to allow economical foundation design for the proposed features.

Some of the upstream work may be founded on the Platteville and Glennwood Formations. The Platteville is a thin bedded, moderately hard limestone characterized by a high frequency of bedding planes and vertical joints. Excavation in this formation will require blasting. The underlying Glennwood Formation consists of 2 feet of soft shale and up to 3 feet of shaly sandstone which can be removed by machine excavation. Neither formation presents any significant or unusual foundation problem.

Natural alluvium consisting of sand and gravel with large limestone blocks is expected in the discharge channel for the upstream (Upper Falls) powerhouse and in the excavation for the downstream (Lower or Combined Falls) powerhouse. In addition, dumped fill ranging from sand to limestone rubble will be encountered in the excavation for the downstream powerhouse.

4.03 Turbines.

a) General. Economic analyses performed by NPD, identified the appropriate type and number of turbines required to develop each sites hydraulic potential. The turbines considered in this investigation based on site characteristics were; Propeller (for the upstream and combined falls sies), "standardized" horizontal tubular type (for all sites), and a double regulated (Kaplan) bulb turbine (for the lower falls site). The turbine type and site is described below. In future studies all appropriate turbine types and configurations will again be considered and evaluated.

b) Upper Falls. The relatively constant head and required number of generating units at this site indicated the selection of two vertical axis, propeller (fixed blade) turbines. The units' centerlines will be located at El 739 to meet cavitation and submergence requirements. They will be operated over a net head range from 47 to 51 feet. Each unit will be rated to produce 14,375 hp at 49 feet net head. Each turbine will discharge approximately 3100 cfs at this condition. The estimated runner diameter is 132 inches, and the synchronous speed is 163.64 rpm. Estimated turbine performance and overall operating net head and flow ranges are shown on Figure 4-1. These curves have been developed from existing model test data and indicate the approximate performance of the turbines selected for evaluation of this site.

c) Lower Falls. A single, horizontal Kaplan (adjustable blade) bulb turbine was selected for this site due to the low head and high flow. The unit's centerline will be located at El 709.0 to meet cavitation and

submergence requirements. The unit will operate over a net head range from 20 to 25 feet. It will be rated to produce 7525 hp at 22 feet net head. The turbine discharge will be approximately 3100 cfs at this condition. The estimated runner diameter is 132 inches, and the synchronous speed is 116.1 rpm. Estimated turbine performance and overall operating net head and flow ranges are shown on Figure 4-2. These curves have been developed from existing model test data and indicate the approximate performance of the turbine selected for evaluation of this site.

d) Combined Falls. Due to the relatively constant head and required number of generating units at this site, two vertical axis, propeller (fixed blade) turbines were selected. Their centerlines will be located at El 703.0 to meet cavitation and submergence requirements. Each unit will be rated to produce 19200 hp at 70 feet net head. The turbine discharge will be approximately 2750 cfs at this condition. The estimated runner diameter is 120 inches, and the synchronous speed is 211.76 rpm. Estimated turbine performance and overall operating net head and flow ranges are shown on Figure 4-3. These curves have been developed from existing model test data and indicate the approximate performance of the turbine selected for evaluation of this site.

4.04 Major Electrical Equipment.

a) Generators and Excitation System. Each generator at the various sites will be directly connected to its respective turbine and be a synchronous, 3-phase, 60 Hz, 13.8 kV type. All will have Class B insulation with a 75 degree C. rise, full run-away speed capability, and no provision for overload.

At the Upper Falls site, each generator will be a vertical axis type, rated at 10.5 MW (11.67 MVA at 0.90 P.F.), 163.64 rpm. They will have totally enclosed housings with duct work. The Lower Falls site generator will be a horizontal axis type, rated at 5.44 MW (6.04 MVA at 0.90 P.F.), 116 rpm. It will be provided with an enclosed housing and external HVAC duct connections. The Combined Falls site will have vertical axis type generators, each rated at 14.0 MW (15.56 MVA at 0.90 P.F.), 211.76 rpm. They will have totally enclosed housings with duct work.

The excitation systems will be specified to be the manufacturer's standard type. This can be either a bus-fed power potential source, static excitation system or a direct connected, brushless exciter. Solid-state, continuously-acting, dynamic type voltage regulators will be used and will be incorporated in the unit switchgear.

b) Governors. The governors will be of the oil pressure, relay valve, actuator type with mechanically driven, speed responsive elements designed for regulating the speed by controlling the turbine wicket gates. Speed responsive elements will be controlled by a speed signal generator which is directly connected to the turbine generator shaft. Each governor unit will consist of actuator, restoring mechanism, motor driven pumping units, pressure or accumulator tanks, air compressor, sump tank, oil piping, and accessories. In addition an automatic gate limit control will be provided for positively limiting gate opening and preventing the turbine from exceeding cavitation limits under varying head conditions. Specific characteristics of the governor, will vary between manufacturers.

c) Transformers. The transformers will be sized as follows: Upper Falls 17.51/23.34 MVA, Lower Falls 4.53/6.04 MVA, and Combined Falls 23.33/31.11 MVA. All transformers will be rated at 13.8/115 kV, OA/FA Class, delta-grounded wye, three-phase, 60 Hz with the minimum non-premium impedance.

4.05 Generator Voltage Systems. The connection between the generators and their respective circuit breakers will be with cable for the Lower Falls and non-segregated-phase bus for the Upper and Combined Falls. The generator and station service circuit breakers will be metal-clad, drawout type rated 500 MVA (nominal), 13.8 kV, 1200 amps continuous. The breakers will be combined in a common switchgear lineup along with generator surge protection and instrument transformers.

4.06 Unit Control and Protective Equipment. A control switchboard will be furnished for each generator and for each transformer. The switchboards will contain a complete complement of protective relays (differential, overvoltage, overcurrent, etc.), metering, and start-up and shut-down circuits. Unit start-up and loading will be performed manually by an operator. The control circuits will provide automatic shut-down when a trouble condition is detected.

4.07 Station Service. The station service power for each powerhouse will be obtained via a tap between the generator circuit breaker and the main power transformer. The station service transformer will be adjacent to the generator switchgear lineup. Station service power distribution will be at 480 volts, 3-phase and 120/240 volts single-phase.

4.08 Load Connection. A 3-phase, 115 kV overhead transmission line will tie each plant to the transmission system, located at the existing NSP switchyard. The line will be connected to the powerhouse through disconnect switches. The one-line diagram for the Upper or Combined Falls is shown on Figure 4-4 and for the Lower Falls on Figure 4-5.

4.09 Mechanical Equipment.

a) HVAC. All powerhouse configurations will utilize outside air mixed with return air for cooling. Heating will be by utilizing equipment heat loss and backed-up with electric resistance heating.

b) Bridge Crane. The Upper and Combined Falls powerhouses will be provided with a bridge crane. The Lower Falls powerhouse will not be equipped with a bridge crane (See 4.09 e). The capacities of the bridge cranes are as follows: Upper Falls 50 tons, Combined Falls 60 tons. Both cranes will have a hook speed of 5 feet per minute, trolley speed of 50 feet per minute, and a bridge speed of 100 feet per minute. The cranes will be pendant controlled at floor level.

c) Piping Systems. Each powerhouse will have similar piping systems. Unwatering and drainage water will go to a common sump. Duplex pumps will pump the water to the tailrace. Raw water for unit cooling and turbine glands will be taken from an intake tap and strained. A small pump and filter will be used for gland water. Two air compressors supplying low and high pressure air respectively will be furnished. Governor and lubricating oil will be handled and filtered by a portable pump/filter unit and 55

gallon drums. CO_2 fire protection will be provided for each generator and a deluge system will be furnished for each transformer. Potable water will be provided by tapping a nearby potable water line. Sanitary waste will be routed to a nearby sewer line.

d) Intake Gate Hoist. An intake gate with a hydraulic hoist will be provided for emergency closure of both the Upper and Lower Falls powerhouses. The Combined Falls powerhouse will have butterfly valves for this purpose. This equipment can also be used for routine dewatering of the units for maintenance purposes.

e) Mobile Crane. A mobile crane will be required at each of the three sites for the following functions:

Item	Upper Falls	Lower Falls	Combined Falls
Install & remove			
intake gates,	X	X	1/
bulkheads & trashracks.	X	X	1/
Perform trash raking.	X	X	1/
Install & remove draft tube bulkheads.	X	X	X

1/ Located at intake works.

ESTIMATED TURBINE PERFORMANCE
ST. ANTHONY FALLS
UPSTREAM FALLS SITE

VERTICAL PROPELLER(FIXED BLADE)

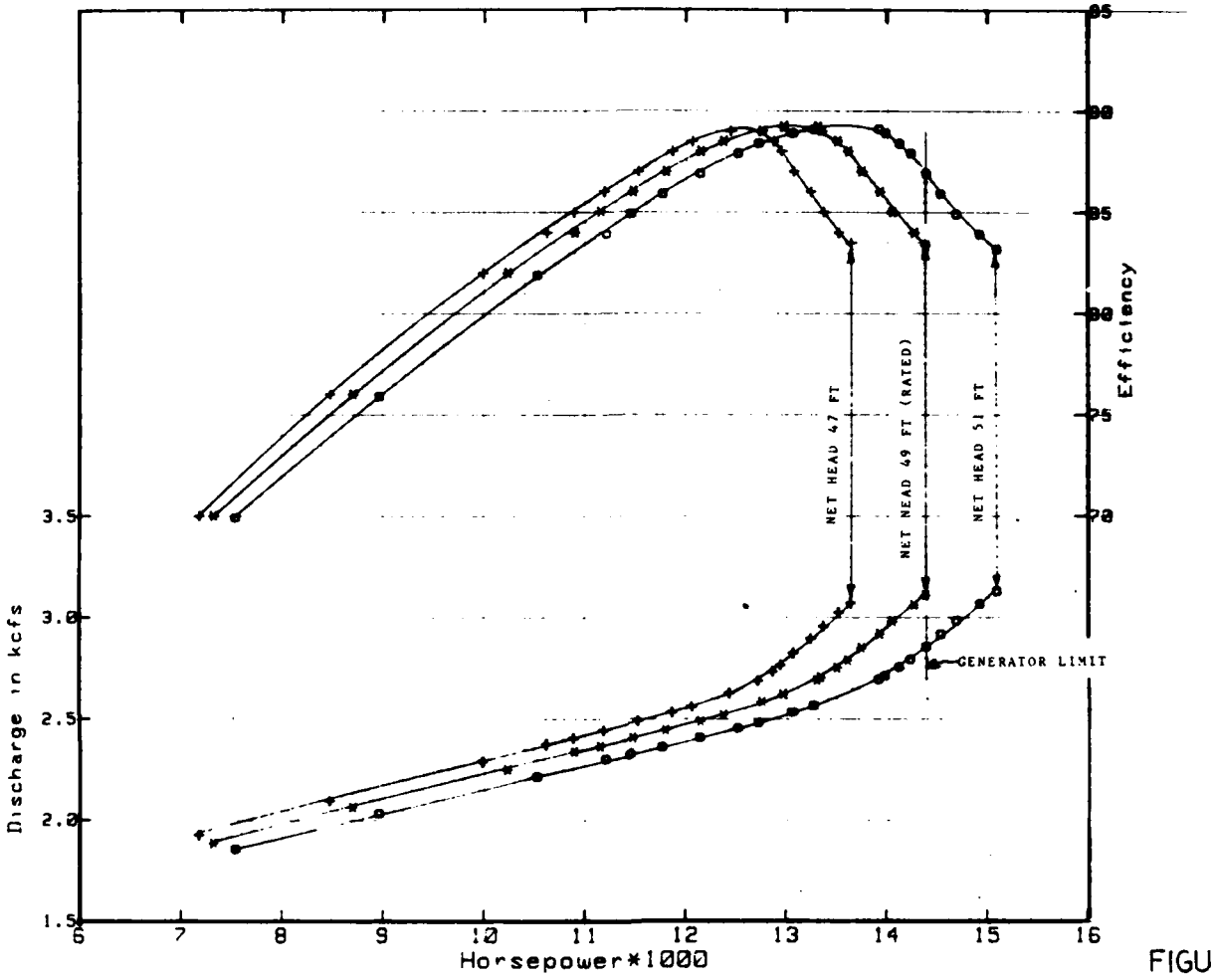


FIGURE 4-1

FIGURE 4-1

ESTIMATED TURBINE PERFORMANCE
ST. ANTHONY FALLS
DOWNSTREAM FALLS SITE
HORIZONTAL BULB TURBINE

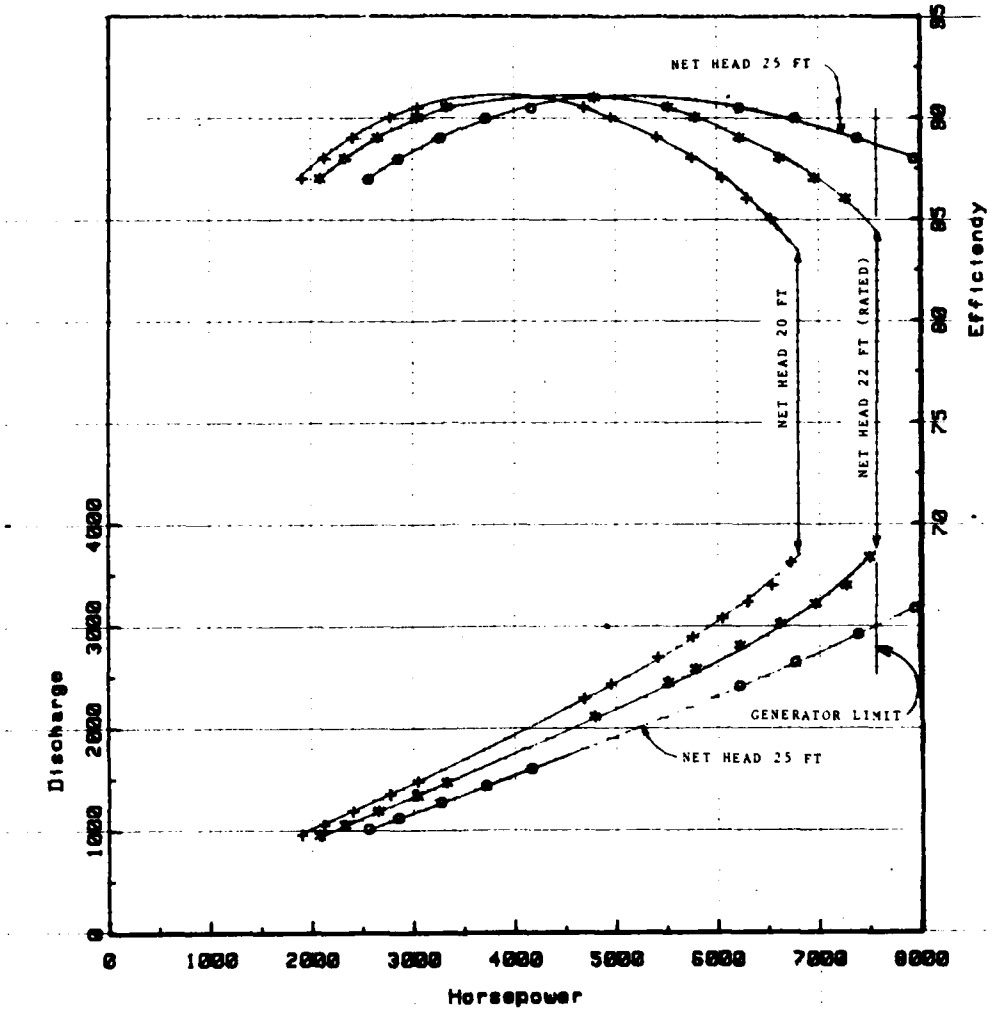


FIGURE 4-2

FIGURE 4-2

ESTIMATED TURBINE PERFORMANCE
ST. ANTHONY FALLS
COMBINED FALLS SITE

VERTICAL PROPELLER (FIXED BLADE)

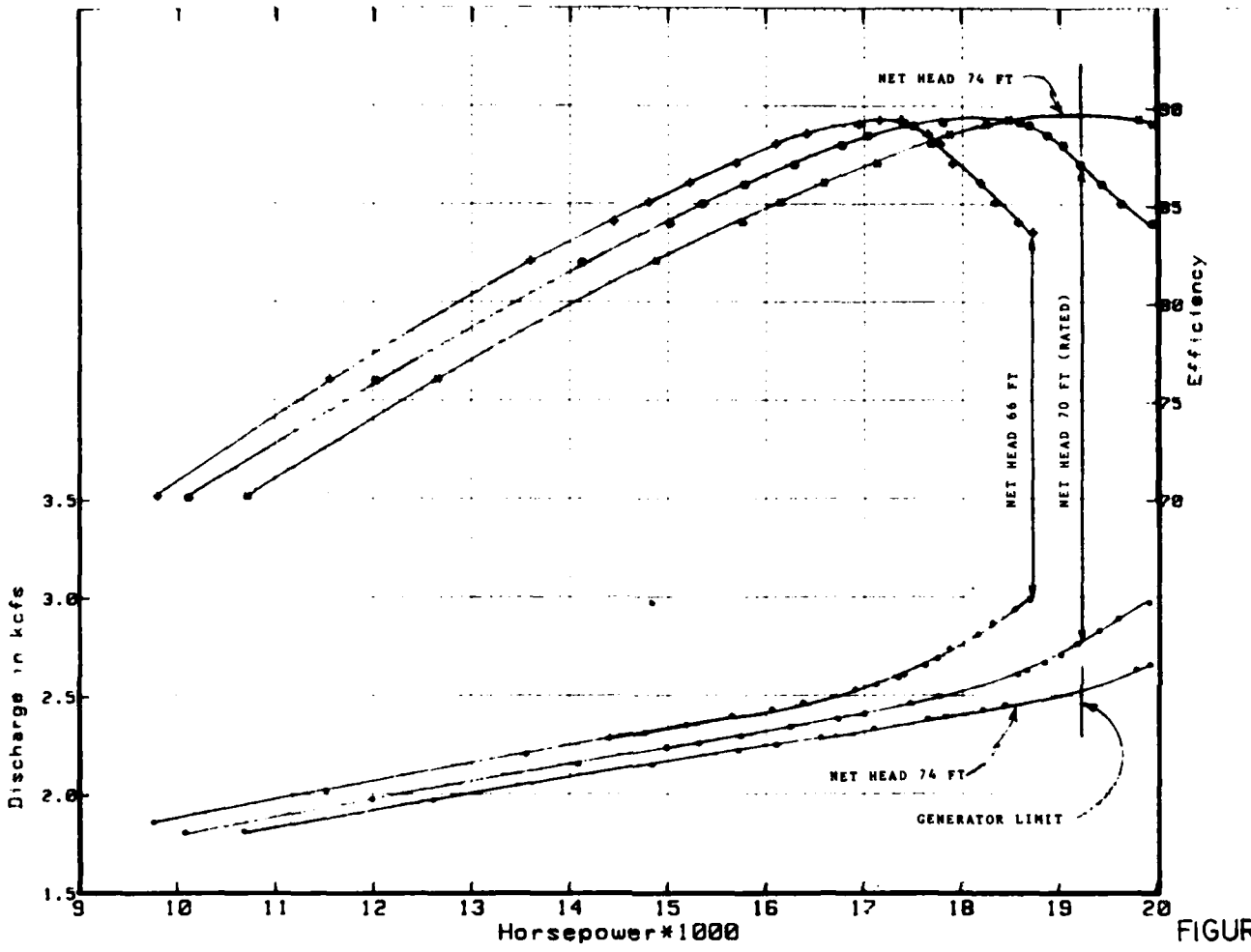


FIGURE 4-3

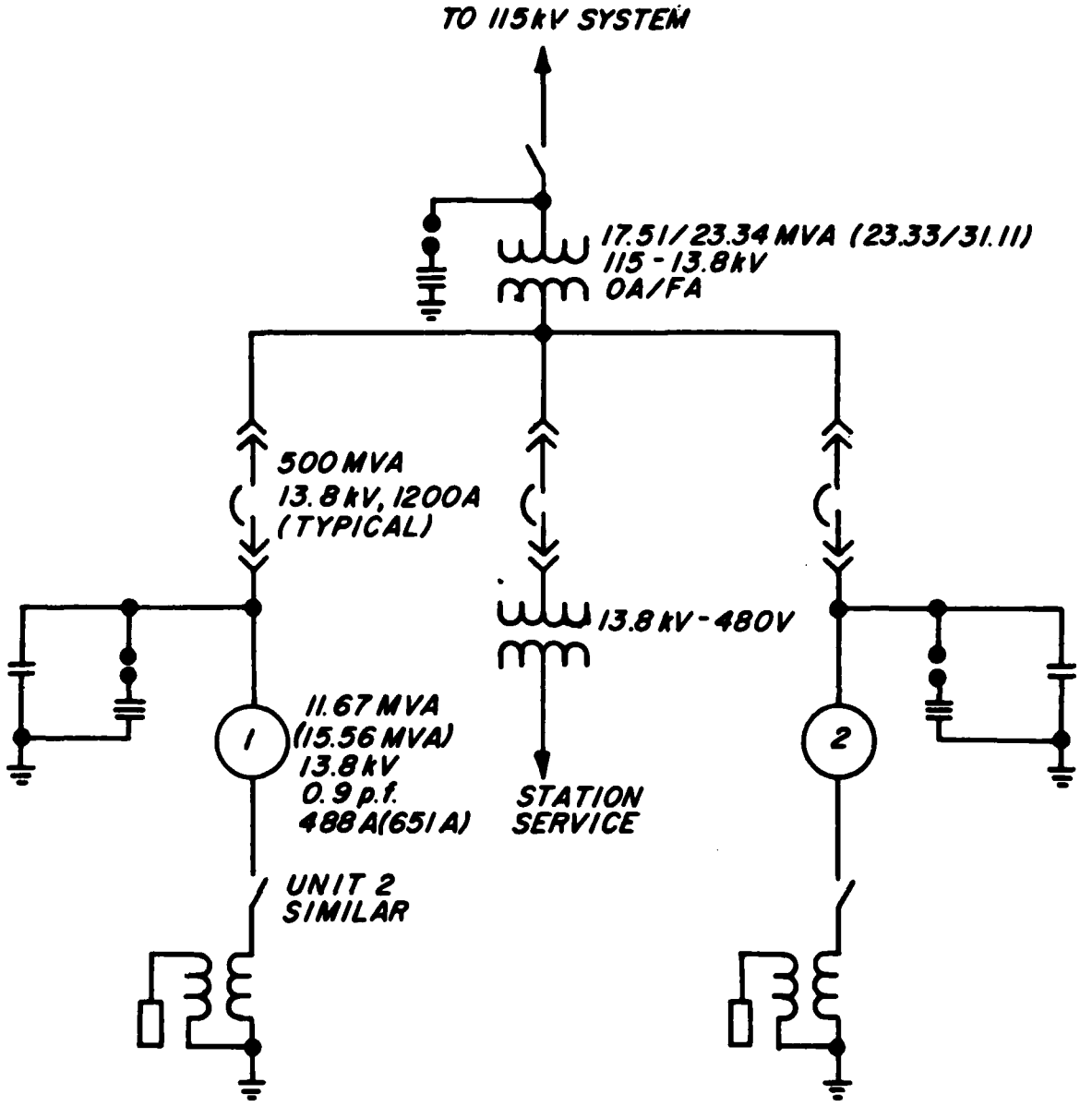
FIGURE 4-3

U. S. ARMY ENGINEER DIVISION, NORTH PACIFIC HYDRO-ELECTRIC DESIGN BRANCH

PROJECT ST. ANTHONY FALLS (UPPER OR COMBINED FALLS)

SUBJECT ONE LINE DIAGRAM

BY GKW DATE 4-29-83 CHECKED



UPPER FALLS SHOWN: COMBINED FALLS SIMILAR EXCEPT WHERE INDICATED BY PARENTHESIS

FIGURE 4-4

PROJECT: ST. ANTHONY FALLS (LOWER FALLS)	COMPUTED BY: GKW	DATE: 4-29-83
SUBJECT: ONE LINE DIAGRAM	CHECKED BY:	SHT OF PART

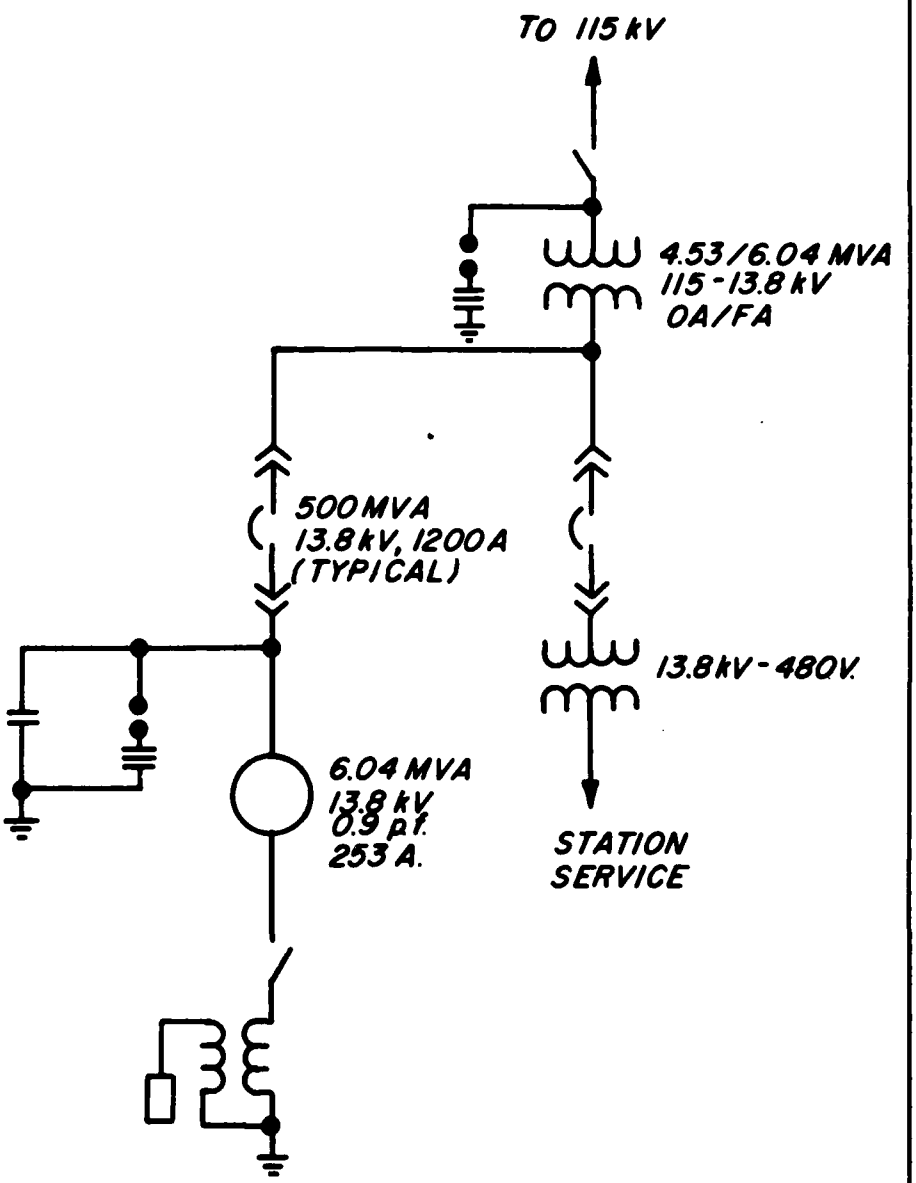


FIGURE 4-5

SECTION 5 - COSTS AND CONSTRUCTION

5.01 Project Costs. The total estimated project construction cost for the proposed powerplants at the Upper Falls, Lower Falls, and Combined Falls sites are summarized below based on October 1, 1982 price levels.

TABLE 5-1
CONSTRUCTION COSTS

FEATURES	UPPER FALLS	LOWER FALLS	COMBINED FALLS
1. POWERHOUSE			
1.1 Excavation & Civil Work[1]	2,645,000	1,283,000	13.076,000
1.2 Reinforced Concrete	4,297,000	952,000	3,037,000
1.3 Misc. Building Items & Architectural	468,000	128,000	385,000
1.4 Bulkheads, Guides & Structural Steel	1,069,000	291,000	137,000
1.5 Bifurcation & Penstock	-------	--------	444,000
2. TURBINES AND GENERATORS			
2.1 Turbines[2]	3,530,000	3,450,000	4,950,000
2.2 Generators	2,788,000	--------	2,863,000
2.3 Governors	360,000	--------	365,000
2.4 Cooling System	31,000	16,000	33,000
3. ACCESSORY ELECTRICAL SYSTEMS AND EQUIPMENT			
3.1 Switchgear, Breakers & Busses	235,000	160,000	250,000
3.2 Station Service Unit	60,000	60,000	60,000
3.3 Control System	233,000	153,000	153,000
3.4 Misc. Electrical Systems	430,000	115,000	430,000
4. AUXILIARY SYSTEMS & EQUIPMENT			
4.1 Heating & Ventilating	23,000	9,000	23,000
4.2 Station Brake & Governor Air	40,000	30,000	41,000
4.3 Unwatering & Drainage Systems	48,000	31,000	51,000
4.4 Misc. Mechanical Systems	48,000	27,000	49,000
4.5 Bridge Crane	290,000	------	330,000
4.6 Intake Gate Hydraulic System	150,000	100,000	------
5. SWITCHYARD			
5.1 Power Transformer	219,000	138,000	262,000
5.2 Disconnects & Electrical Equipment	35,000	35,000	35,000
TOTAL	16,999,000	6,978,000	26,974,000

1 See Appendix A. Items do not include SAF contingencies. See Section 6 for contingency calculations.

2 This includes the turbine, generator and governor cost for the Lower Falls and the butterfly valves for the Combined Falls.

5.02 Design and Construction Schedule. The estimated design and construction schedules are shown in Figures 5-1 and 5-2.

ST. ANTHONY FALLS-UPPER FALLS OR COMBINED FALLS

DESIGN AND CONSTRUCTION SCHEDULE

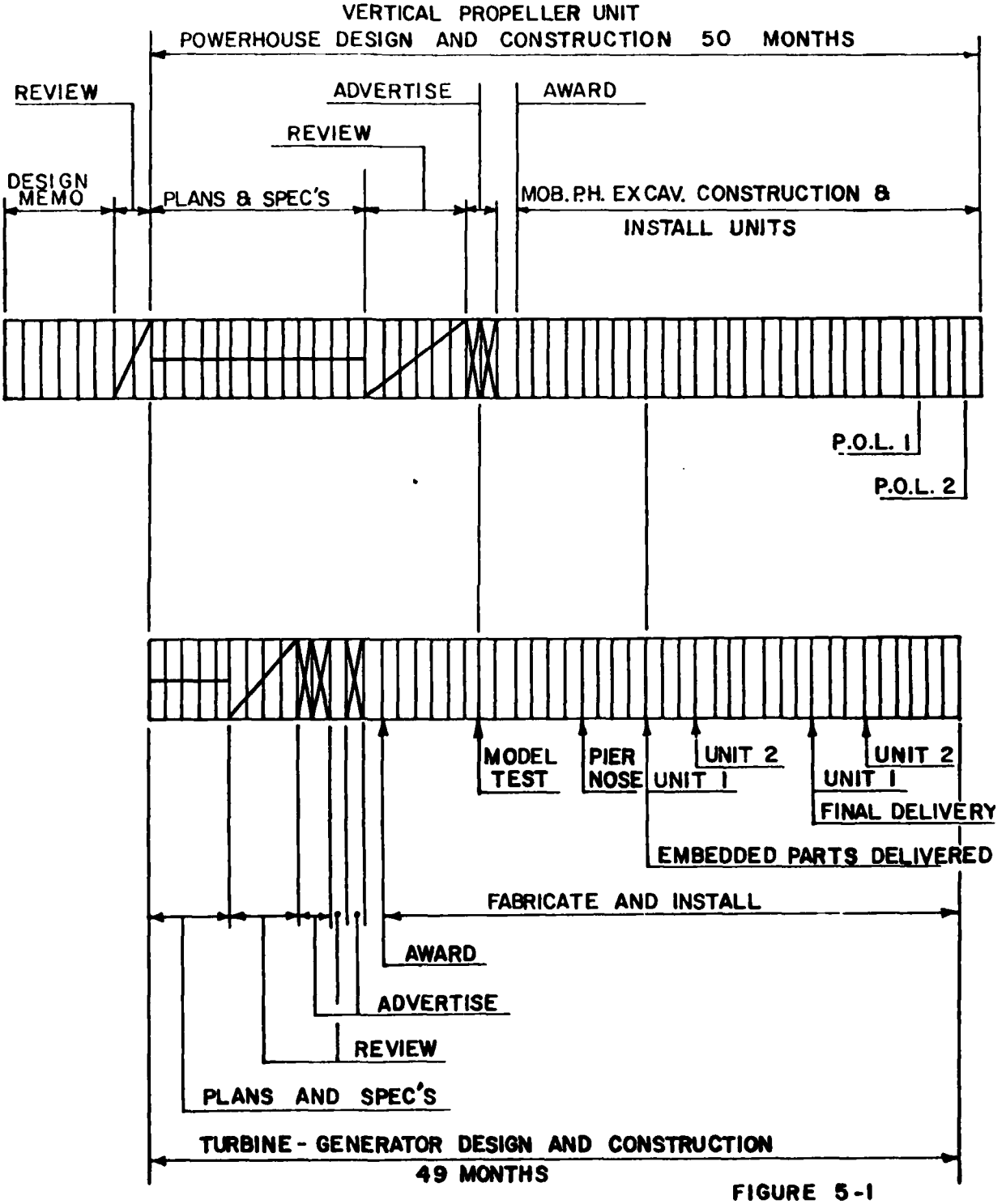


FIGURE 5-1

ST. ANTHONY FALLS - LOWER FALLS

DESIGN AND CONSTRUCTION SCHEDULE

BULB UNITS

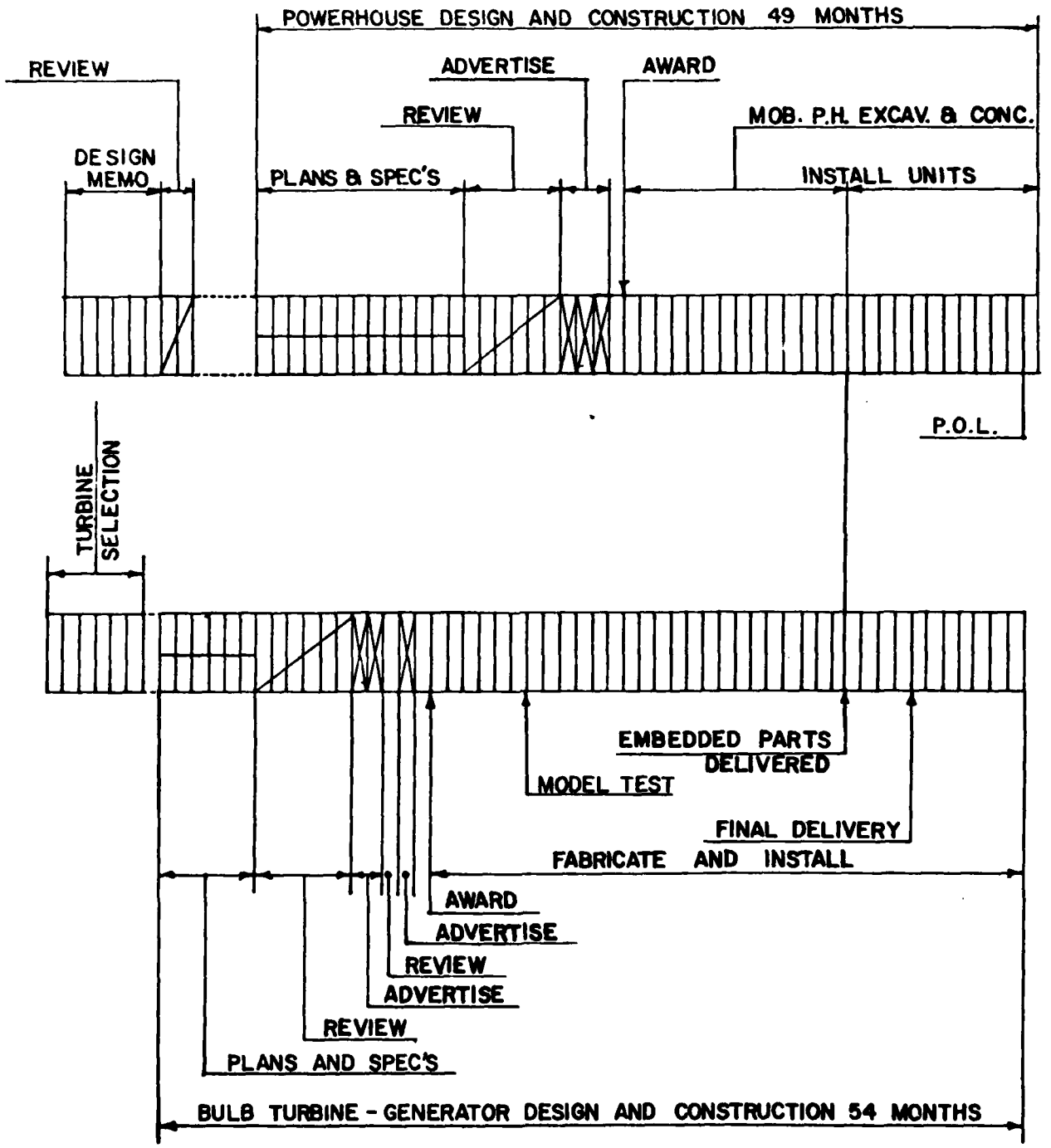


FIGURE 5-2

SECTION 6 ECONOMICS

6.01 General. The purpose of this section is to estimate the economic value of the proposed power installations; the optimum size of the power plants will also be determined. Annual project costs for three seperate site locations (Upper Falls, Lower Falls, and Combined Falls) will be determined. The corresponding benefits based on power values provided by the Federal Energy Regulatory Commission (FERC) will also be determined. The power values are based on alternative development of a coal-fired thermal plant.

6.02 Cost Estimates. All cost levels in this report are based on October 1982 levels. Cost estimates were prepared for different sizes of generating plants that could utilize the available flows. For scoping it was found that construction costs varied nearly linearly with installed capacity. After the optimum plant size had been determined, a final, more refined cost estimate was developed for each site (also see Section 6.06 Scoping).

Costs for the powerplant equipment were developed by North Pacific Division, while other project costs (intake structures, penstock, excavation, etc.) were developed by St. Paul District. These "other" costs are described in Appendix A. Detailed construction costs for the powerplant equipment are summarized in Section 5-1.

For the Upper Falls site, cost estimates were prepared for a powerhouse and related facilities to be located within the existing abandoned wasteway. The Lower Falls site costs were developed based on locating the powerplant adjacent to the existing plant, on the left bank. The Combined Falls site was assumed to be located in the same area as the

new Lower Falls plant. Other powerhouse site locations were eliminated because of re-evaluation of the 1981 reconnaissance report and other identified sites, using current cost levels and designs.

For the powerplant, engineering and design (E&D) costs of 6 percent and supervision and administration (S&A) costs of 6 percent were included. Because a large portion of the costs of the powerplant represents electrical and mechanical equipment purchased under supply contracts, E&D and S&A costs represent a smaller portion of total project costs than for most other similar types of construction projects. To obtain the total investment cost, interest during construction was added based on an approximate construction period of 36 months for each site. Interest during construction (IDC) costs were compounded based on the estimated midpoints of yearly construction expenditures. Based on experiences with similar projects in North Pacific Division, the estimated yearly costs expressed as a percentage of the total cost for each site were as follows:

TOTAL PROJECT EXPENDITURE PERCENTAGES

	Year 1	Year 2	Year 3
Powerplant Equipment[1/]	60%	30%	10%
Items Exclusive[2/] of Powerplant Equip.	0%	85%	15%

1/ Items 2 and 3, Section 5.01
2/ Items 1, 4 and 5, Section 5.01

6.03 Cost Adjustment for Inflation During Construction. Construction cost estimates for feasibility level reports are based largely on bids made by contractors on similar projects. Since contractors must cover all costs over the entire construction period, their bid estimates include an allowance for increases in the price of labor and material (inflation) over the entire construction period. Water Resources Council (WRC) NED benefits manual,[1/] states that a project's NED benefit and cost must be computed at a common point in time. The NED benefits for this report are based on October 1982 price levels; therefore, an adjustment was made to the project cost estimate to arrive at NED costs for the same price level. Procedures for making allowance in the cost estimate for inflation is specified in Engineering Manual 1110-2-1301, dated 15 April 1982. Based on the experience of North Pacific Division, a 6.1 percent total inflation rate adjustment was made to the powerhouse portion of the project cost estimate. This inflation rate was computed from several completed powerhouses using an average length of construction of 24 months.

The process for making the appropriate inflation costs adjustment involves the following steps:

a. From the total project cost, deduct the cost of the turbines and generators and their contingency allowances. Cost estimates for supply contract items (i.e. turbines and generators) are point estimates with

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1/ Water Resources Council, Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C), December 14, 1979, Section 713.23.

inflation during construction provided for by escalating the contract payment at the time of delivery or partial payment.

b. An inflation adjustment factor is computed on the basis of an inflation rate of 6.1% compounded over a two-year construction period.

c. The inflation adjustment factor is then subtracted from the total project cost. To this subtotal, engineering, design, supervision and administration--and interest during construction are added to derive the total investment cost (NED).

TABLE 6-1

INVESTMENT COST, UPPER FALLS SITE ($1,000)

Selected Plant Size 21.0 MW

	Powerplant Equipment 7/	Items Exclusive of Powerplant Equipment	Total
Subtotal 1/	$7,667	$9,332	
Contingencies 2/	1,150	1,866	
Subtotal	8,817	11,198	
Inflation Adjustment 3/	---	-1,250	
Subtotal	8,817	9,948	
EDS & A 4/	1,058	1,194	
Subtotal	9,875	11,142	
IDC 5/	1,640	1,203	
Total NED 6/ Invest. Cost	$11,515	$12,345	$23,860

1/ Basic construction costs from Section 5.01.

2/ For powerplant equipment, use 15%; for items exclusive, use 20%.

3/ Adjustment for inflation during construction, items exclusive of powerplant equipment only, two-years; see Section 6.03.

4/ Engineering, design, supervision, and administration, 12%.

5/ Interest during construction, compounded from estimated yearly expenditures.

6/ National Economic Development (NED) investment cost for scoping and economics excludes inflation during construction cost.

7/ Cost items 2 and 3 only from Section 5.01.

TABLE 6-2

INVESTMENT COST, LOWER FALLS SITE ($1,000)

Selected Plant Size 5.4 MW

	Powerplant[7] Equipment	Items Exclusive of Powerplant Equipment	Total
Subtotal[1]	$3,954	$3,024	
Contingencies[2]	593	605	
Subtotal	4,547	3,629	
Inflation Adjustment[3]	---	- 405	
Subtotal	4,547	3,224	
EDS & A[4]	545	387	
Subtotal	5,092	3,611	
IDC[5]	845	390	
Total NED[6] Invest. Cost	$5,937	$4,001	$9,938

1/ , through 7/ See footnotes Table 6-1

TABLE 6-3

INVESTMENT COST, COMBINED FALLS SITE ($1,000)

Selected Plant Size 28.0 MW

	Powerplant 7/ Equipment	Items Exclusive of Powerplant Equipment	Total
Subtotal 1/	$9,104	$17,870	
Contingencies 2/	1,366	3,574	
Subtotal	10,470	21,444	
Inflation Adjustment 3/	---	- 2,395	
Subtotal	10,470	19,049	
EDS & A 4/	1,256	2,286	
Subtotal	11,726	21,335	
IDC 5/	1,946	2,304	
Total NED 6/ Invest. Cost	$13,672	$23,639	$37,311

1/ , through 7/ See footnotes Table 6-1

6.04 Annual Costs. The period of analysis for the projects is 100 years.[1/] The annual interest and amortization rate is 7-7/8 percent. Operation, maintenance, and replacement costs are based on curves and procedures published in the Corps of Engineers' 1979 Hydropower Cost Estimating Manual,[2/] adjusted to October 1982 price levels. It is assumed that operation of the plant will be remote; however, personnel associated with the other project functions (navigation) could be called in on emergencies.

Table 6-4 summarizes annual costs for the selected plant size for each site. The costs for all plant sizes considered at each site are also shown in Tables 6-5, 6-6, and 6-7 along with the corresponding annual benefits.

1/ Also see section 6.08 for comparison to 50-year period of analysis.

2/ Corps of Engineers, Hydropower Cost Estimating Manual, May 1979 (Rev. July 1981), pp. 46-49 (prepared by North Pacific Division for the Institute for Water Resources).

TABLE 6-4

ANNUAL COSTS FOR SELECTED PLANT SIZES
($1,000)

	U/S Site 21.0 MW	D/S Site 5.4 MW	Combined Site 28.0 MW
NED Investment Cost	$23,860	$ 9,938	$37,311
Annual Cost			
Interest & Amortization 1/	1,880	783	2,940
Operation & Maintenance 2/	96	48	109
Replacement 3/	148	68	143
Total	$2,124	$899	$3,192

1/ 7-7/8 percent and 100 years (I & A factor = 0.07879)
2/ See section 6.04
3/ See section 6.04

6.05 Power Values. Power benefits are based on avoided costs, the costs that would be incurred if the hydro project were not constructed. Hydro power project benefits are represented by the cost of the most likely alternative project, which would usually be a thermal generation plant. Hydro generation can displace thermal generation in two ways: (1) by displacing an increment of new generating plant, or (2) by displacing the operation of existing power plants (energy displacement).

Discussions with FERC Chicago office indicated that generation from St. Anthony Falls project would most likely displace an increment of new coal fired generation. Thus, the total power benefit will include both capacity and energy components (see FERC letters of 19 October 1982 and 11 March 1983 and telephone logs of 14 March and 7 April 1983).

In their 19 October 1982 and 11 March 1983 letters, FERC supplied adjusted capacity values which varies with site and plant size. A subsequent telephone conversation indicated that FERC had included in these values, hydrologic availablility adjustments, based on preliminary data developed by St. Paul District. For this study, it was necessary to develop capacity benefits on more refined hydrologic availability factors developed in Section 3.04. To simplify the analysis, FERC subsequently provided a single unadjusted capacity value of $145.22/kW-yr, which was based on the same assumptions as in their earier correspondence. NPD then made the adjustments to account for hydrologic availability.

Likewise, the energy values provided in the two letters varied with site and plant size. FERC indicated that the values contained in the 19 October 1982 were based on the assumption that some daily load-shaping would be possible. Inasmuch as only minor pool fluctuating is permissible, it was decided to use the 38.0 mills/kwh energy value provided in the 11

March 1983 letter, because it is based on run-of-river operation.

The following unit power values were used to compute the project benefits. These values are based on October 1982 price levels, an interest rate of 7-7/8 percent, and escalated energy values relfecting a 1990 power-on-line date.

POWER VALUES

Capacity	$145.22/kw-yr
Energy	38.0 mills/kwh-yr

6.06 Annual Benefits. Project annual benefits were computed for the series of plant sizes shown on Table 3.1 (Also see project scoping Section 6.07). The annual benefit for each of the St. Anthony Falls projects is the sum of the capacity and energy benefits.

The energy benefit is the product of the annual energy output and the FERC-supplied energy value of 38.0 mills/kwh.

The capacity benefit was developed from the relationship,

Cap. Benefit = Dependable Cap. x CV x HMA/TMA

where,

CV = annual investment cost of the thermal alternative

HMA = mechanical availability - hydro project = .975

TMA = mechanical availability - thermal project = .80

The Chicago Regional Office of the FERC provided a value of $145.22/kw-yr as the annual investment cost for a coal-fired steam plant and, which they identified as the thermal alternative to a hydroelectric plant in that area. Applying the mechanical availability adjustments, on adjusted capacity value of ($145.22) x (0.975/0.80) = $177.00/kw-yr is

obtained, and this value is applied to the dependable capacity to obtain the project's capacity benefit.

Tables 6-5, 6-6, 6-7 summarize annual costs and benefits, for each plant size at each site.

TABLE 6-5
UPPER FALLS SITE
ANNUAL COSTS AND BENEFITS
For Project Scoping
(October 1982 Price levels, $1,000)

Installed Capacity	9.9 MW	13.6 MW	17.3 MW	21.0 MW	25.1 MW
Generation					
Dep. Capacity MW 1/	5.4	6.8	7.8	8.8	9.5
Annual Energy, MWh	45,950	57,250	66,710	74,880	81,240
Plant Factor 2/	53%	48%	44%	41%	37%
Costs					
Annual Cost 3/	800	1,240	1,660	2,120	2,580
Production Cost 4/ (mills/kwh)	17	22	25	28	32
Benefits					
Annual Capacity 5/	956	1,204	1,381	1,558	1,681
Annual Energy 6/	1,746	2,176	2,535	2,845	3,087
Total Annual 7/	2,702	3,380	3,916	4,403	4,768
Net Benefits 8/	1,902	2,140	2,256	2,283	2,188
B/C Ratio 9/	3.4	2.7	2.4	2.1	1.8

1/ From Table 3-1
2/ (Annual Energy, MWh)/(Installed capacity, MW x 8760 hr)
3/ Annual Cost for selected plant from Table 6-4.
4/ (Annual Cost, $)/(Annual Energy, kwh x 1000 mills/$)
5/ (Dependable Capacity) x $177.00/kw-yr
6/ (Annual Energy) x $.038/kwh
7/ (Annual Cap. Benefit) + (Annual Energy Benefit)
8/ (Annual Benefit) - (Annual Cost)
9/ (Annual Benefit)/(Annual Cost)

TABLE 6-6
LOWER FALLS SITE
ANNUAL COSTS AND BENEFITS
For Project Scoping
(October 1982 Price levels, $1,000)

Installed Capacity	2.6 MW	4.4 MW	5.4 MW	7.0 MW	8.8 MW
Generation					
Dep. Capacity MW 1/	1.3	1.9	2.3	2.6	3.0
Annual Energy, MWh	10,270	15,450	18,900	21,640	25,070
Plant Factor 2/	44%	40%	40%	35%	33%
Costs					
Annual Cost 3/	520	770	899	1,140	1,400
Production Cost 4/ (mills/kwh)	50	50	48	53	56
Benefits					
Annual Capacity 5/	230	336	407	460	531
Annual Energy 6/	390	587	718	822	953
Total Annual 7/	620	923	1,125	1,282	1,484
Net Benefits 8/	100	153	226	142	84
B/C Ratio 9/	1.2	1.2	1.2	1.1	1.1

1/ From Table 3-1
2/ (Annual Energy, MWh)/(Installed capacity, MW x 8760 hr)
3/ Annual Cost for selected plant from Table 6-4.
4/ (Annual Cost, $)/(Annual Energy, kwh x 1000 mills/$)
5/ (Dependable Capacity) x $177.00/kw-yr
6/ (Annual Energy) x $.038/kwh
7/ (Annual Cap. Benefit) + (Annual Energy Benefit)
8/ (Annual Benefit) - (Annual Cost)
9/ (Annual Benefit)/(Annual Cost)

TABLE 6-7
COMBINED FALLS SITE
ANNUAL COSTS AND BENEFITS
For Project Scoping
(October 1982 Price levels, $1,000)

Installed Capacity	15.0 MW	22.7 MW	28.0 MW	30.3 MW	36.2 MW
Generation					
Dep. Capacity MW 1/	6.3	8.4	9.5	10.0	10.9
Annual Energy MWh	54,860	73,020	83,710	87,770	98,080
Plant Factor 2/	42%	37%	34%	33%	31%
Costs					
Annual Cost 3/	1,880	2,680	3,192	3,470	4,060
Production Cost 4/ (mills/kwh)	34	37	38	40	41
Benefits					
Annual Capacity 5/	1,115	1,487	1,681	1,770	1,929
Annual Energy 6/	2,085	2,775	3,181	3,335	3,727
Total Annual 7/	3,200	4,262	4,862	5,105	5,656
Net Benefits 8/	1,320	1,582	1,670	1,635	1,596
B/C Ratio 9/	1.7	1.6	1.5	1.5	1.4

1/ From Table 3-1
2/ (Annual Energy, MWh)/(Installed capacity, MW x 8760 hr)
3/ Annual Cost for selected plant from Table 6-4.
4/ (Annual Cost, $)/(Annual Energy, kwh x 1000 mills/$)
5/ (Dependable Capacity) x $177.00/kw-yr
6/ (Annual Energy) x $.038/kwh
7/ (Annual Cap. Benefit) + (Annual Energy Benefit)
8/ (Annual Benefit) - (Annual Cost)
9/ (Annual Benefit)/(Annual Cost)

6.07 Scoping. All three configurations were scoped using a net benefit analysis. Unit power values were used as described in the preceeding section. Tables 6-5, 6-6, and 6-7 list the annual costs and the annual benefits for the range of plant sizes used to scope each site. Figures 6-1, 6-2, and 6-3 show graphically these costs and benefits. Figure 6-4 shows the net benefits for each site. The optimum plant sizes were then selected based on these net benefit curves.

For the Upper Falls and for the Combined Falls Sites, two-unit configurations were selected while the Lower Falls uses a single unit plant. Initially different unit combinations and types were considered (Also see Section 4.03). The two-unit configuration was selected, primarily, from an operational standpoint.

As discussed in Section 3.02, it was assumed that operation of the new powerplant(s) will be very closely coordinated with the operation of the older existing plants. This is especially important in the operational transition from moderately low flows (when only the old plants would operate) to medium and higher flows, when both new and old plants would be operating. For example, as the river flows increase from a low-flow state to a higher-flow state and the new plant would need to operate, the old plant would momentarily back down, to permit passing enough flow to the new plant to allow it to operate at its minimum discharge. Once the total river flows increased beyond that transition point, both old and new plants would then operate at their best efficiencies. This same situation would occur when the streamflows were in a regressive state. It is beyond the scope of this study, to fully evaluate this situation, but an operating agreement between all plant entities will be necesary to accommodate this operating transition. The agreement should be relatively easy to

accomplish. For example, an equivalent amount of energy could be exchanged to offset the loss of generation during these periods.

In order to facilitate coordinated plant operations, it was decided to use two units at Upper Falls and Combined Falls plants. Experience in operating Corps'owned plants in North Pacific Division shows that during the operational transition period, the existing plant's total hydraulic capacity can be reduced by about 50% without incuring serious operating problems. This requires the installation of two units at the two larger new plants in order to generate with their minimum flows. To summarize, the maximum turbine sizes required to minimize energy losses are as show in the following table.

MAXIMUM TURBINE FLOW LIMITS

NEW PLANTS

	Existing Plant		New Plant		
	Total Hydraulic Capacity	Min Hydraulic Capacity 1/	Number of Units Required	Single-Unit Max. Hyd. Capacity 2/	Single-Unit Minimum Hyd. Cap. 3/
Upper Falls	3300 cfs	1650 cfs	2	3100 cfs	1240 cfs
Lower Falls	4500 cfs	2250 cfs	1	3100 cfs	1240 cfs
Combined Falls	4500 cfs	1650 cfs	2	2750 cfs	1100 cfs

1/ One half total hydraulic capacity.
2/ Total hydraulic capacity of selected plant from Table 3-1 divided by number of units.
3/ Assumed to be 40% of the single-unit maximum hydraulic capacity.

6.08 Comparison: Interest Rates and Periods of Economic Analysis. The economic analysis used in this study was based on a Federal interest of 7 7/8 percent and a 100-year project life. To evaluate the effect of higher interest rates and shorter periods of economic life, analyses were made at 14-percent interest and at a 50-year project life. Project economic values are developed and presented in this section as a sensitivity analysis. While the values shown in Table 6-8 are for two interest rates and two periods of economic analysis, the effect of other interest rates or economic periods may be determined by interpolation.

TABLE 6-8

COMPARISON: INTEREST RATES AND PERIODS OF ECONOMIC ANALYSIS
(for selected plant sizes, Oct 82 cost levels)

Site	Interest Rate	Annual[1/] Cost ($1000)	Annual[2/] Benefit ($1000)	Net Benefit ($1000)	B/C
100-Year Period of Analysis:					
Upper Falls (21.0 MW)	7 7/8%	2,120	4,400	2,280	2.08
	14%	3,920	5,400	1,480	1.38
Lower Falls (5.4 MW)	7 7/8%	900	1,130	230	1.25
	14%	1,650	1,390	-260	0.84
Combined Falls (5.4 MW)	7 7/8%	3,190	4,860	1,670	1.52
	14%	5,970	5,940	-30	0.99
50-Year Period of Analysis:					
Upper Falls (21.0 MW)	7 7/8%	2,170	4,400	2,230	2.03
	14%	3,930	5,400	1,470	1.38
Lower Falls (5.4 MW)	7 7/8%	920	1,130	210	1.23
	14%	1,660	1,390	-270	0.84
Combined Falls (5.4 MW)	7 7/8%	3,260	4,860	1,600	1.49
	14%	5,980	5,940	-40	0.99

1/ Costs for 7 7/8% and 100-year life from Table 6-4; other costs developed using appropriate interest rates and period of analysis.

2/ Benefits for 7 7/8% from tables 6-5, 6-6 and 6-7; Benefits for 14% based on adjusted power values, see telephone log dated 18 November 1983.

From Table 6-8 some conclusions can be made.

a. The project economics are affected very little by changing from a 100-year life to a 50-year life. If a 50-year period of economic life is used the net benefits will be reduced slightly and the B/C ratio will be decreased only about 0.05.

b. If the interest rate is nearly doubled to 14-percent, both costs and benefits will increase; however, the costs increase more rapidly. Thus the B/C ratio is reduced significantly -- by about one third.

c. Of the three alternative developments only the Upper Falls site will be economically feasible at the 14-percent interest rate.

6.09 Comparison: Summertime vs. Wintertime Dependable Capacity. As discussed earlier, project benefits were derived from the average annual energy and the dependable capacity of the project.

The dependable capacity is based on the hydro project's performance in the months of peak power demand. While the region experiences both summer and winter peaks, the summer peak is somewhat higher at the present time, and it is expected to become more predominent as the region's air conditioning demand grows. For these reasons, FERC recommended that dependable capacity be based on project output in the months of July and August. However, a sensitivity analysis was made to determine the impact of basing dependable capacity on the project's performance during the winter peak demand months of December and January. Table 6-9 shows the project benefits for the selected plant sizes for each site.

TABLE 6-9
ANNUAL BENEFIT COMPARISON
SUMMERTIME vs WINTERTIME PEAK
(For selected plant sizes)

Jul-Aug Critical Months

	Energy Benefit ($1,000)	Dependable Capacity	Capacity Benefit ($1000)	Total Benefit ($1000)	Net Benefit ($1000)
Upper Falls (21.0 MW)	2,845	8.8 MW	1,558	4,403	2,283
Lower Falls (5.4 MW)	718	2.3 MW	407	1,125	226
Combined Falls (28.0 MW)	3,181	9.5 MW	1,681	4,862	1,670

Dec-Jan Critical Months

	Energy Benefit ($1,000)	Dependable Capacity	Capacity Benefit ($1000)	Total Benefit ($1000)	Net Benefit ($1000)
Upper Falls (21.0 MW)	2,845	4.26 MW	754	3,599	1,499
Lower Falls (5.4 MW)	718	0.9 MW	161	879	49
Combined Falls (28.0 MW)	3,181	3.1 MW	549	3,730	509

Table 6-8 shows that the dependable capacity based on the winter months would be about half that of the summer months. However, when the benefit is combined with the energy benefit, the total benefit is reduced only about 20 percent. The net benefits are substantially reduced; however, the Upper Falls and Combined Falls developments remain feasible when using the winter peak, but the Lower Falls alternative is not feasible using the winter peak. Again, this comparison is only a sensitivity test to provide additional information for the marketability analysis. The appropriate months for determining dependable capacity are July and August, the critical load months.

6.10 Marketability. Generation from the project would appear to be highly marketable. Because the project is relatively small, a thorough marketing analysis is not required. Discussions with Chicago office of the Federal Energy Regulatory Commission indicate that the generation can be readily absorbed into the area power load. The region's electric load is supplied through the Mid-America Power Pool (MAPP). Of the many utilities that supply MAPP, there are several relatively large cooperative utilities who are preference customers and indicate need for future generation in their systems.[1/] Preliminary discussions with DOE's office at Power Marketing and Coordination indicate that the generation can be marketed through DOE (see phone log dated 9 May 1983 in Appendix C). A formal marketability statement from DOE will be included in the feasibility report, confirming that the power from the recommended projects can be marketed and that costs can be repaid with interest in 50 years, as required by the 1944 Flood Control Act. Because the recommended projects

will be smaller than 80 MW, the marketability statement will also serve to confirm the need for future generation.[2/]

Figures 6-5, 6-6, and 6-7 show the annual distribution of energy at the project. The figures show that the spring and early summer months produce the major portion of energy; however, the summer to early winter months do produce a substantial amount of energy. Only during the peak winter months (Dec, Jan, Feb) would the energy production be substantially reduced.

1/ US Department of Energy, Power Marketing: Great Lakes Area (Draft), January 1981, Chapter III.

2/ Water Resources Counsel, Procedures for Evaluation of National Economic Development Benefits in Water Sources Planning (Level C), Section 713.601.

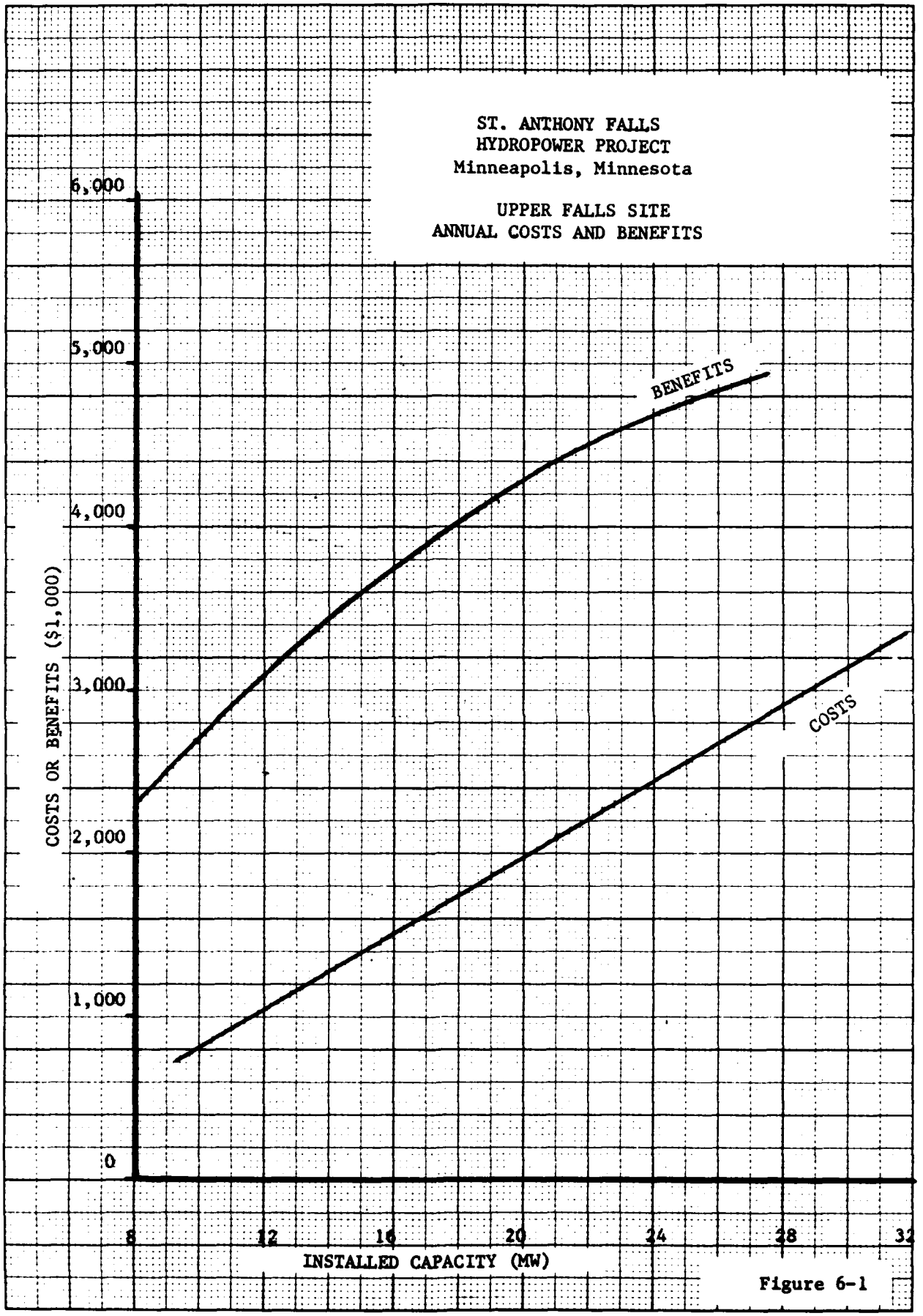

ST. ANTHONY FALLS
HYDROPOWER PROJECT
Minneapolis, Minnesota
UPPER FALLS SITE
ANNUAL COSTS AND BENEFITS
6,000
5,000
4,000
3,000
2,000
1,000
0
COSTS OR BENEFITS ($1,000)
BENEFITS
COSTS
8
12
16
20
24
28
32
INSTALLED CAPACITY (MW)

Figure 6-1

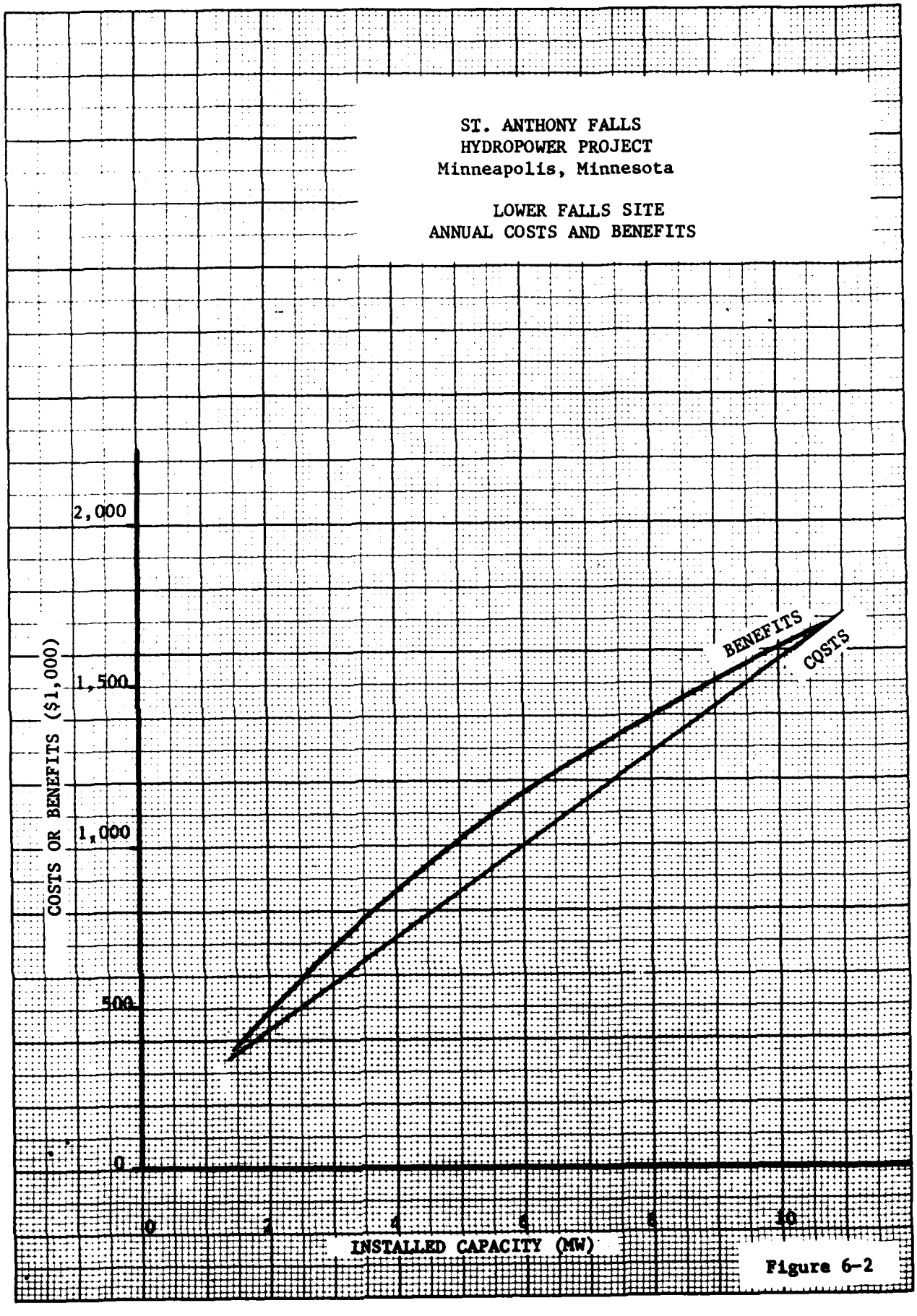

ST. ANTHONY FALLS
HYDROPOWER PROJECT
Minneapolis, Minnesota
LOWER FALLS SITE
ANNUAL COSTS AND BENEFITS
COSTS OR BENEFITS ($1,000)
2,000
1,500
1,000
500
0
BENEFITS
COSTS
0
2
4
6
8
10
INSTALLED CAPACITY (MW)

Figure 6-2

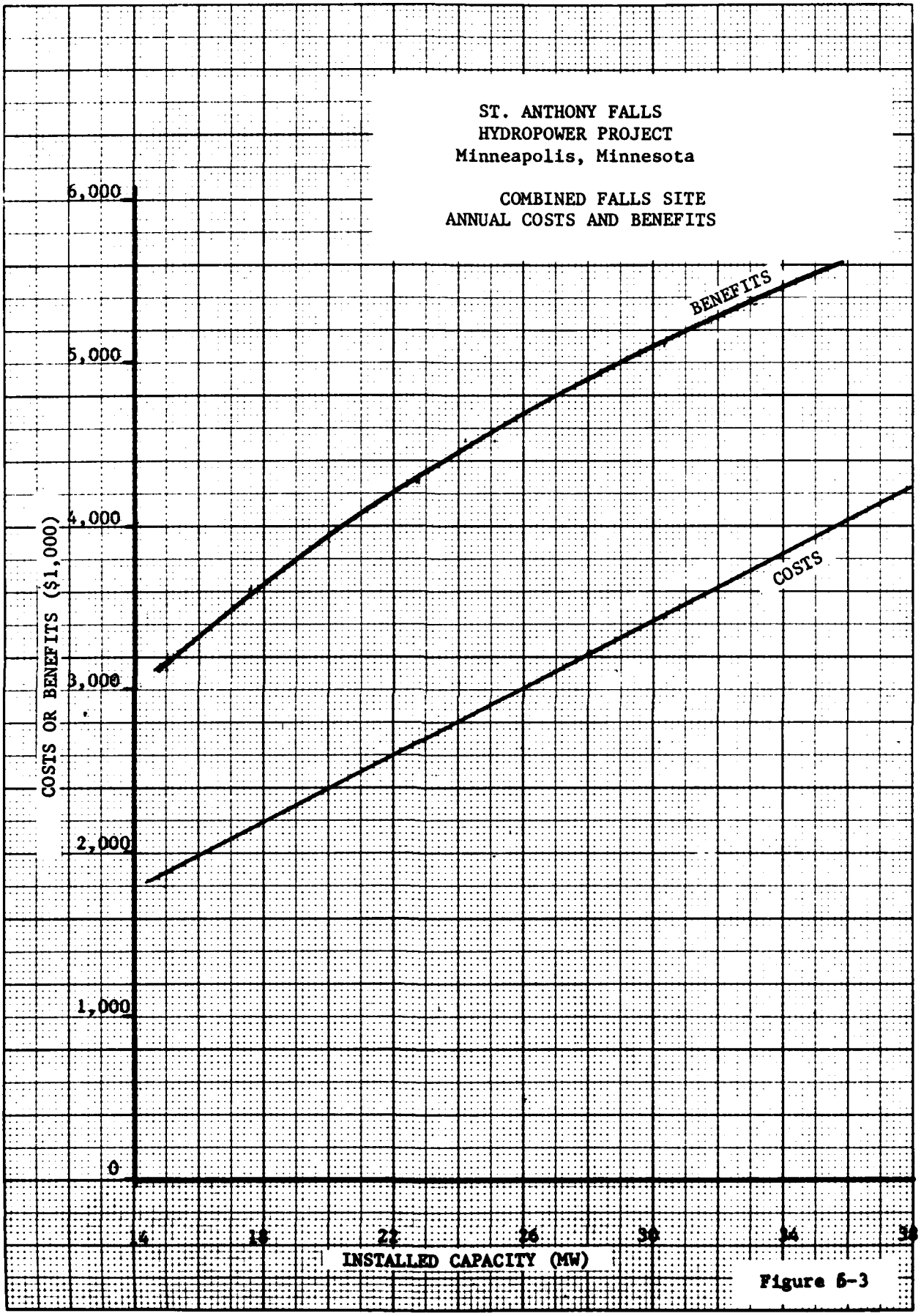

ST. ANTHONY FALLS
HYDROPOWER PROJECT
Minneapolis, Minnesota
COMBINED FALLS SITE
ANNUAL COSTS AND BENEFITS
BENEFITS
COSTS
COSTS OR BENEFITS ($1,000)
6,000
5,000
4,000
3,000
2,000
1,000
0
14
18
22
26
30
34
38
INSTALLED CAPACITY (MW)

Figure 6-3

ST. ANTHONY FALLS
HYDROPOWER PROJECT
Minneapolis, Minnesota

NET BENEFIT CURVES

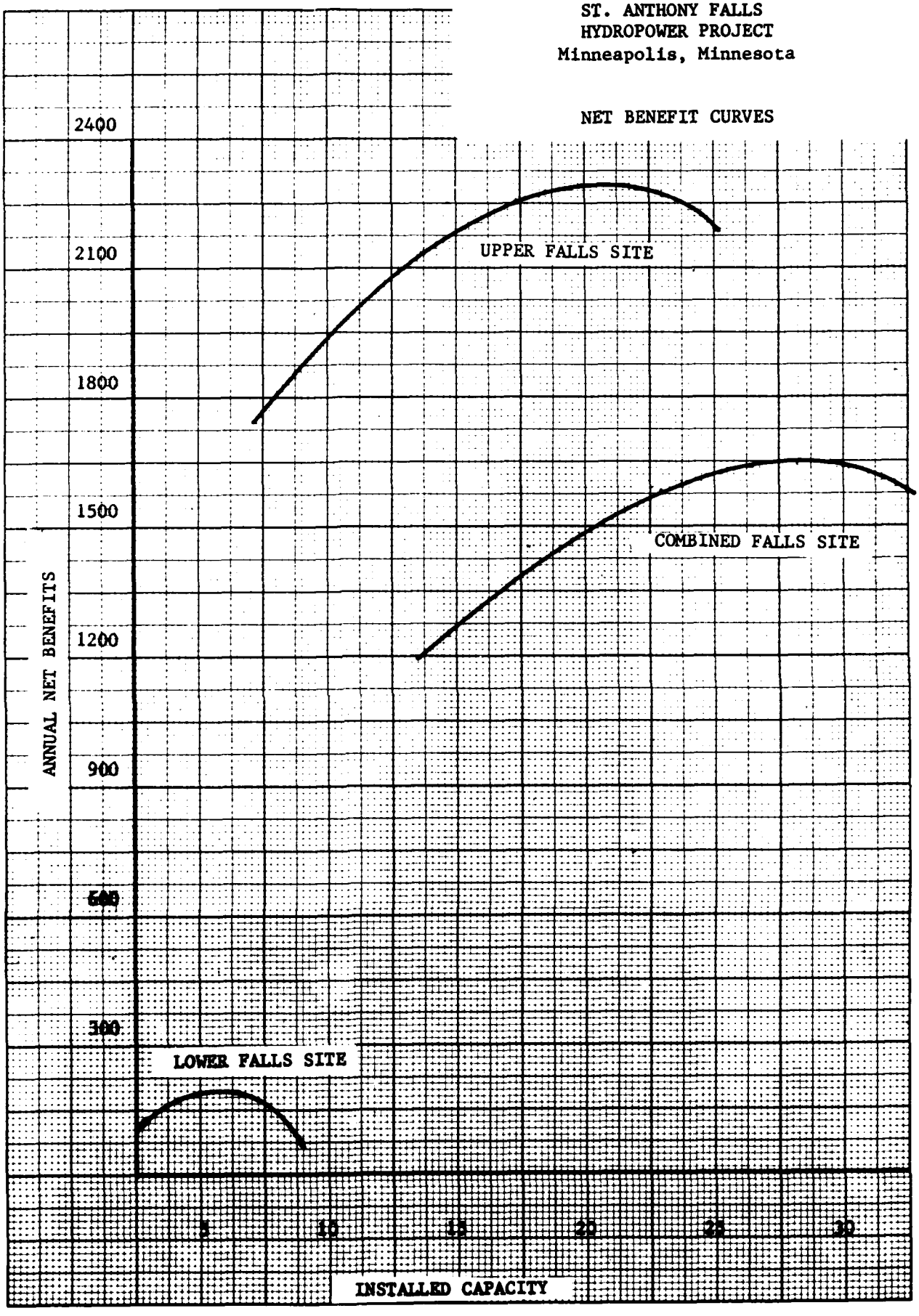


Figure 6-4

ST. ANTHONY - UPPER FALLS

AVERAGE MONTHLY GENERATION

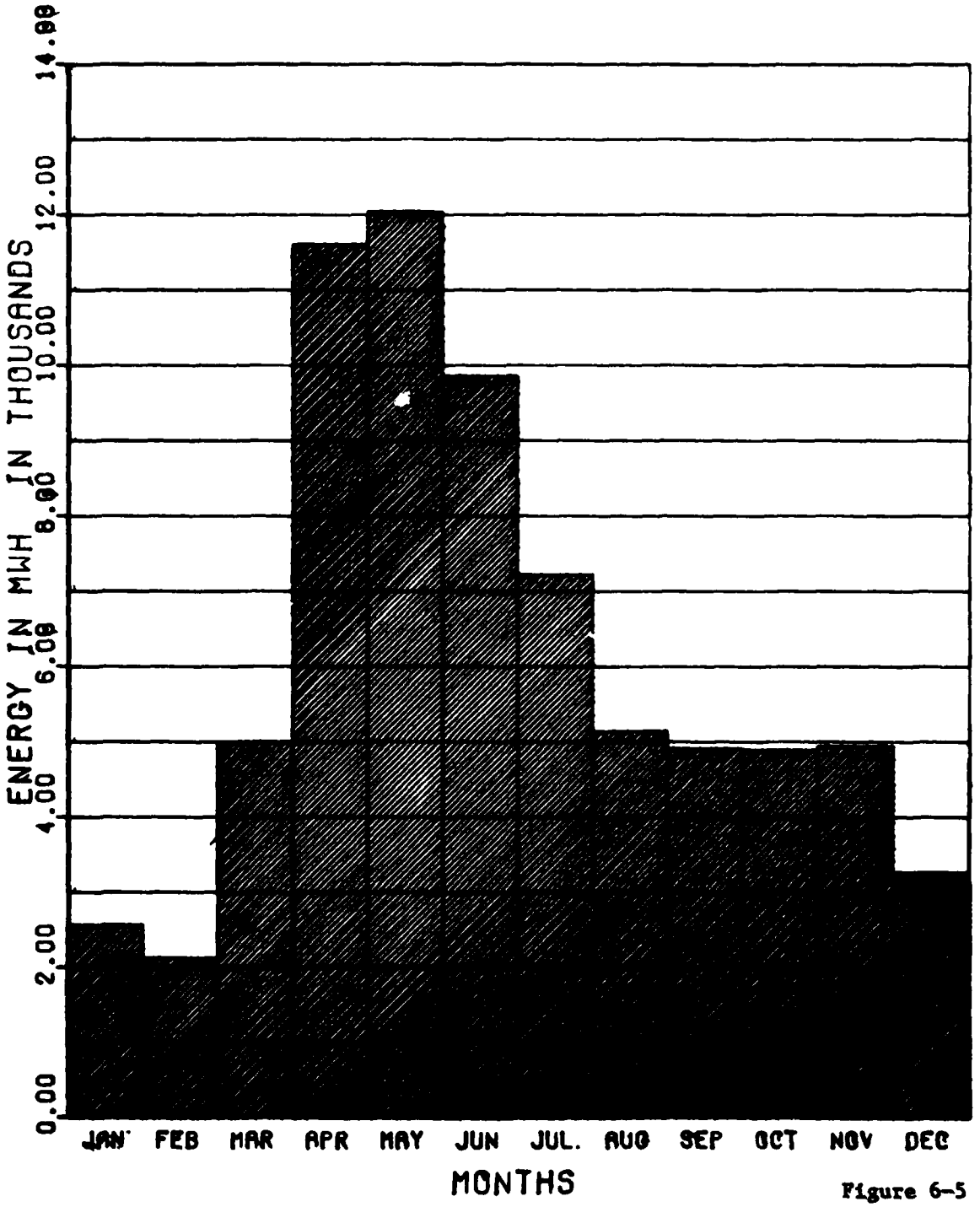


Figure 6-5

ST. ANTHONY - LOWER FALLS

AVERAGE MONTHLY GENERATION

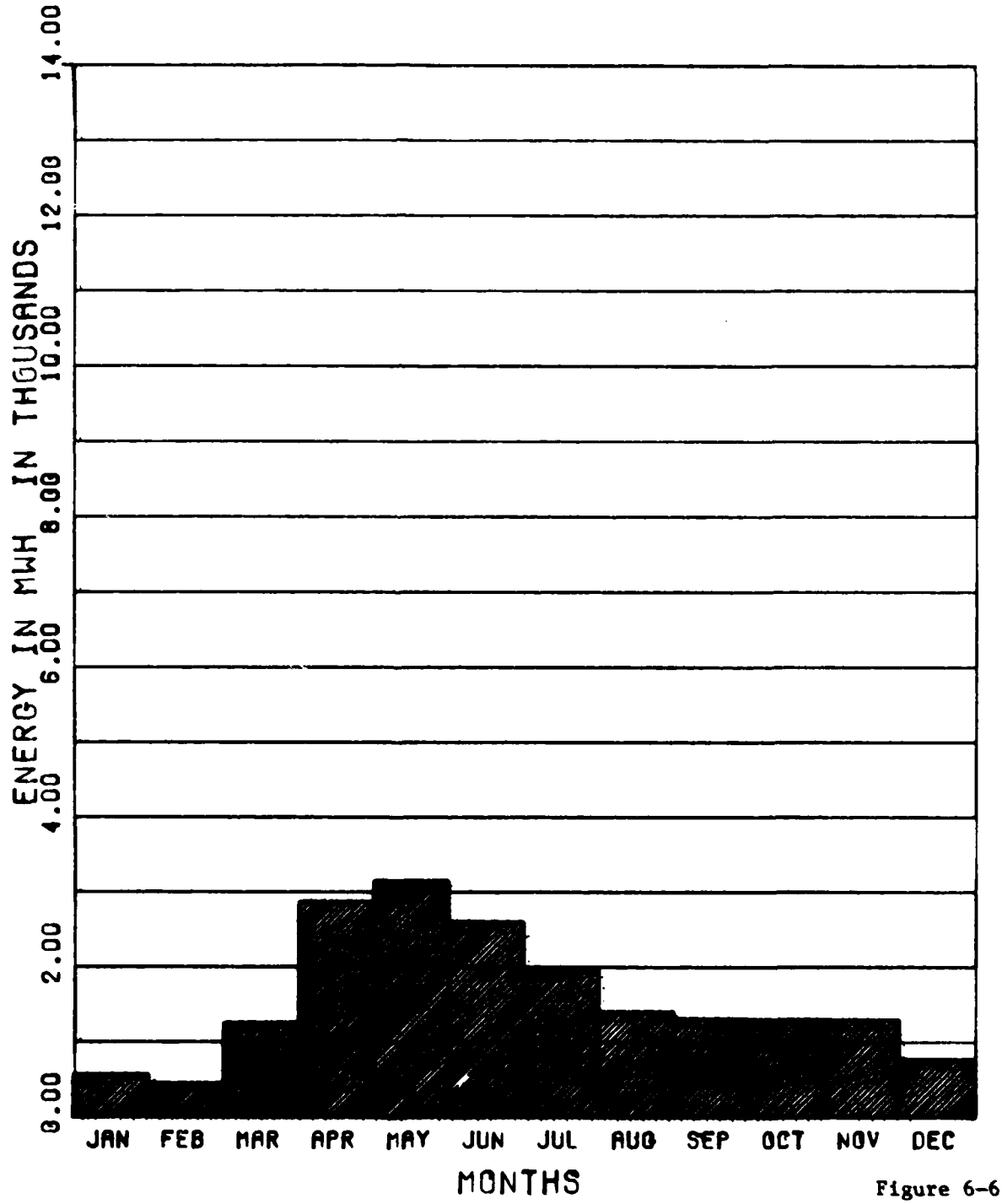


Figure 6-6

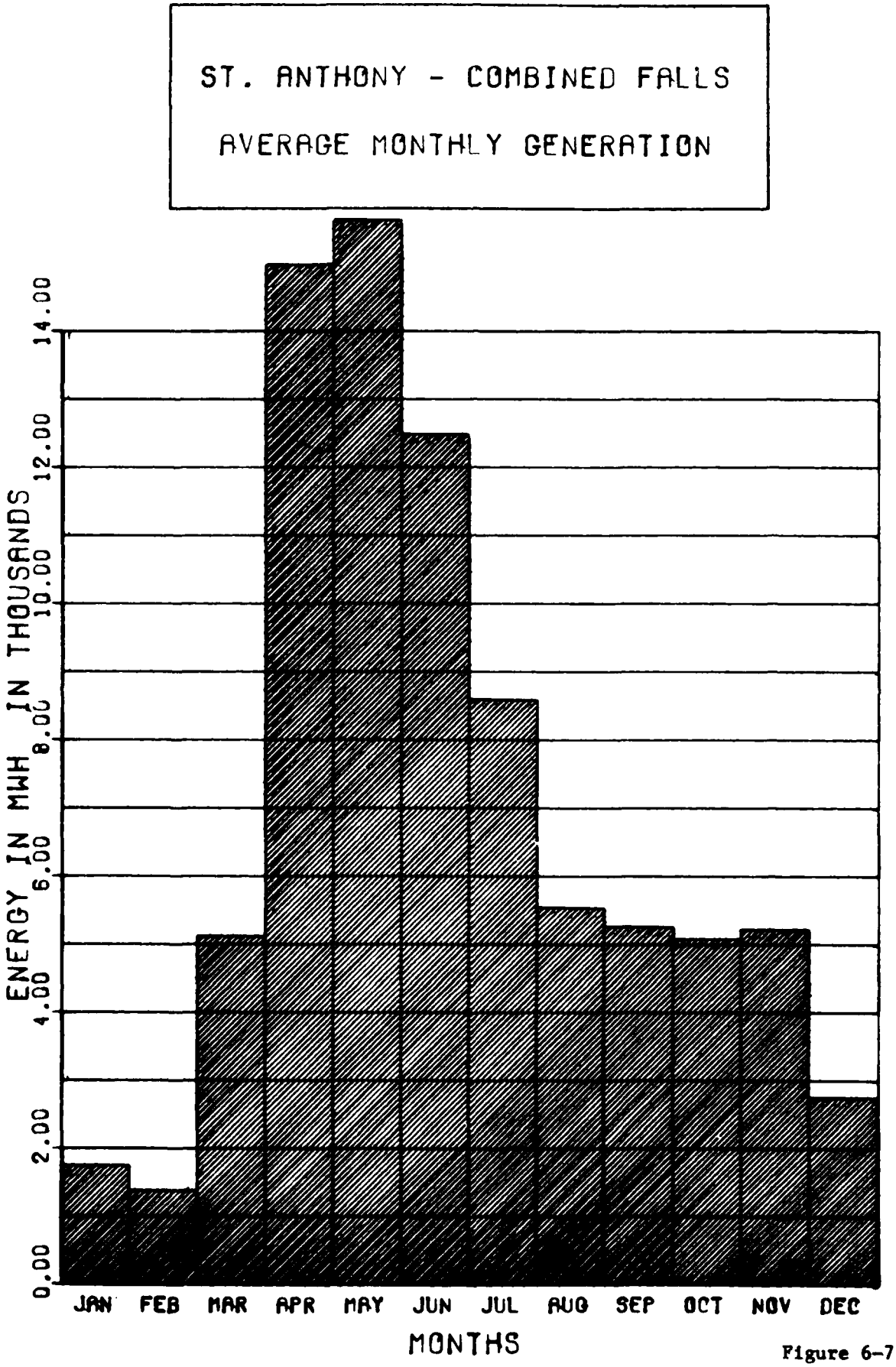

ST. ANTHONY - COMBINED FALLS
AVERAGE MONTHLY GENERATION
ENERGY IN MWH IN THOUSANDS
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MONTHS

Figure 6-7

SECTION 7 - CONCLUSION

Three separate sites at St. Anthony Falls were investigated for additional hydropower development. Each site was found to be economically feasible. The Upper Falls and Lower Falls sites could be developed either separately or together. However, the Combined Falls site development would eliminate construction of the other sites.

The selected plant for the Upper Falls site was a two-unit, 21.0 megawatt plant; the total NED[1/] investment cost will be $23,860,000 while the annual costs will be $2,124,000. The selected plant for the Lower Falls site was a single unit 5.4 megawatt plant; the total NED investment cost will be $9,938,000, while annual costs will be $899,000. The Combined Falls selected site was a two-unit, 28.0 megawatt plant; the total NED investment cost will be $37,311,000, while annual costs will be $3,192,000. Annual costs of production for the sites are 28, 48, and 38 mills per kwh respectively.

All three sites are economically feasible for development. Their respective benefit-to-cost ratios are: 2.1, 1.2, and 1.5. The upstream site is clearly the best site based on economics. Other project considerations such as environmental (not assessed in this study) could have an effect on the final selection and economics. The final site selection and recommendation will be determined by St. Paul District.

The generation would be marketable in the present power system. The power system is located in the Mid-American Power Pool (MAPP). Several large cooperative utilities (preference customers) are members of MAPP.

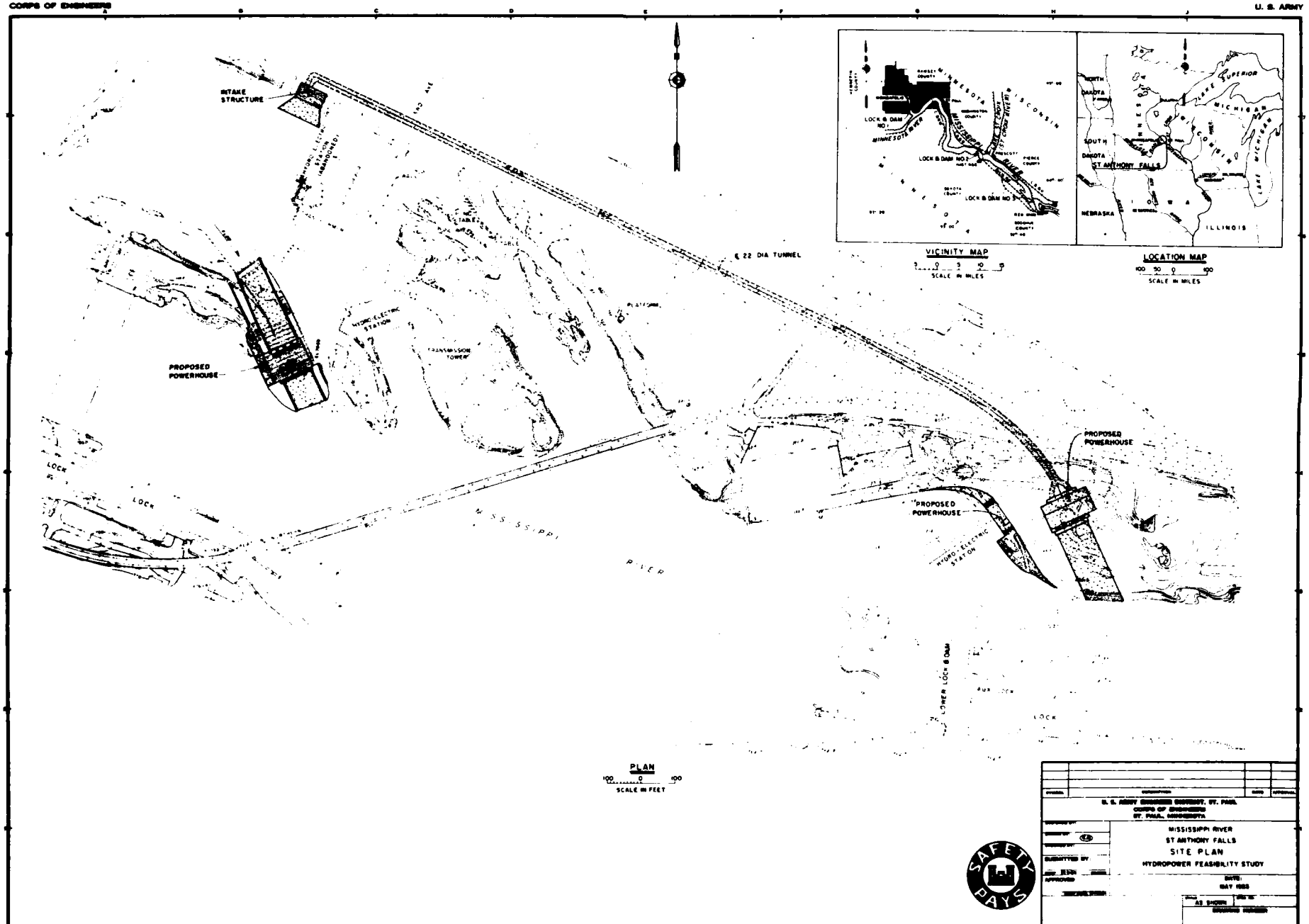
For comparison, the total project generation for the upstream site alone would be the equivalent of about 123,000 barrels of oil annually. In other terms, the project annual generation would produce the equivalent need for about 11,000 residential homes in the area. 2/

1/ National Economic Development

2/ Based on U.S. Department of Energy Publication Statistics of Privately Owned Electrical Utilities in the United States - 1980 annual residential usage of 6,800 kwh.

CORPS OF ENGINEERS

U. S. ARMY



VICINITY MAP

SCALE IN MILES

LOCATION MAP

SCALE IN MILES

PLAN

SCALE IN FEET

U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

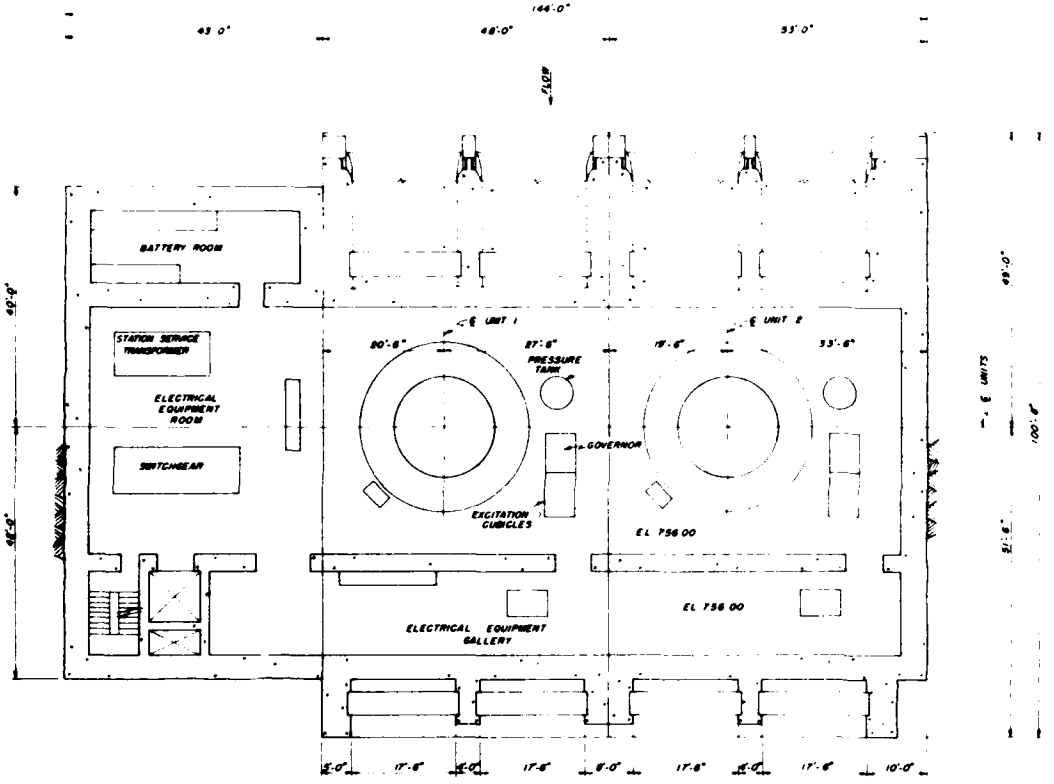
MISSISSIPPI RIVER
ST ANTHONY FALLS
SITE PLAN
HYDROPOWER FEASIBILITY STUDY

DATE:
MAY 1980

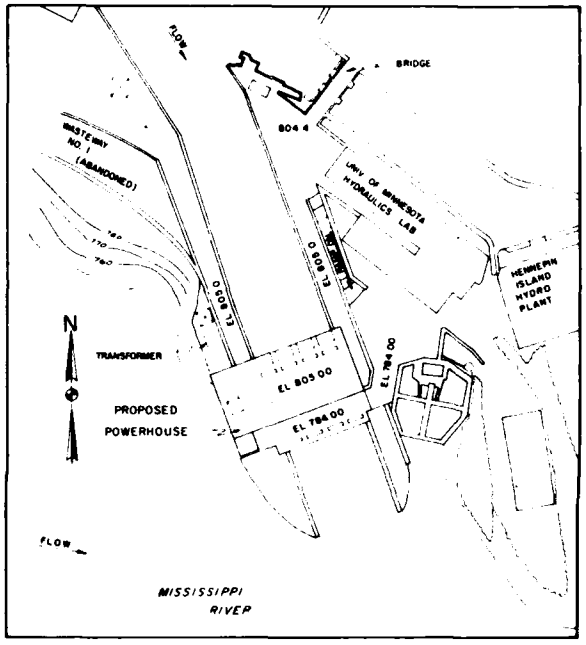
AS SHOWN

SAFETY PAYS

PLATE 1



PLAN



GENERAL LOCATION PLAN

1"=80' 80' 0 80' 160'

GRAPHIC SCALE

1"=1'-0" 4" 0 4" 8" 12" 16" 20"

NUMBER	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DIVISION, N.P.
PORTLAND, OREGON

ST ANTHONY FALLS PROJECT
MISSISSIPPI RIVER MINNESOTA

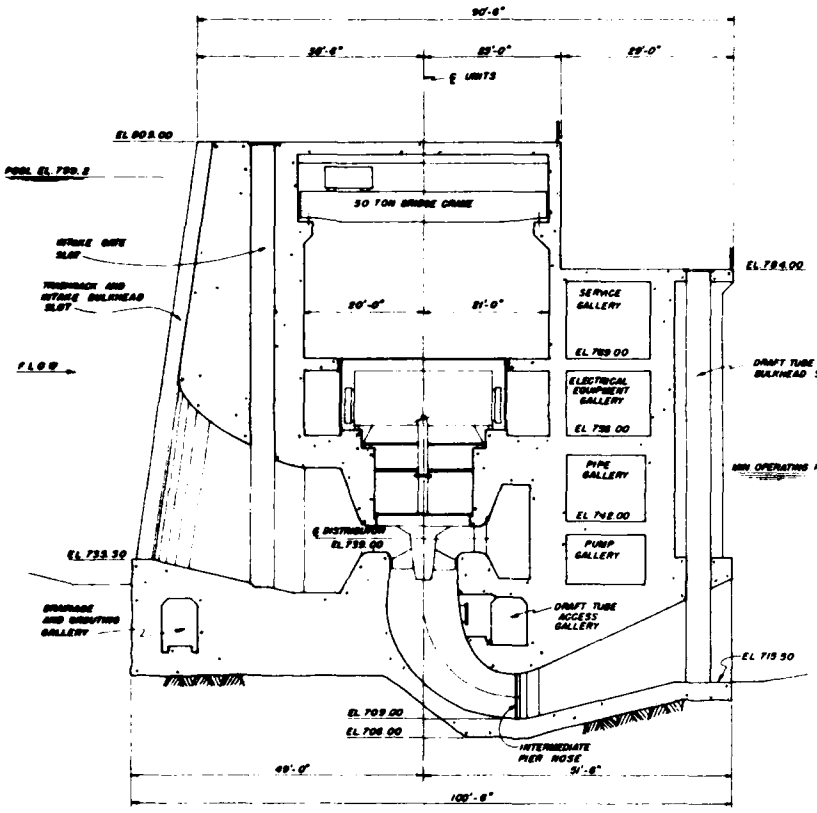
UPPER FALLS POWERHOUSE

PLAN EL. 756.00

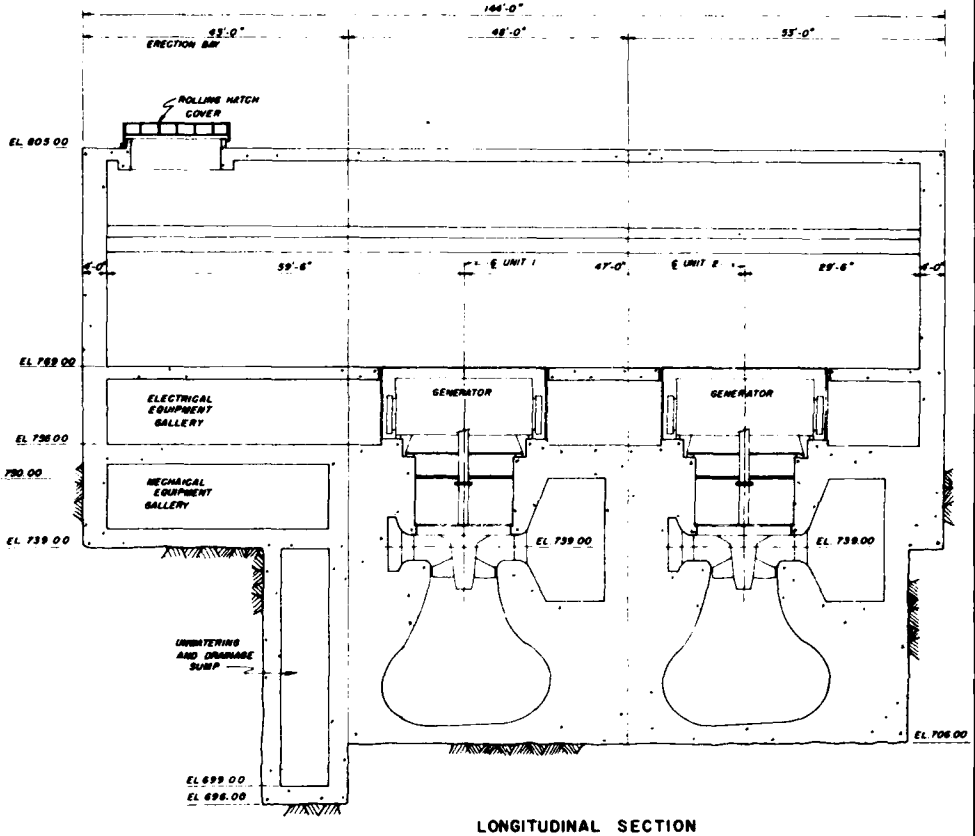
DESIGNED BY P.E.	
DRAWN BY P.E.	
CHECKED BY S.R.S.	
TRACED	
SCALE AS SHOWN	SPEC. NO.

APPROVED FOR DIVISION ENGINEER 1983 NOV 30

PLATE 2



TRANSVERSE SECTION



LONGITUDINAL SECTION

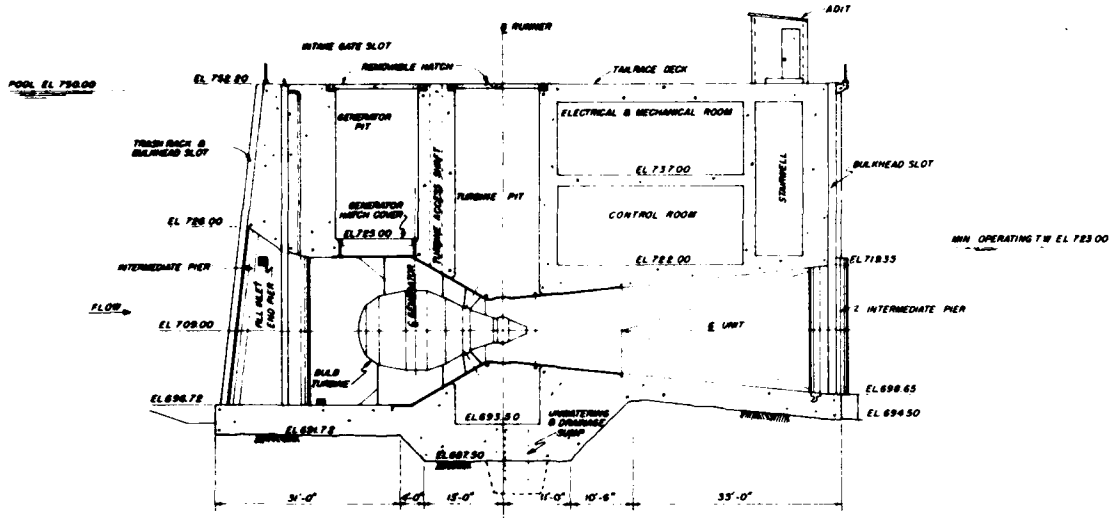
LOOKING UPSTREAM

GRAPHIC SCALE

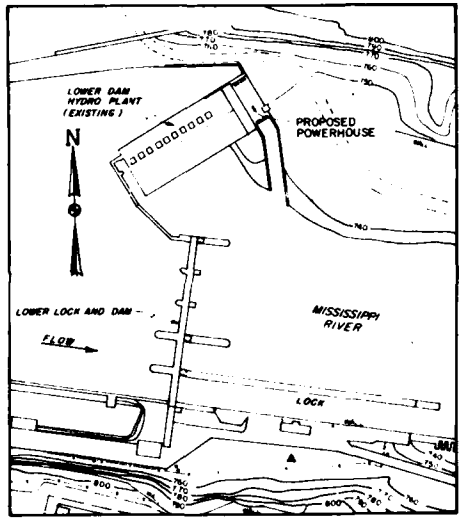
U.S. ARMY ENGINEER DIVISION, N.P.
PORTLAND, OREGON

ST ANTHONY FALLS PROJECT
MISSISSIPPI RIVER MINNESOTA
UPPER FALLS POWERHOUSE
TRANSVERSE AND LONGITUDINAL SECTIONS

SCALE AS SHOWN SPEC. NO.

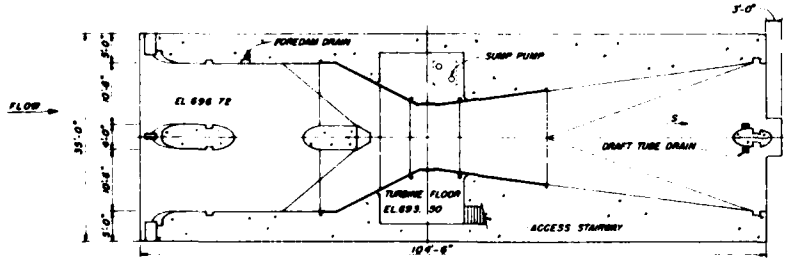


TRANSVERSE SECTION



GENERAL LOCATION PLAN

1" = 100' 100' 0 100' 200'



WATERWAY PLAN EL.709.00

GRAPHIC SCALE

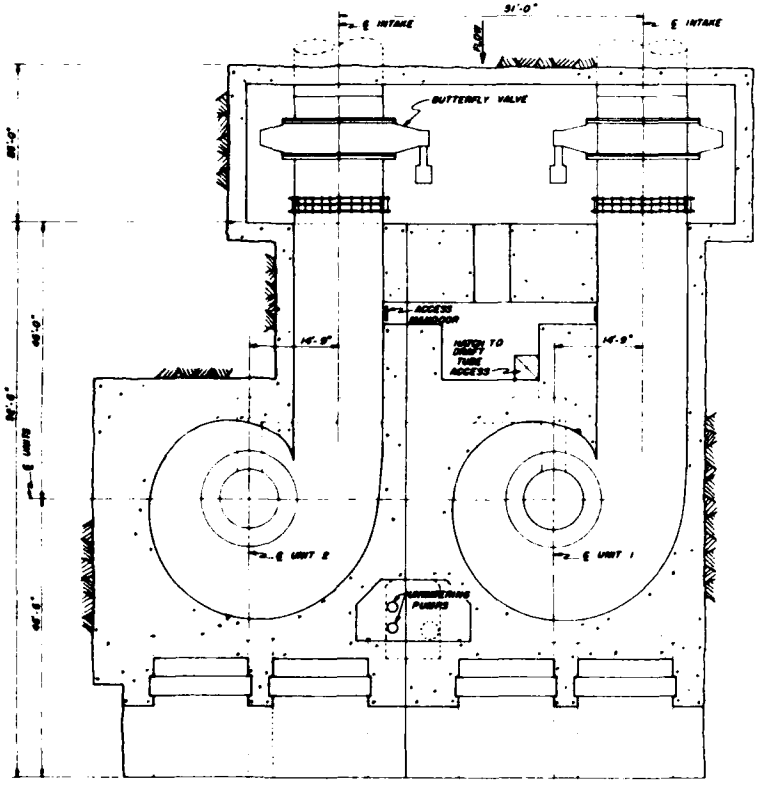
1" = 1'-0" 0 6 9 12 15 30

U.S. ARMY ENGINEER DIVISION, N.P.
PORTLAND, OREGON

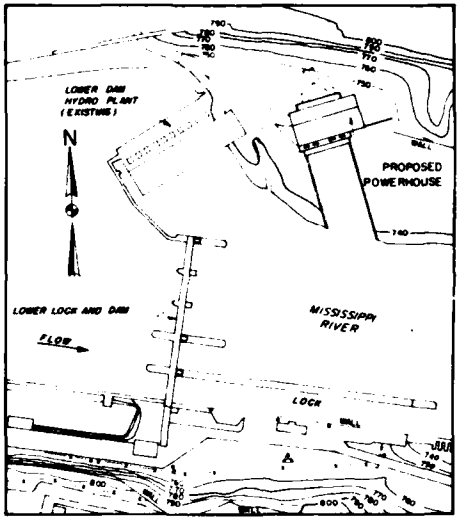
ST ANTHONY FALLS PROJECT
MISSISSIPPI RIVER MINNESOTA
LOWER FALLS POWERHOUSE

PLAN AND SECTION

SCALE AS SHOWN SPEC. NO.



PLAN



GENERAL LOCATION PLAN

1" = 100' 100' 0 100' 200'

GRAPHIC SCALE

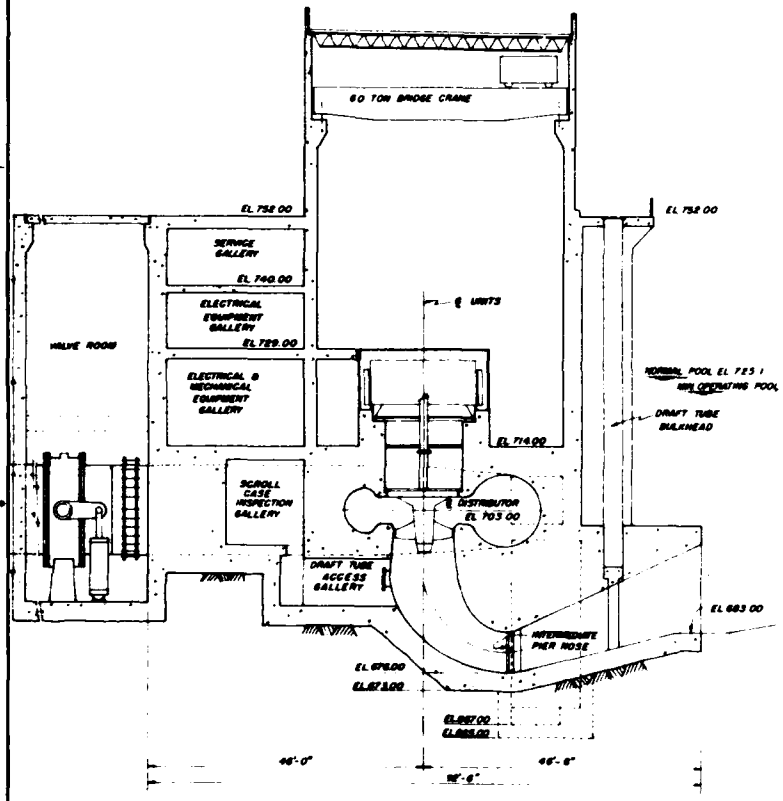
1" = 1'-0"

U.S. ARMY ENGINEER DIVISION, N.P.
PORTLAND, OREGON

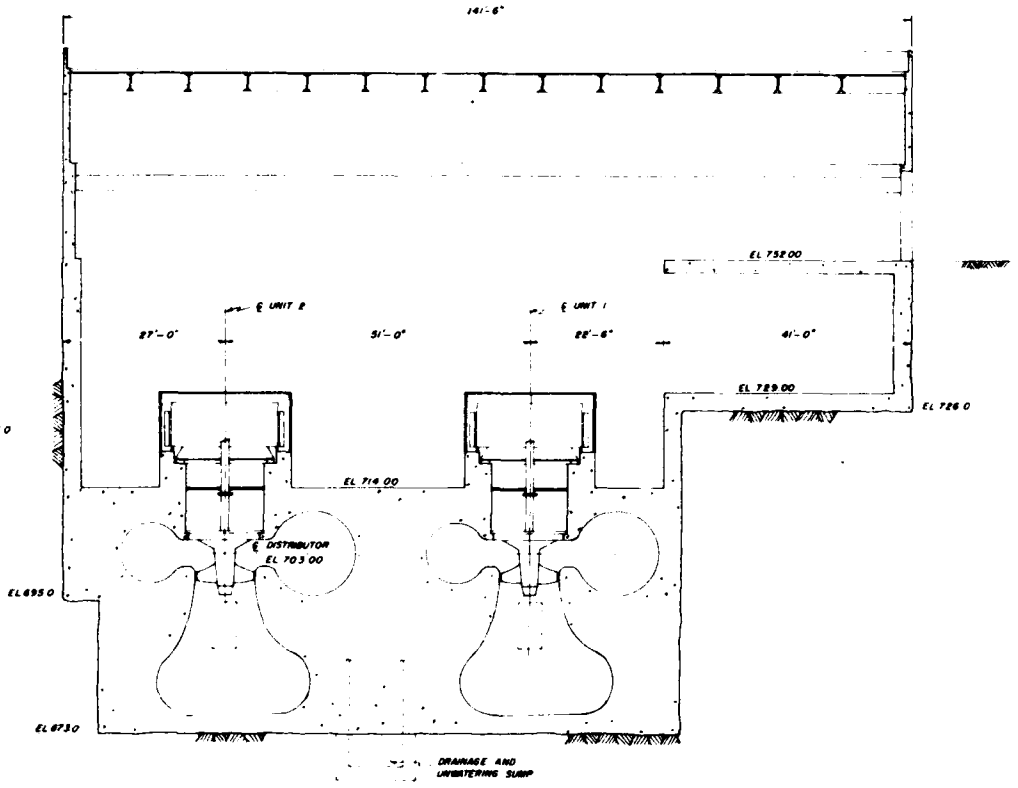
ST ANTHONY FALLS PROJECT
MISSISSIPPI RIVER MINNEAPOLIS, MINNESOTA
COMBINED FALLS POWERHOUSE

PLAN EL. 793.00

SCALE AS SHOWN SPEC. NO.



TRANSVERSE SECTION



LONGITUDINAL SECTION
LOOKING UPSTREAM

GRAPHIC SCALE
1" = 1'-0"

U.S. ARMY ENGINEER DIVISION, N.P.
PORTLAND, OREGON

ST ANTHONY FALLS PROJECT
MISSISSIPPI RIVER
COMBINED FALLS POWERHOUSE

TRANSVERSE AND LONGITUDINAL SECTIONS

SCALE AS SHOWN | SPEC. NO.

APPENDIX A

DETAILED COST ESTIMATES FOR

EXCLUSIVE OF POWERPLANT

ITEMS

(prepared by St. Paul District)

NAME OF OFFICE: St. Paul District | COMPUTATION: SAF Upper Site | DATE: April 83 | PAGE OF

SUBJECT: Hydropower (2nd Iteration)

PRICE LEVEL: April 83

COMPUTED BY: ESD | CHECKED BY | APPROVED BY

		Unit	Quant.	Unit Price	Total
Upstream Channel					
Concrete Removal		CY	165	25.00	4125
New Concrete		CY	260	250.00	65000
Misc. Metal Removal		Job	Sum	N.A.	5000
Rock Excavation		CY	1960	25.00	49000
Concrete U-Channel					
Rock Excavation		CY	1980	25.00	49500
Concrete		CY	1600	250.00	450,000
Powerhouse POR					
Rock Excavation		CY	5530	25.00	138250
Concrete		CY	1285	250.00	321,250
Powerhouse Excavation					
Rock Excavation		CY	24,060	25.00	601500
Rubble Excavation		CY	10,190	10.00	101,900
Downstream Channel					
Concrete		CY	840	250.00	210,000
Rock Excavation		CY	4165	25.00	104,125
Rubble Excavation		CY	4980	10.00	49800
Fill Excavation		CY	2130	5.00	10,650
Cofferdams					
(U.S.) Earth Dam		CY	7510	7.00	52570
(D.S.) Sheet Pile Cells		Ea.	6	60,000	360,000
Earth Dam		CY	10,260	7.00	71,820
Misc.					
By-Pass Spillway Concrete		CY	245	300.00	73500
Remove Exist. Channel Wall		CF	160	50.00	8000
					1,425,350
Contingencies (25%)					666,650
Total					$2,092,000

NCS Form 19 22 Dec. 78

NAME OF OFFICE	COMPUTATION	DATE	PAGE
St. Paul District	3AF - 2nd Iteration	April 83	

SUBJECT: Hydropower - Lower Falls Site

PRICE LEVEL: April 83

COMPUTED BY	CHECKED BY	APPROVED BY
EJW		

		Unit	Quant.	Unit Price	Total
Upstream Channel					
	Dirt Excavation	CY	13200	2 ≈	26400
	Rock Excavation	CY	3760	25 ≈	94000
	Concrete Tie Back Wall	SF	8520	13.85	118002
Powerhouse Excavation					
	Dirt Excavation	CY	27600	2 ≈	55200
	Rock Excavation	CY	7820	25 ≈	195,500
Downstream Channel					
	Dirt Excavation	CY	20900	2 ≈	41800
	Rock Excavation	CY	5430	25 ≈	135,750
	Ramp	CY	1790	30 ≈	53700
	Concrete Tie Back Wall	SF	10,870	13.85	139,470
Cofferdams					
	Sheet Pile Cells	Ea	5	60,000	300,000
	Cofferdam (Earth)	CY	1000	7 ≈	7000
Misc.					
	Remove Conc. Spillway	LF	170	50 ≈	8500
	Asphalt Conc. Spillway	LF	135	350 ≈	47250
	3" Waterstop	SF	2000	0 ≈	6000
	Conc. Retaining Wall	CY	210	250 ≈	52,500
	Dirt Excavation	CY	1050	2 ≈	2100
	Sub-Total				1,282,772
	Contingencies (25%)				317,228
	Total				1,600,000

NCS Form 19 82 Dec. 78 • 200 (

NAME OF OFFICE: St. Paul District | COMPUTATION: SAF 2nd Iteration | DATE: Apr. 83 | PAGE

SUBJECT: Hydropower - Combined Falls Site

PRICE LEVEL: Apr 83

COMPUTED BY: FTW | CHECKED BY | APPROVED BY

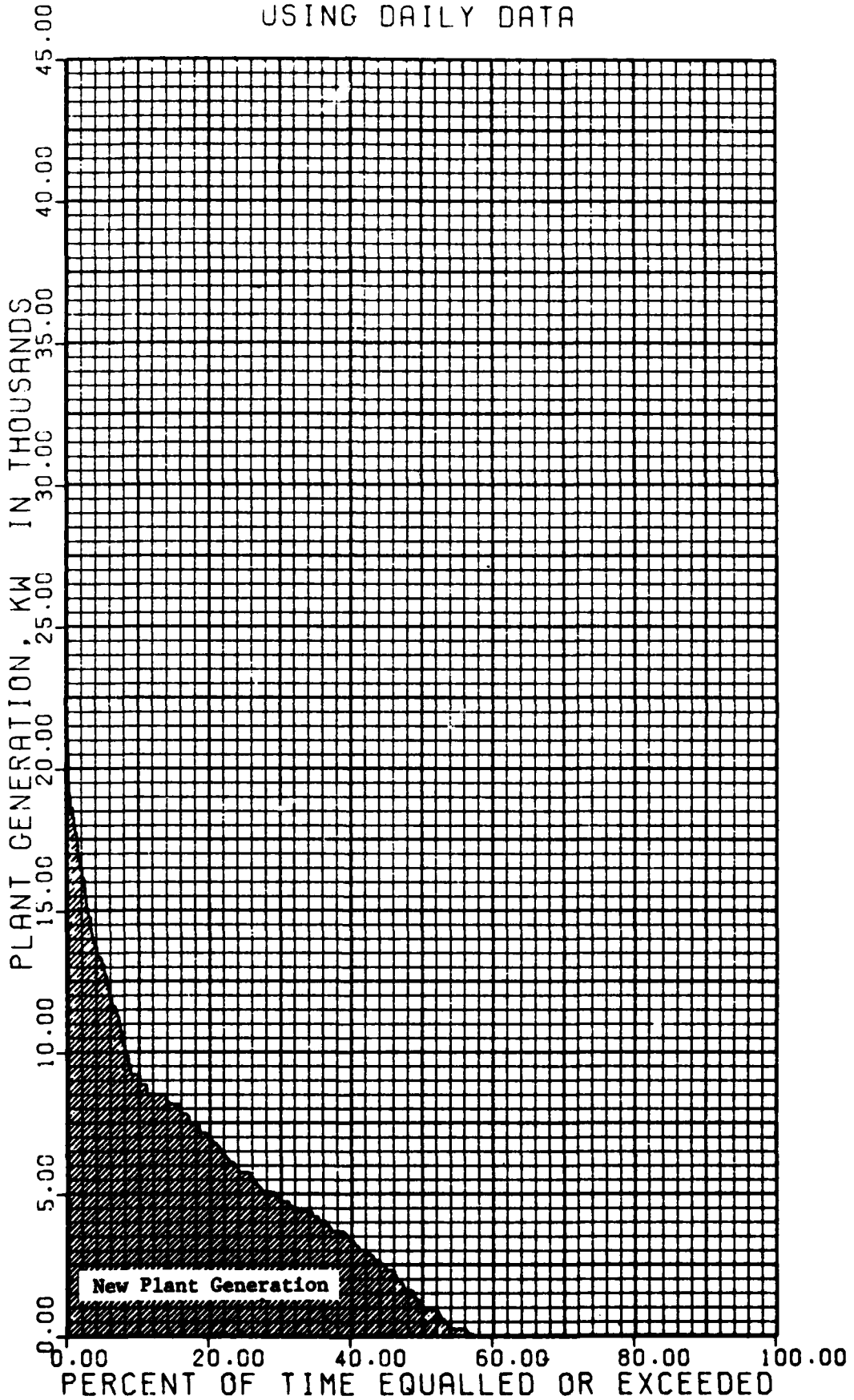
					UNIT	QUANT.	UNIT PRICE	TOTAL
Upstream Inlet								
	Common Excavation				CY	1210	2 **	2420 **
	Rock Excavation				CY	6520	25 **	163,000 **
	Concrete				CY	2050	250 **	512,500 **
	Wall Guides (20 lb)				Ea	2	210.00	420.00
	Precast Conc. Bldg				Job	SUM	***	50,000
Tunnel								
	22' ϕ (Complete)				LF	2400	3600 **	8,640,000
Powerhouse Excavation								
	Rock Excavation				CY	22,950	25 **	573,750
	Earth Excavation				CY	1035	2 **	2070 **
Downstream Channel								
	Rock Excavation				CY	22180	25 **	554,500
	Earth Excavation				CY	5700	2 **	11,400
	Concrete				CY	5320	250 **	1,330,000
	Tie Back Wall				SF	12760	12.85	176,926
Cofferdams								
	Sheet Pile Cells				Ea	6	50,000	300,000
	Earth fill				CY	6720	7 **	47040
Misc.								
	Utility Relocation				Job	SUM	***	125,000
		Sub Total					13,076,416	13,076,416
	Contingencies 25%						3,423,584	3,423,584
	Total						16,500,000	16,500,000

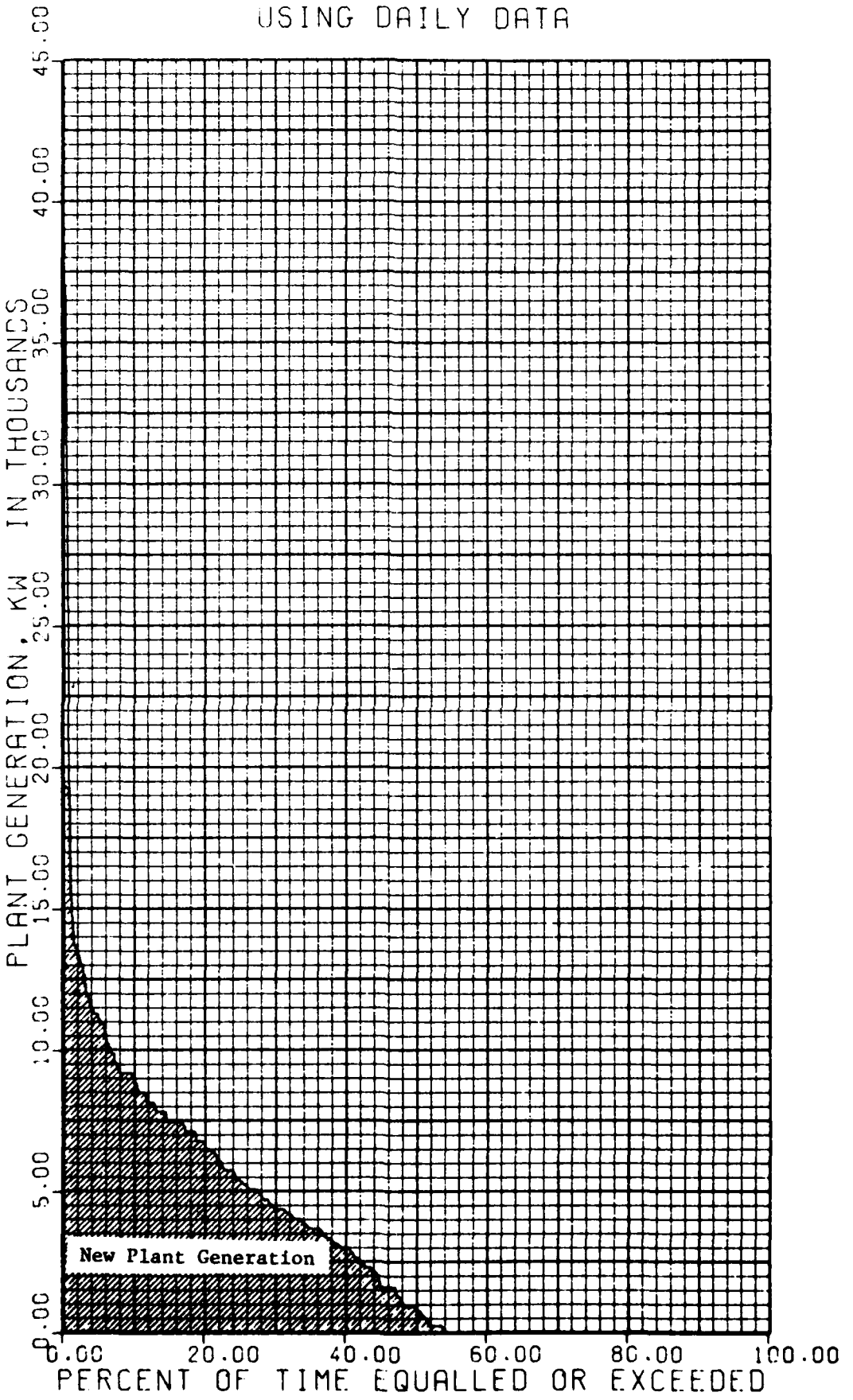
NCS Form 15 22 Dec. 78

APPENDIX B

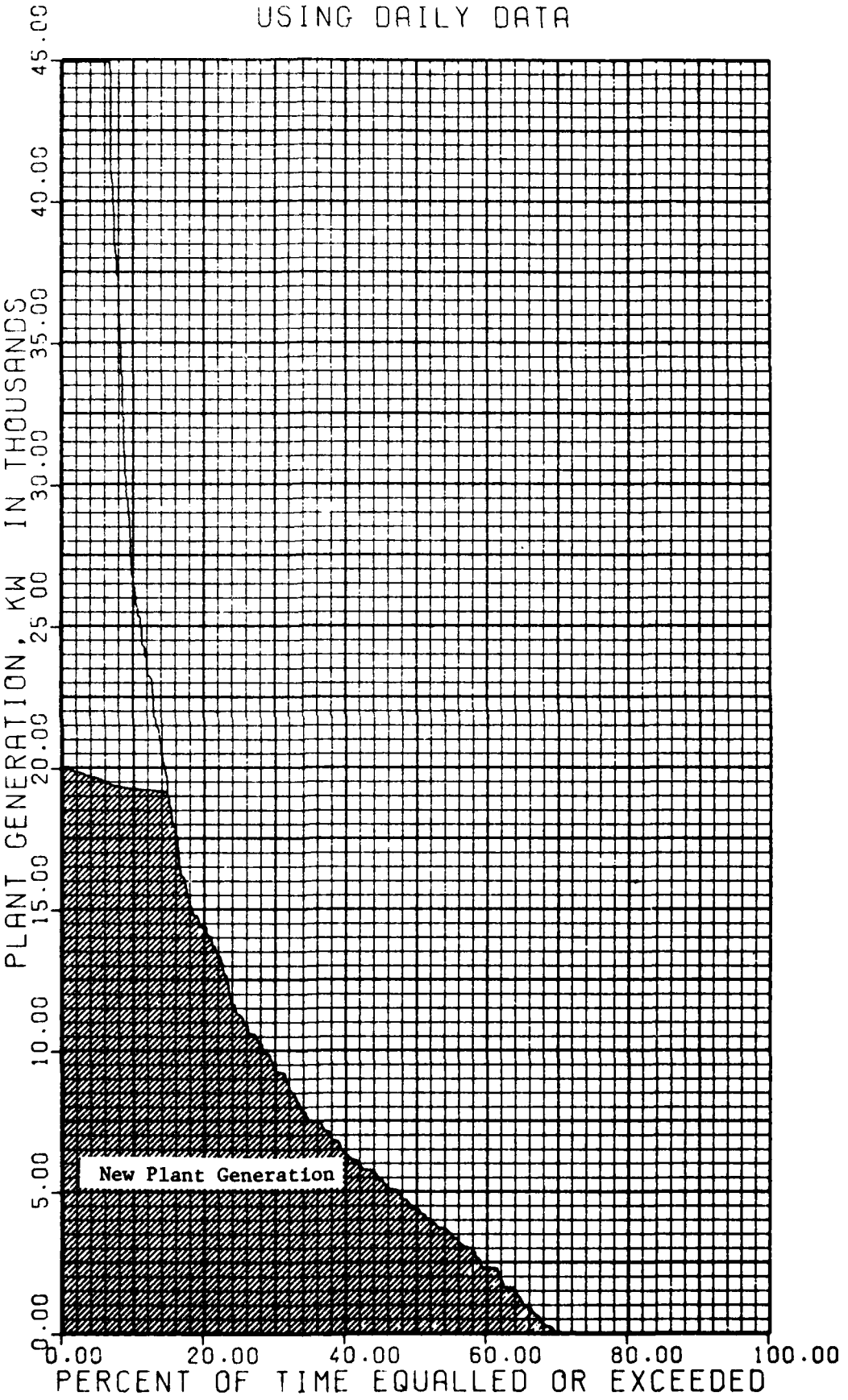
MONTHLY POWER DURATION CURVES

ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR JAN
USING DAILY DATA

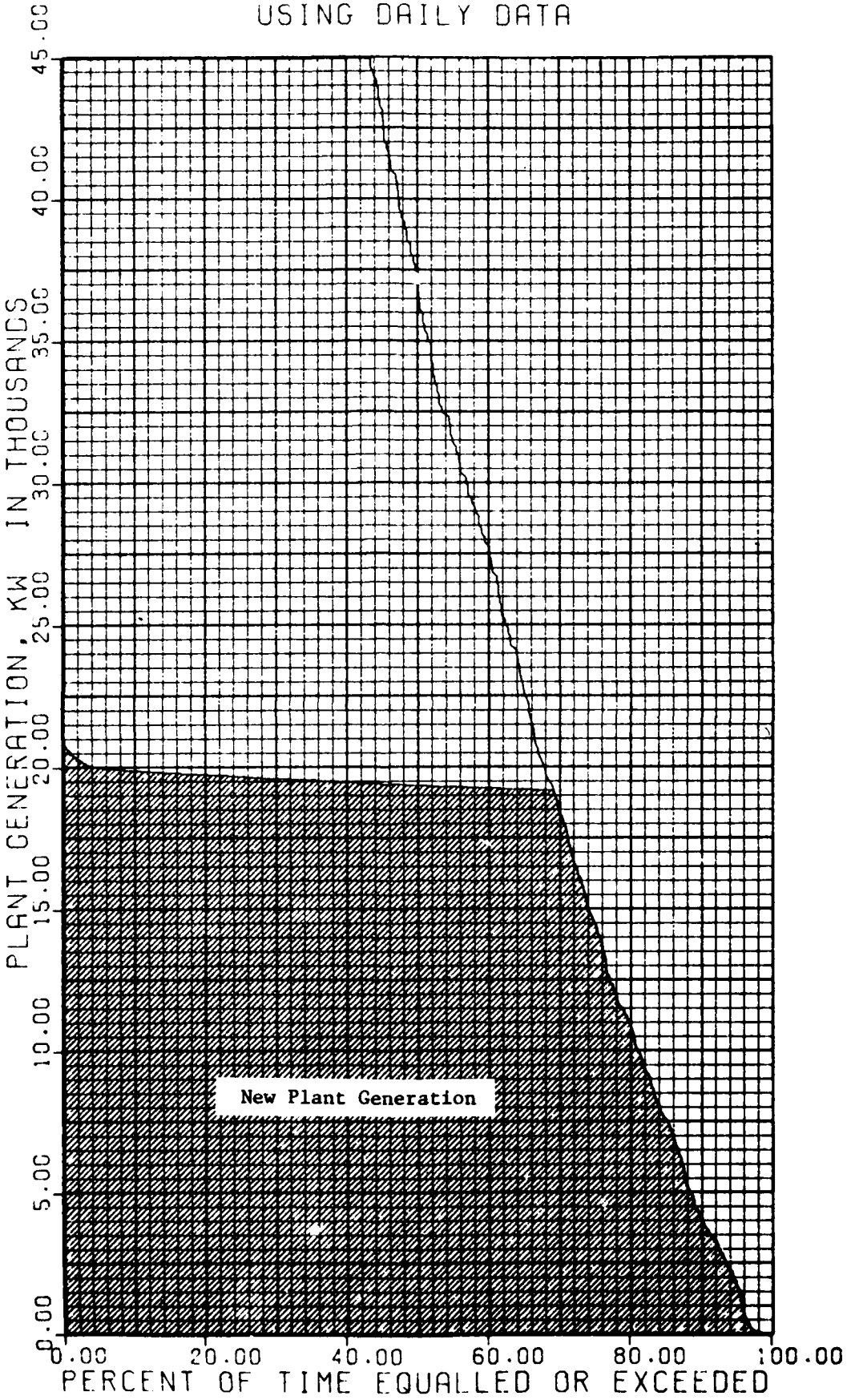



ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR FEB
USING DAILY DATA
PLANT GENERATION, KW IN THOUSANDS
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
New Plant Generation
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

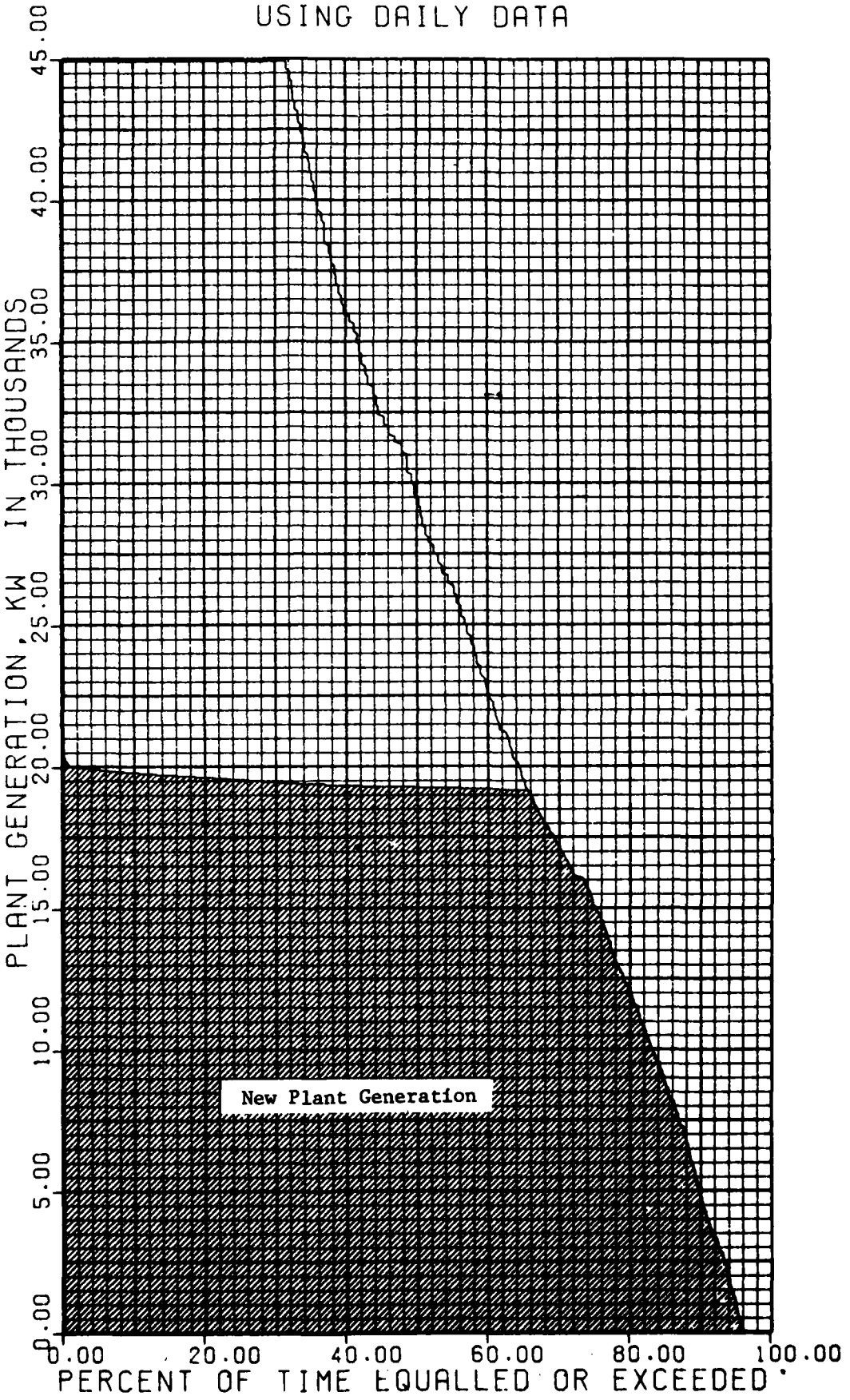
ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR MAR
USING DAILY DATA



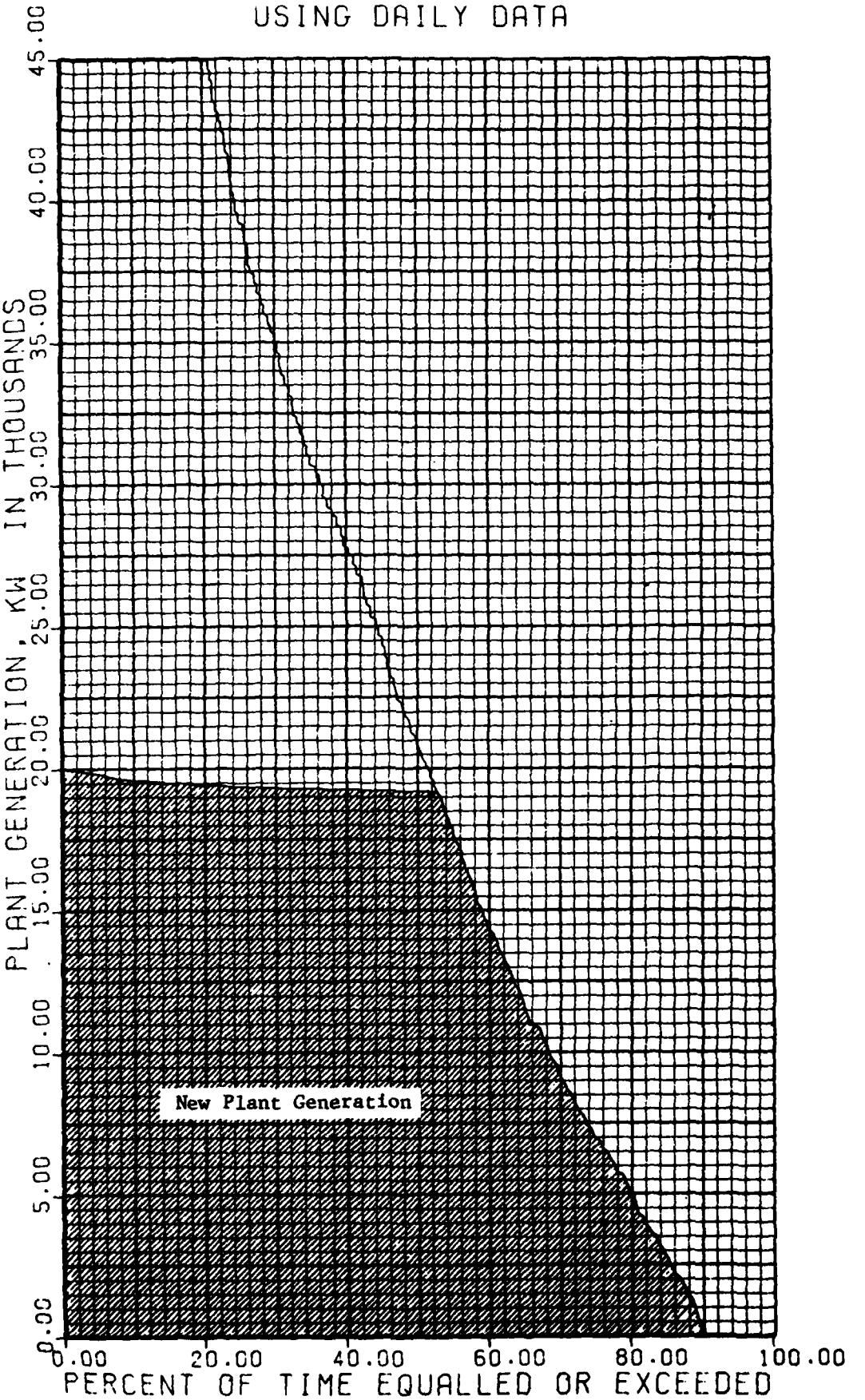
ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR APR
USING DAILY DATA



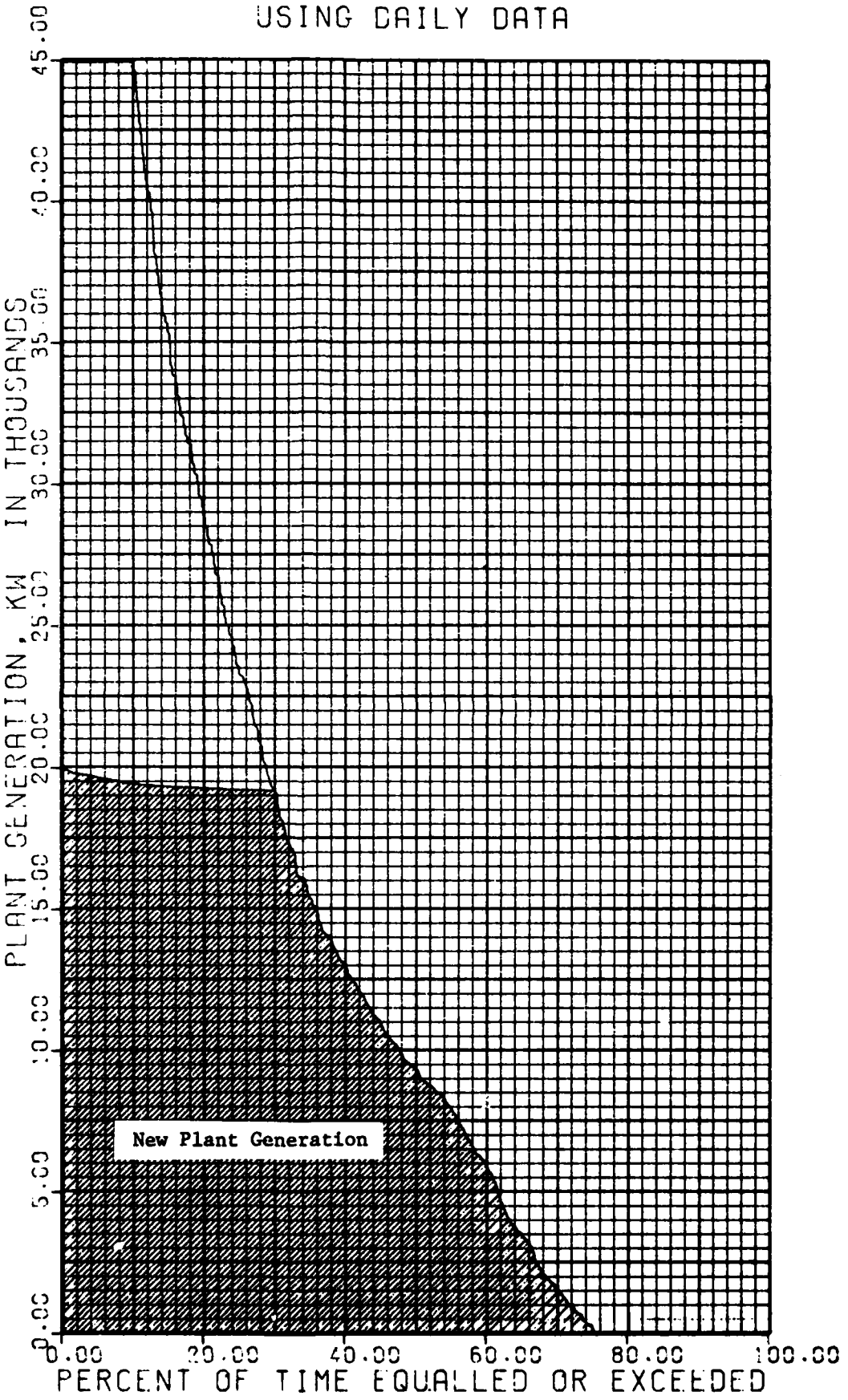
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POWER DURATION CURVE FOR MAY
USING DAILY DATA



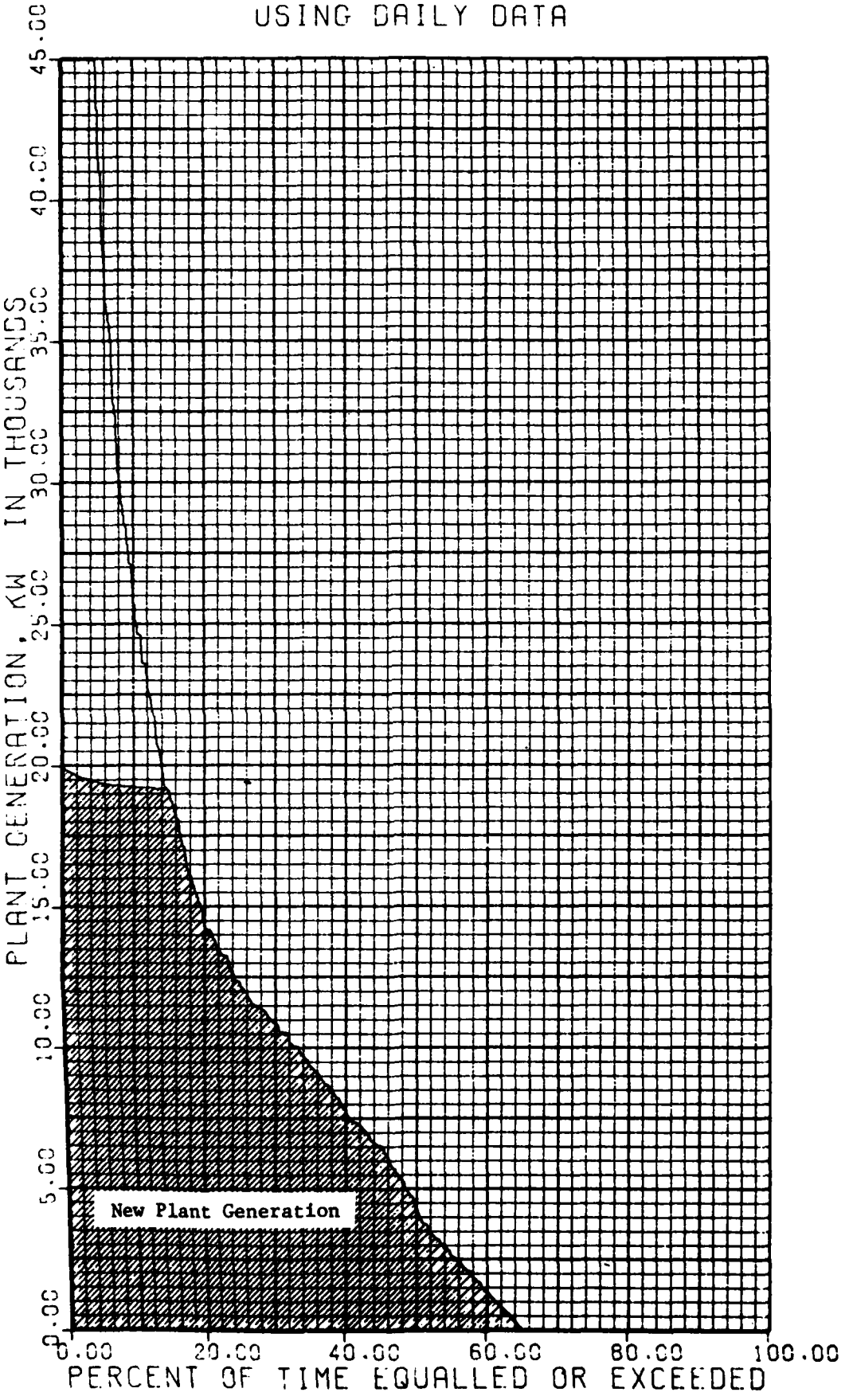
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POWER DURATION CURVE FOR JUN
USING DAILY DATA

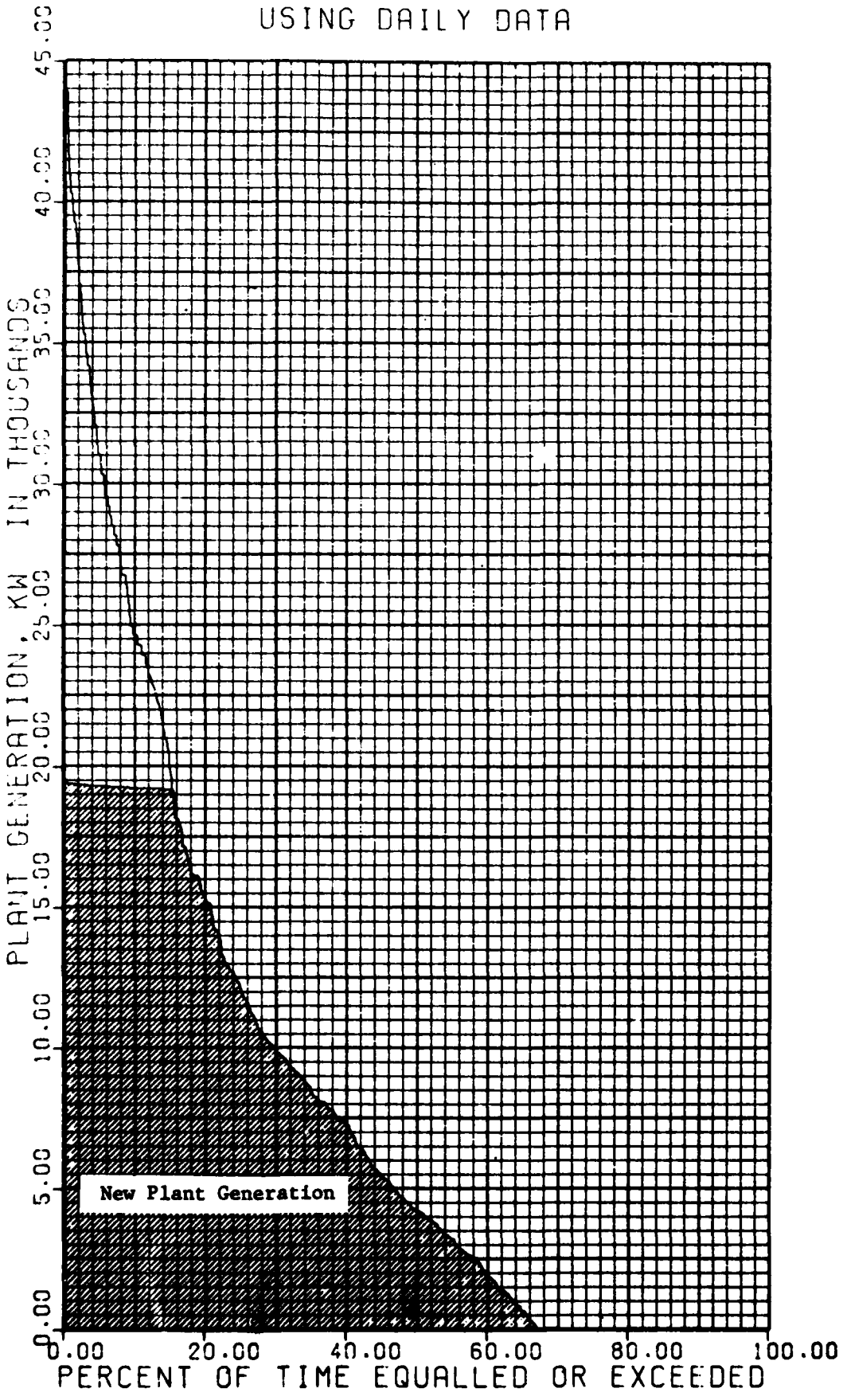


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POWER DURATION CURVE FOR JUL
USING DAILY DATA

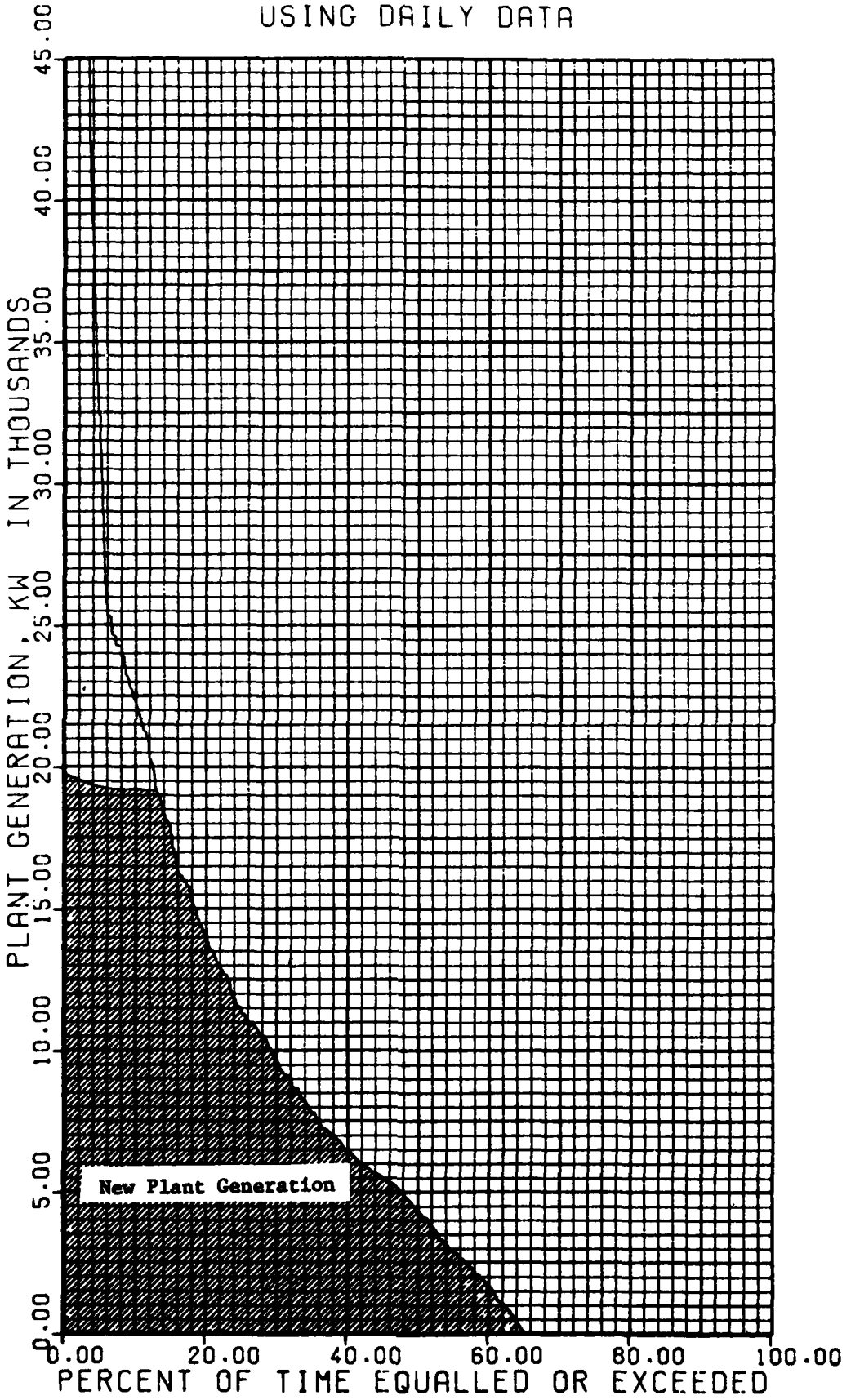


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POWER DURATION CURVE FOR AUG
USING DAILY DATA

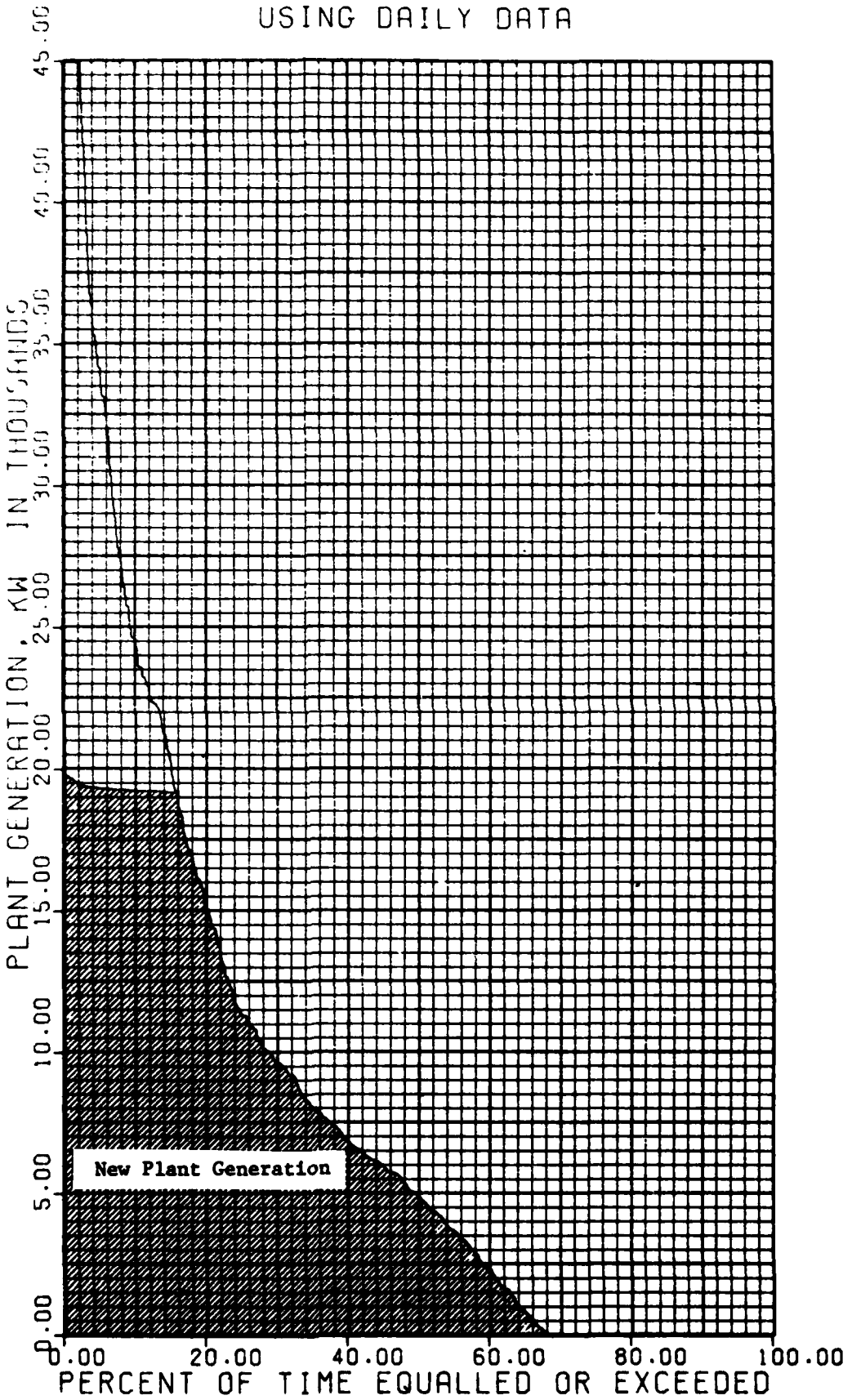



ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR SEP
USING DAILY DATA
PLANT GENERATION, KW IN THOUSANDS
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
New Plant Generation
0.00
20.00
40.00
60.00
80.00
100.00
PERCENT OF TIME EQUALLED OR EXCEEDED

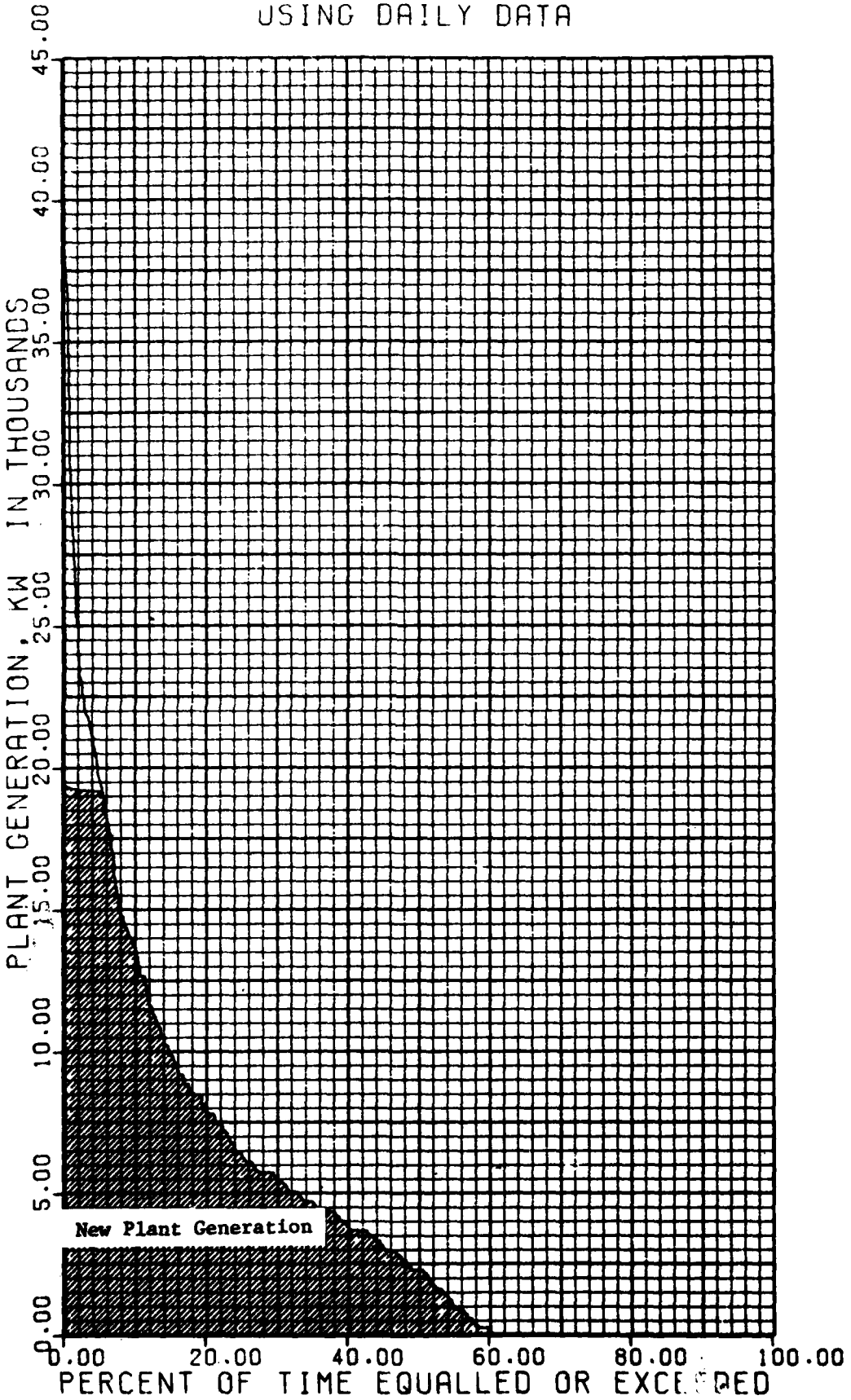
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POWER DURATION CURVE FOR OCT
USING DAILY DATA



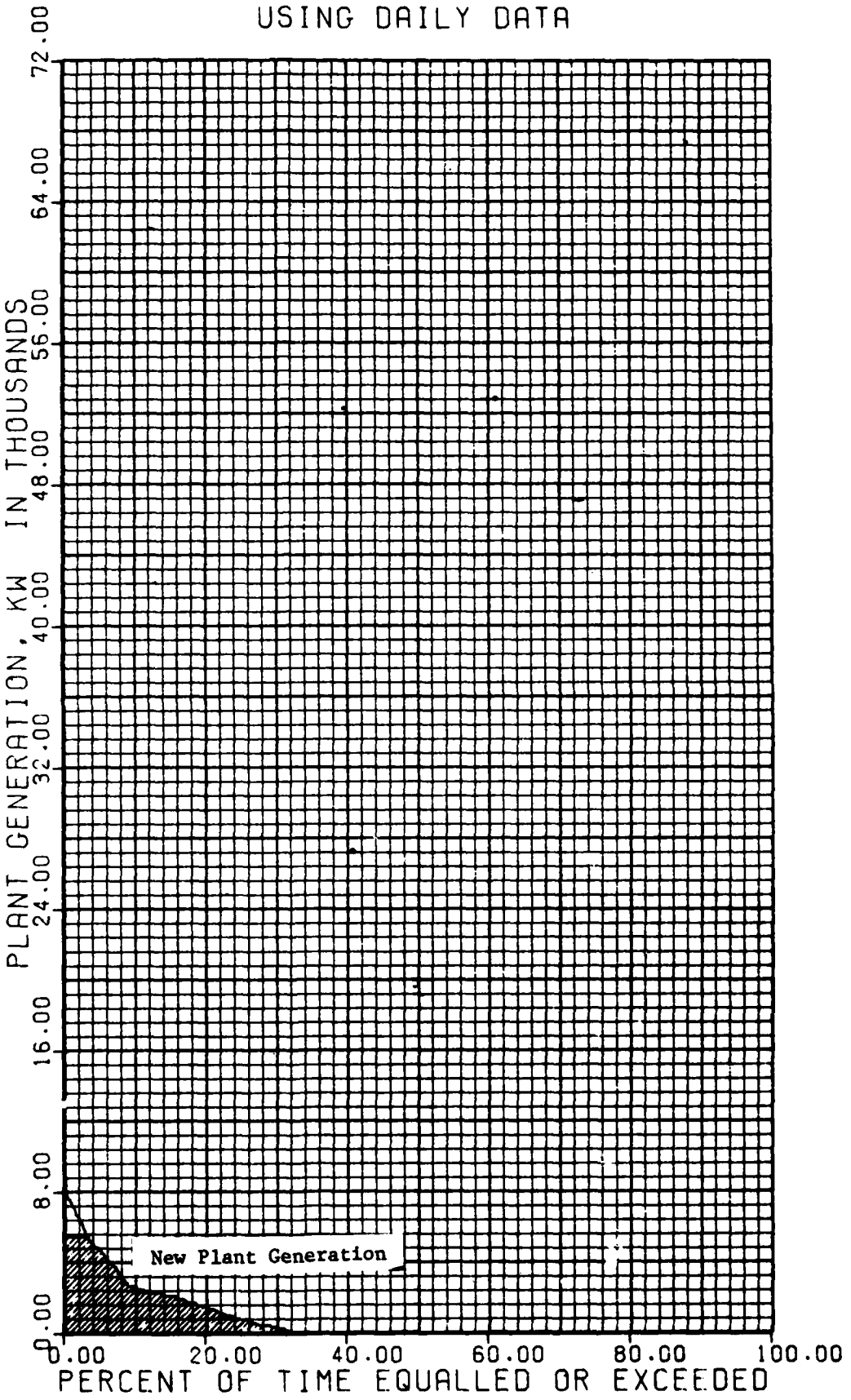
ST. ANTHONY - UPPER FALLS
POWER DURATION CURVE FOR NOV
USING DAILY DATA



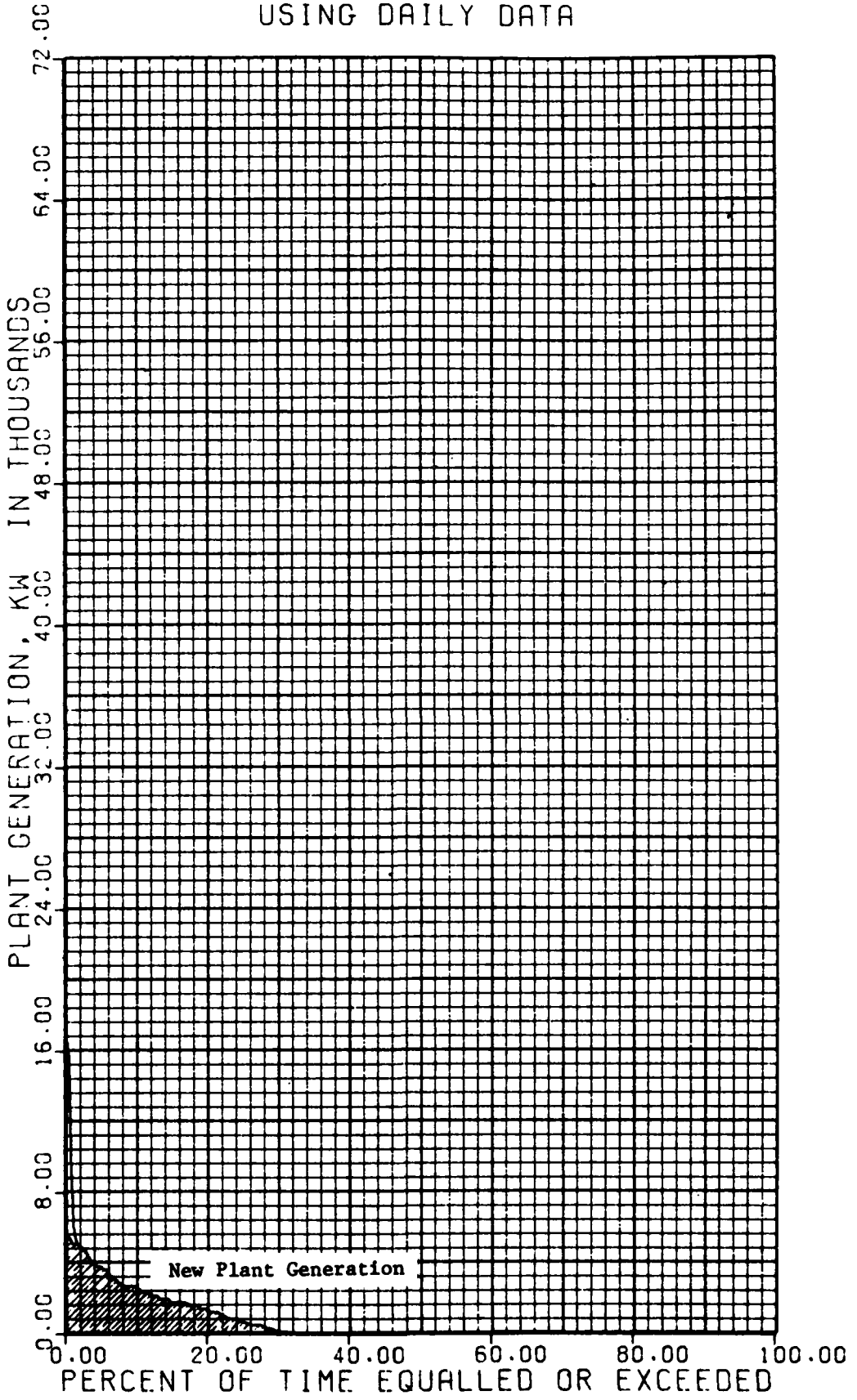
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POWER DURATION CURVE FOR DEC
USING DAILY DATA



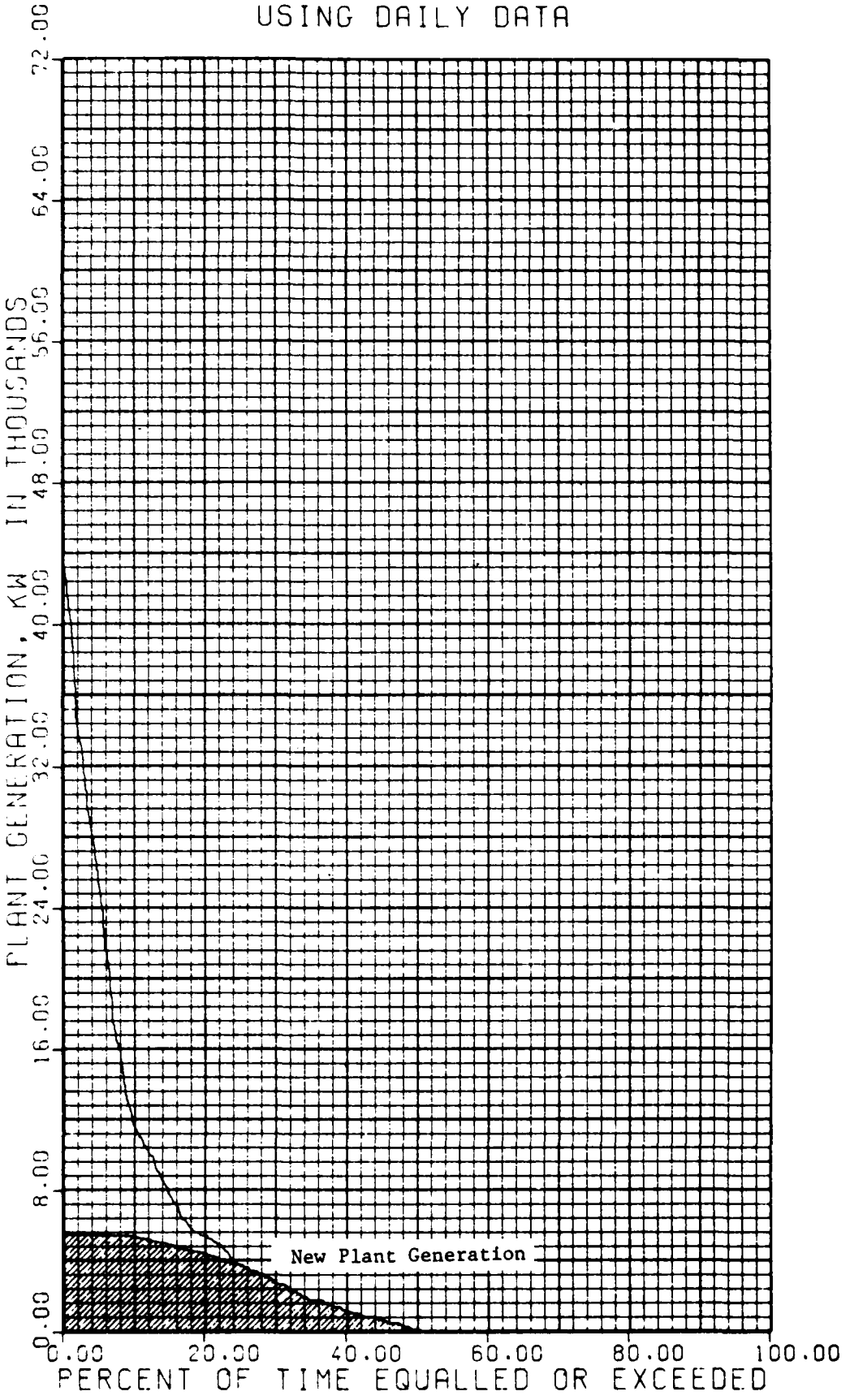
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR JAN
USING DAILY DATA



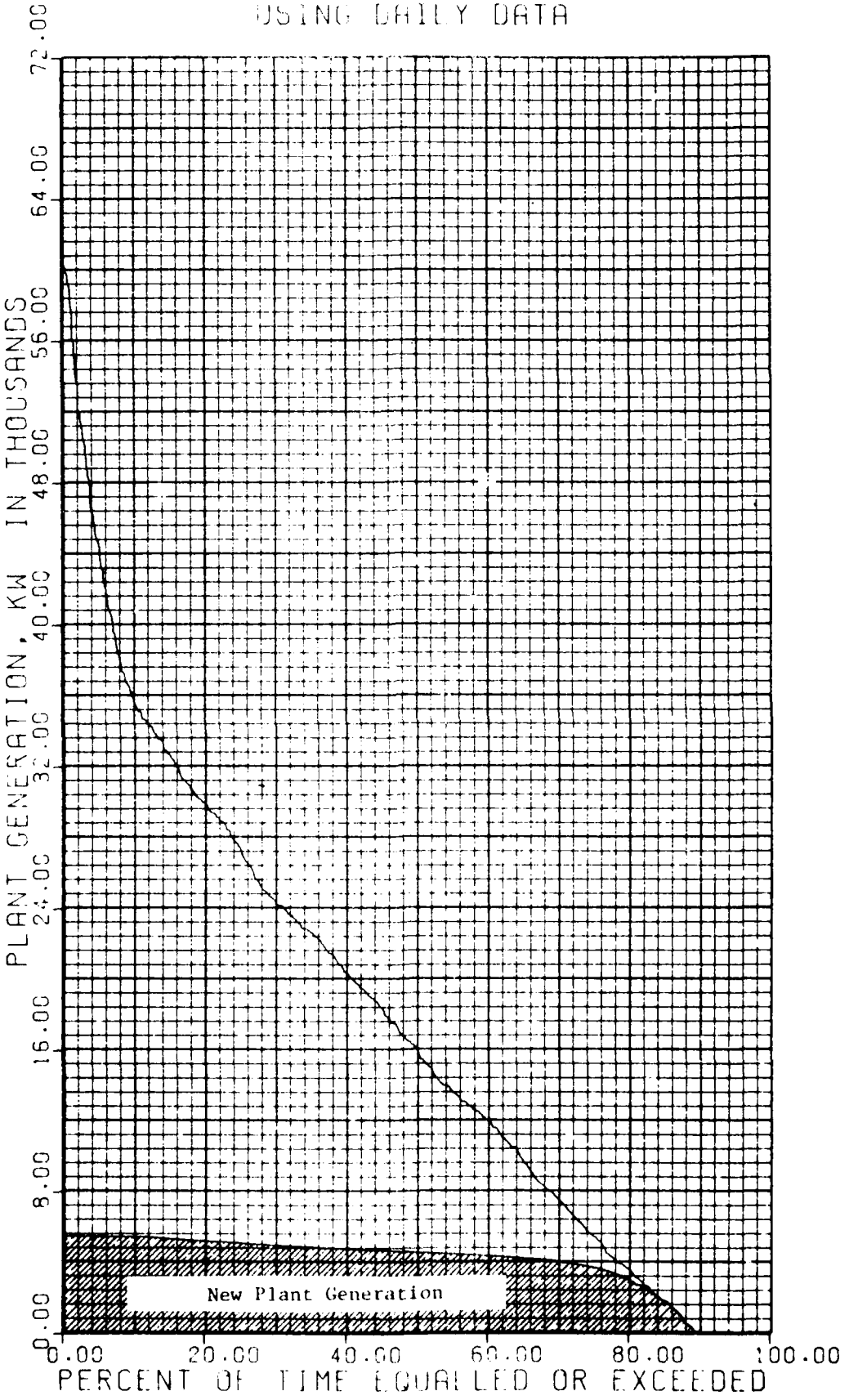
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR FEB
USING DAILY DATA



ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR MAR
USING DAILY DATA



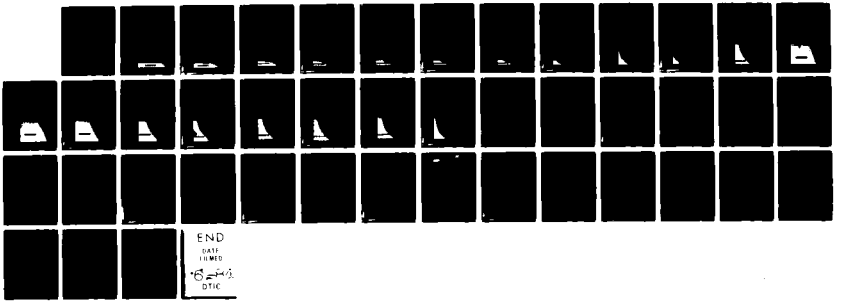
ST. ANTHONY LOWER FALLS
POWER DURATION CURVE FOR APR
USING DAILY DATA



AD-A140 262 FEASIBILITY REPORT FOR HYDROPOWER ST ANTHONY FALLS LOCKS AND DAMS MISSISSIPPI RIVER MINNEAPOLIS MINNESOTA (U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT

UNCLASSIFIED FEB 84 F/G 13/2 NL

6/6

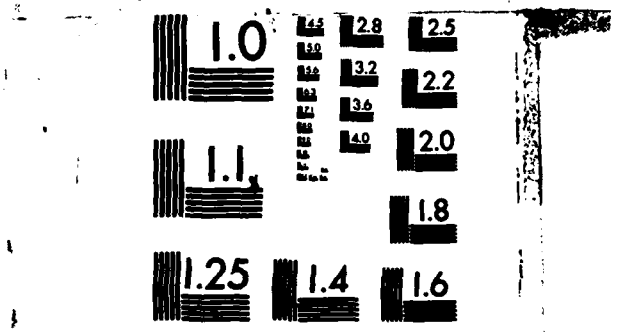


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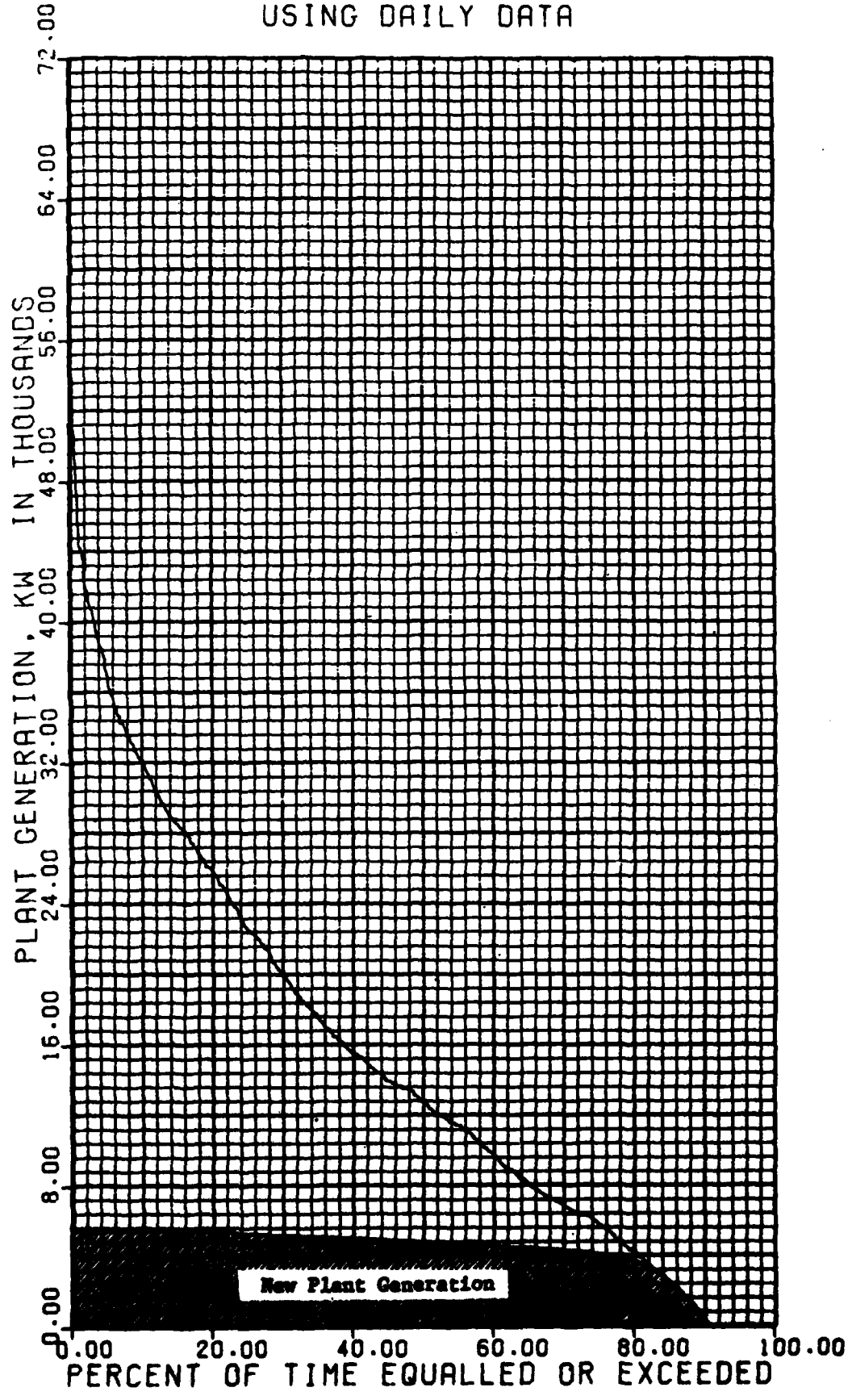
8-84

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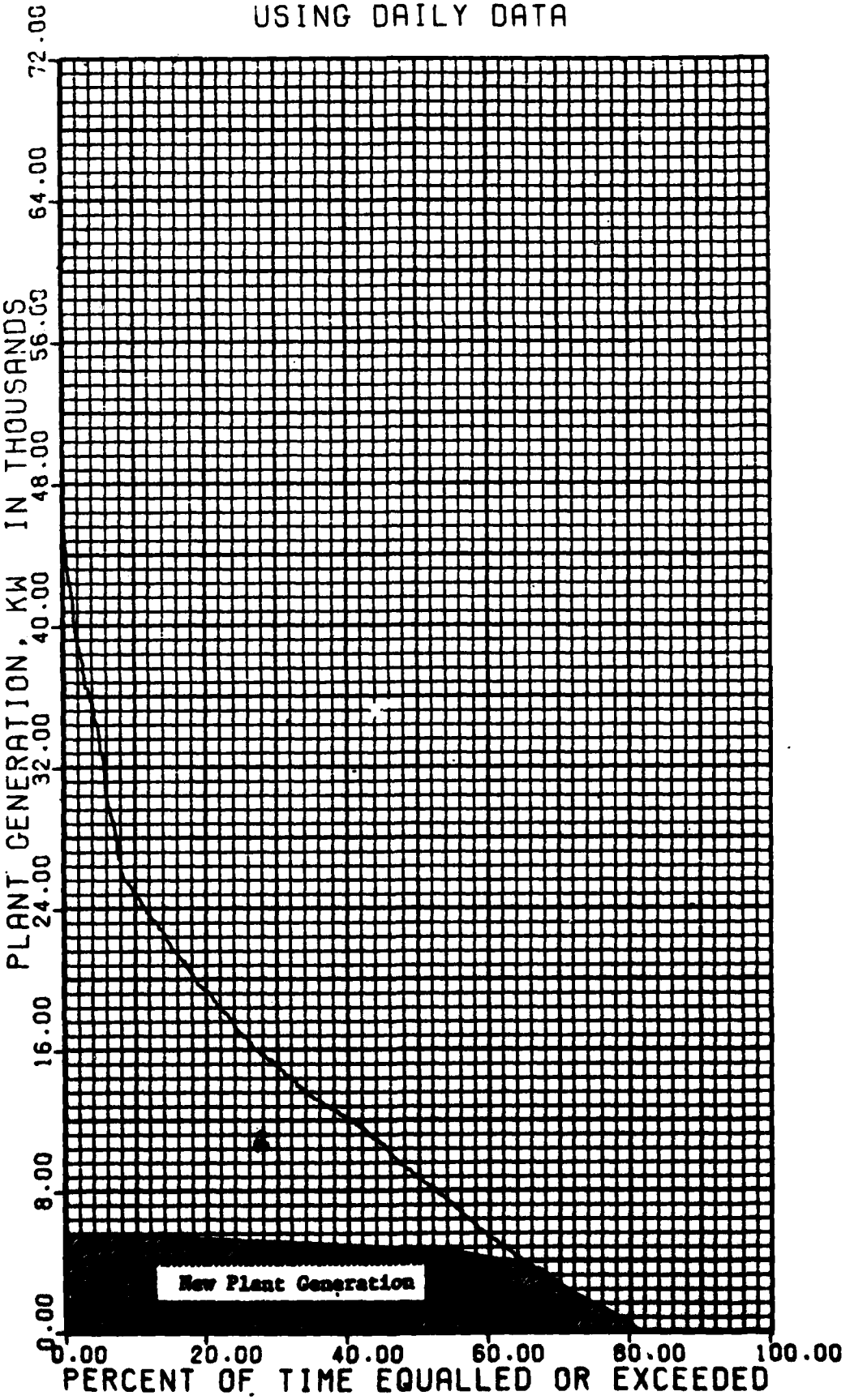


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

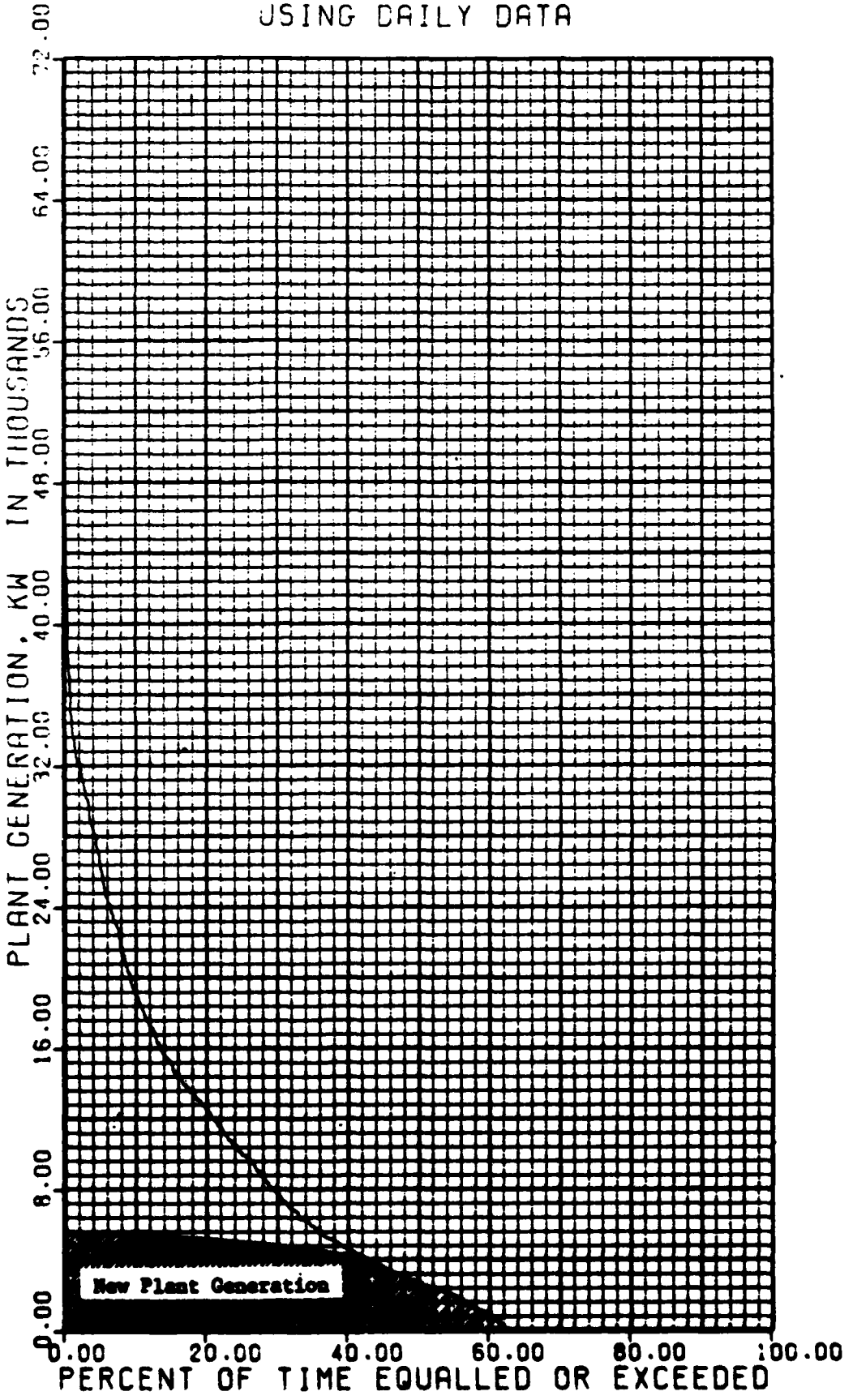
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR MAY
USING DAILY DATA



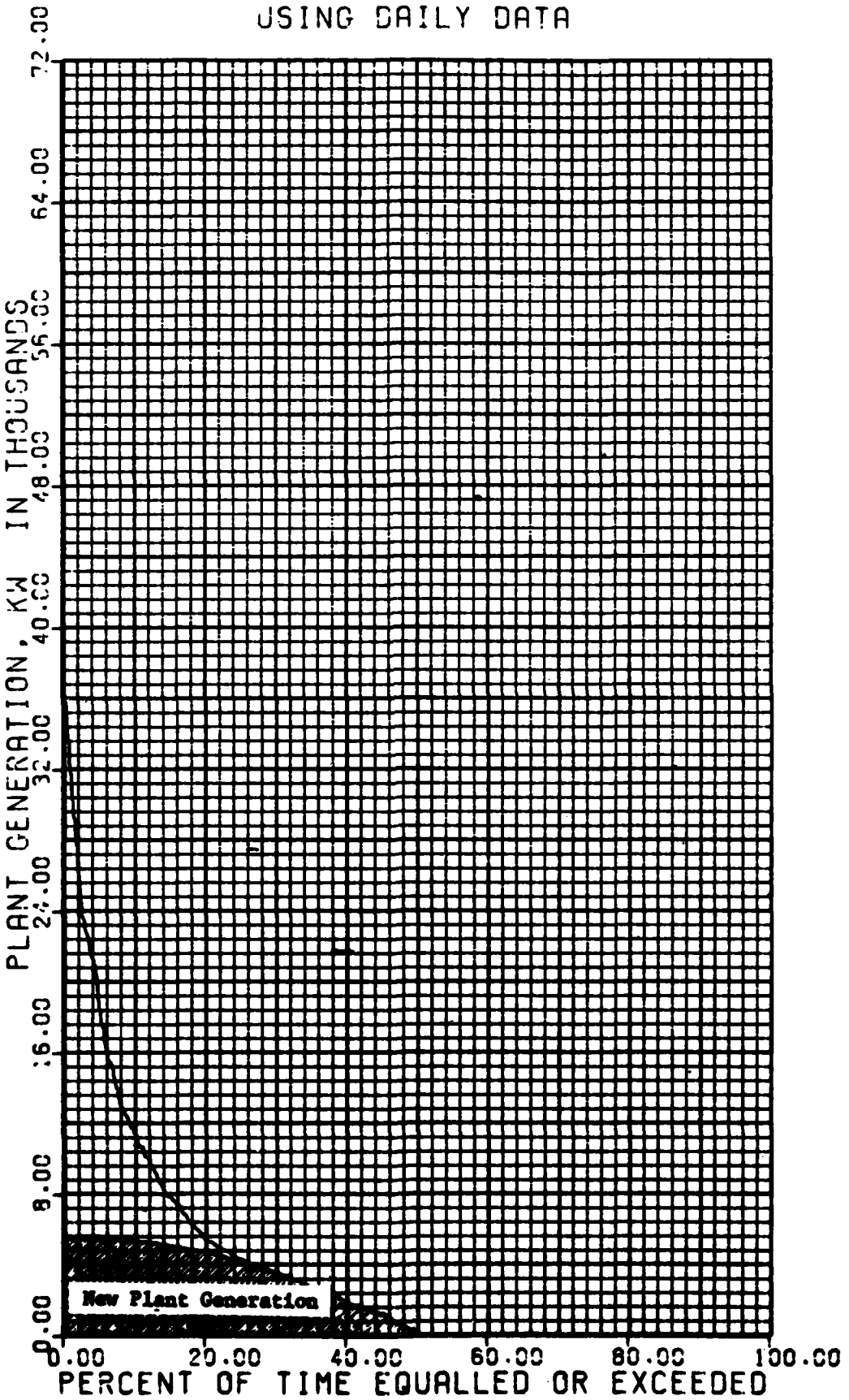
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR JUN
USING DAILY DATA



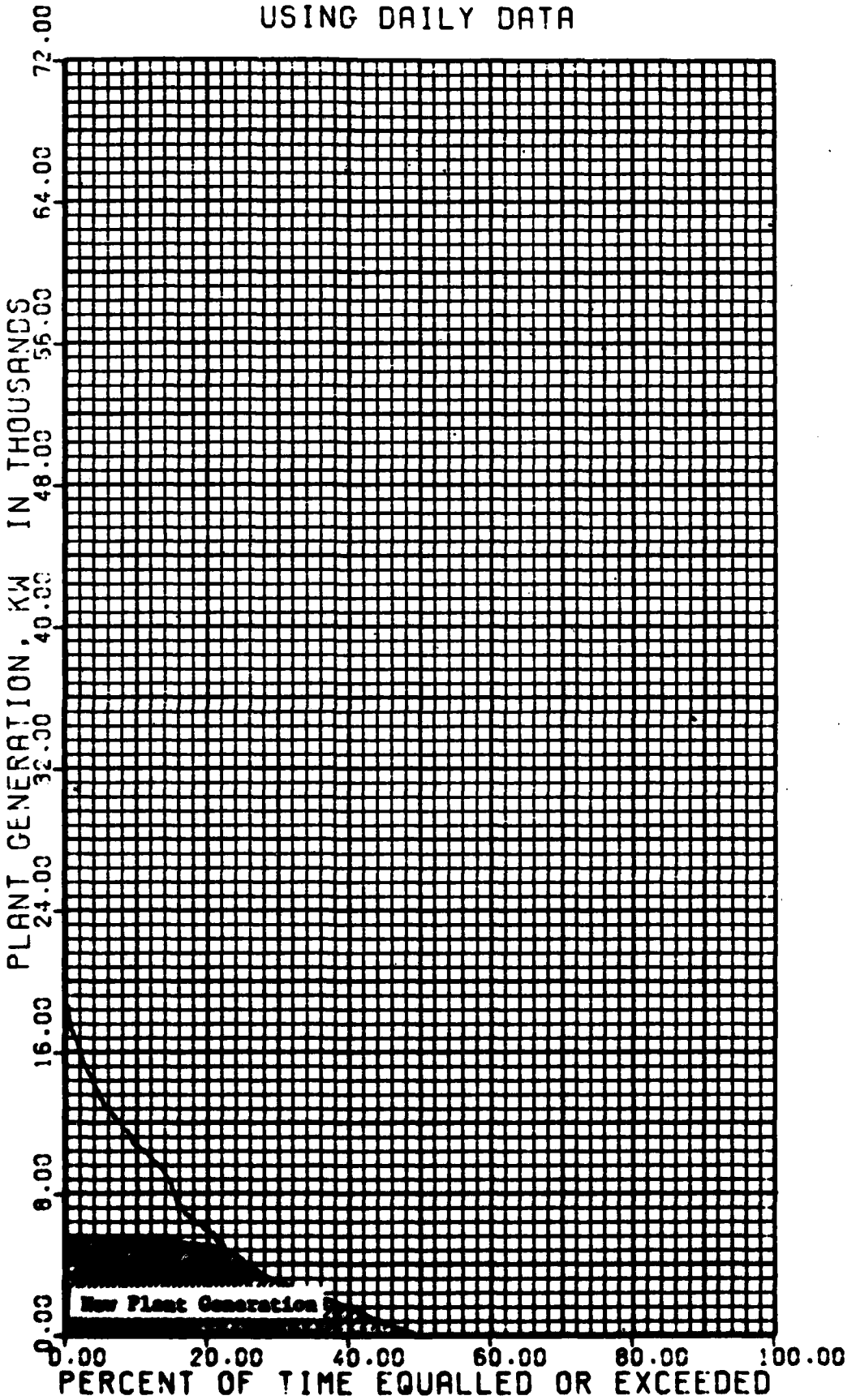
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR JUL
USING DAILY DATA



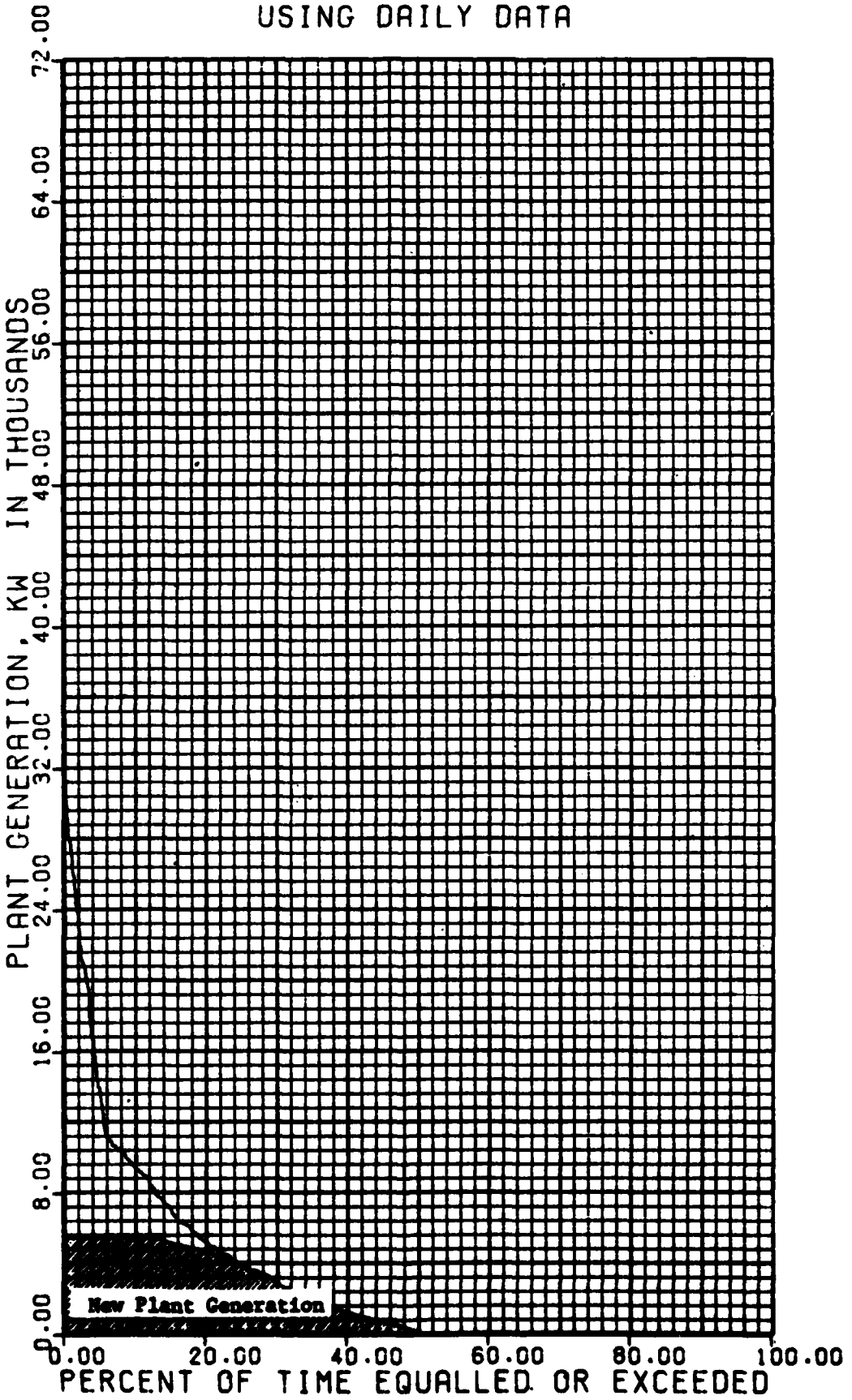
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR AUG
USING DAILY DATA



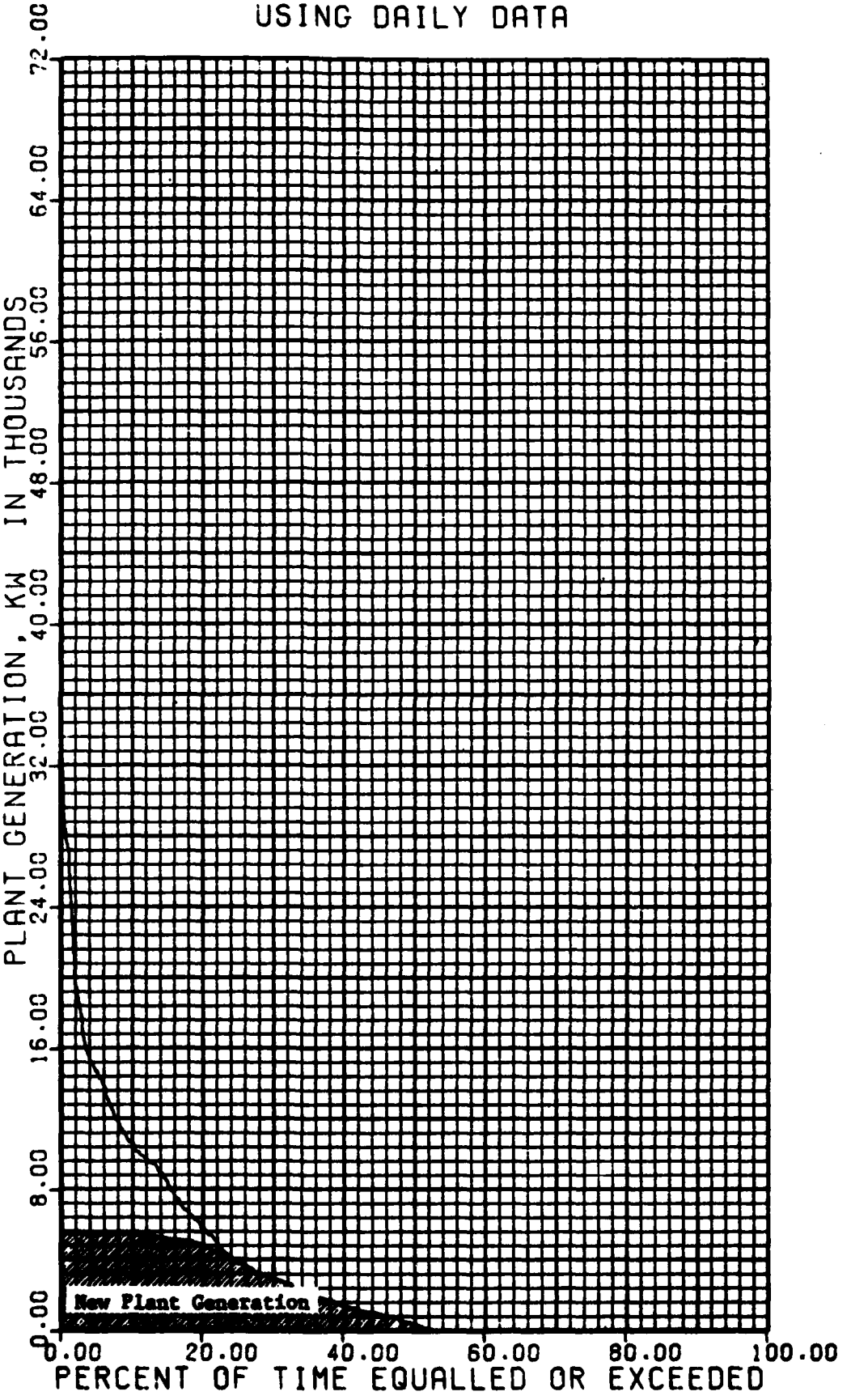
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR SEP
USING DAILY DATA



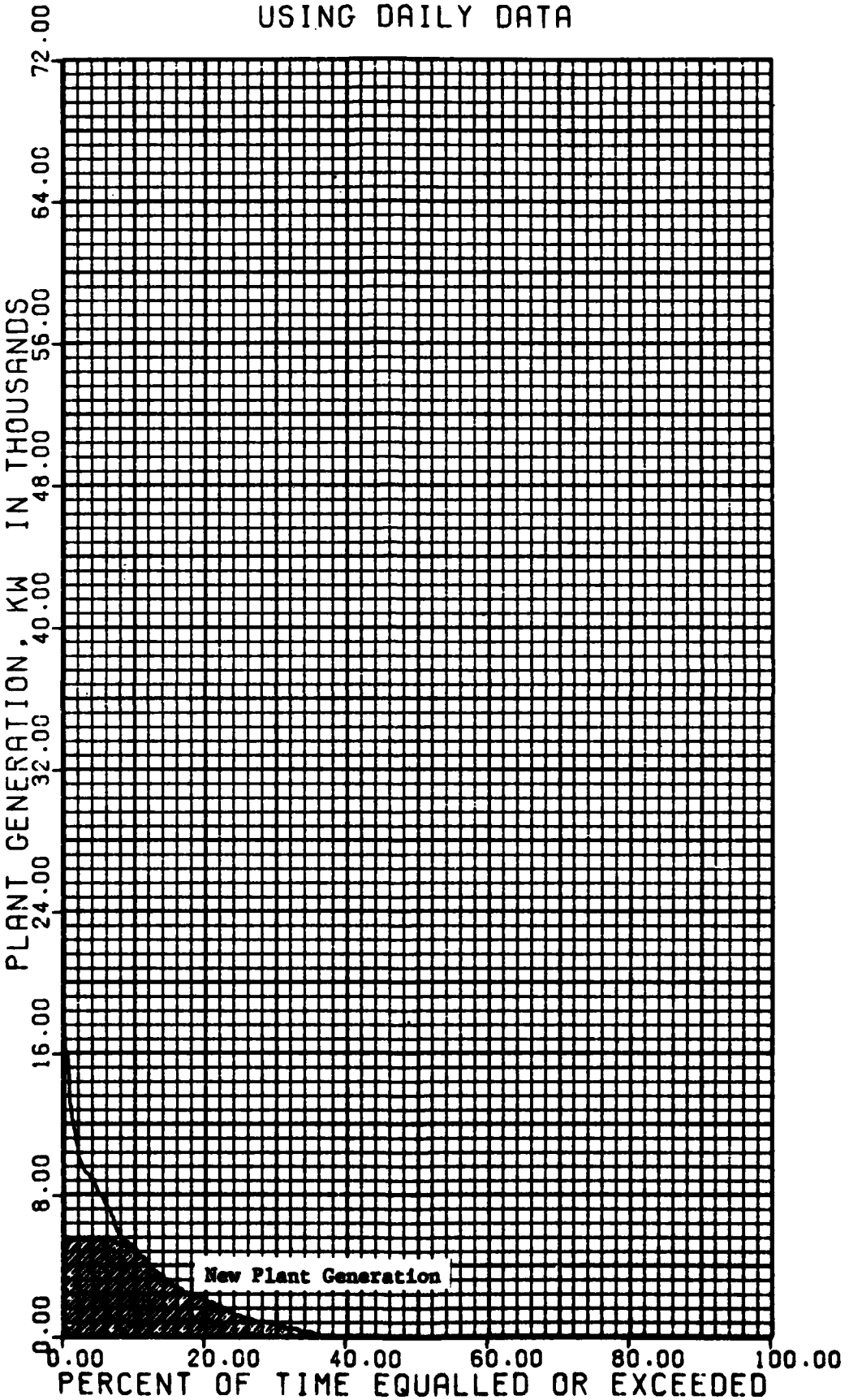
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR OCT
USING DAILY DATA



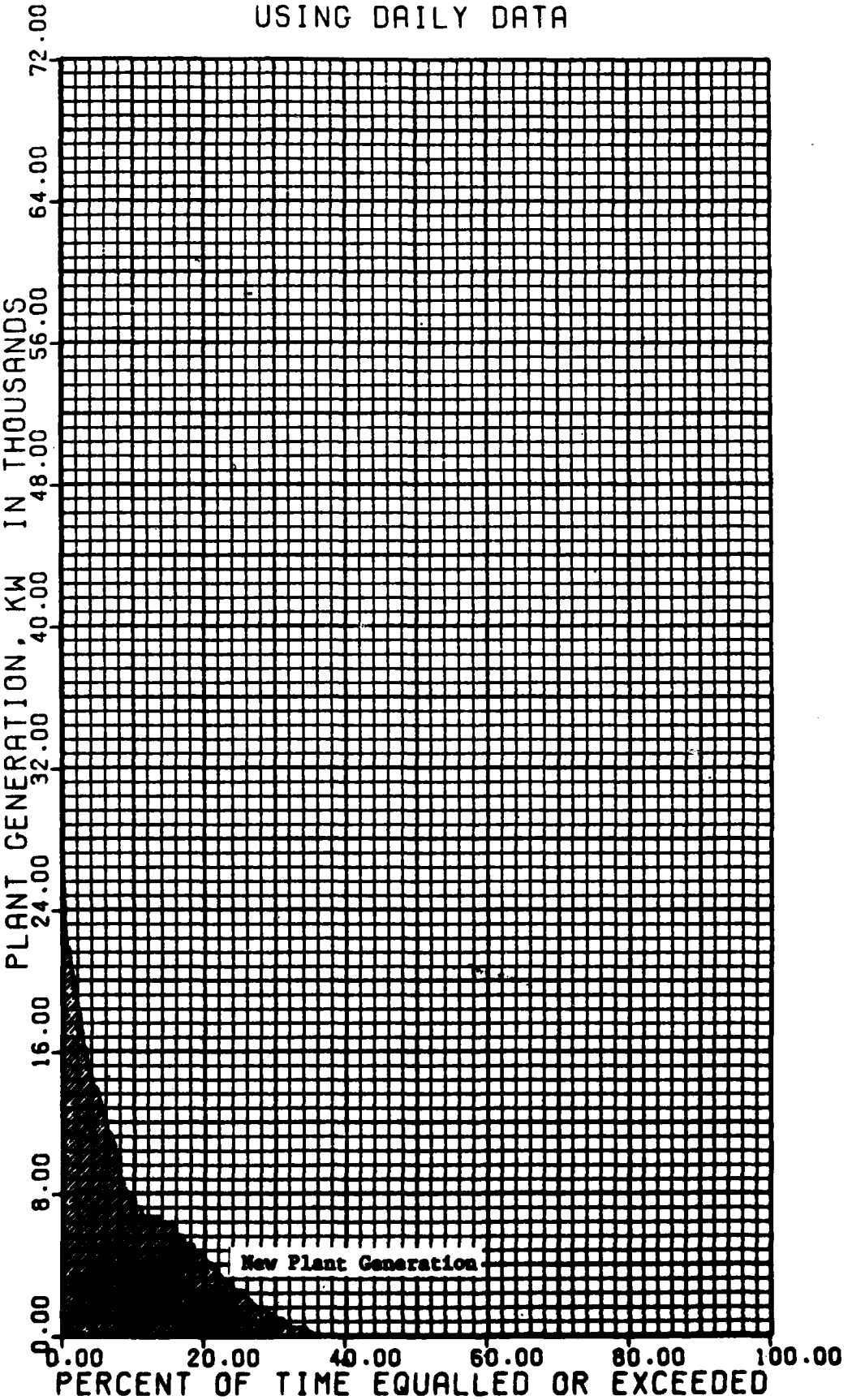
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR NOV
USING DAILY DATA



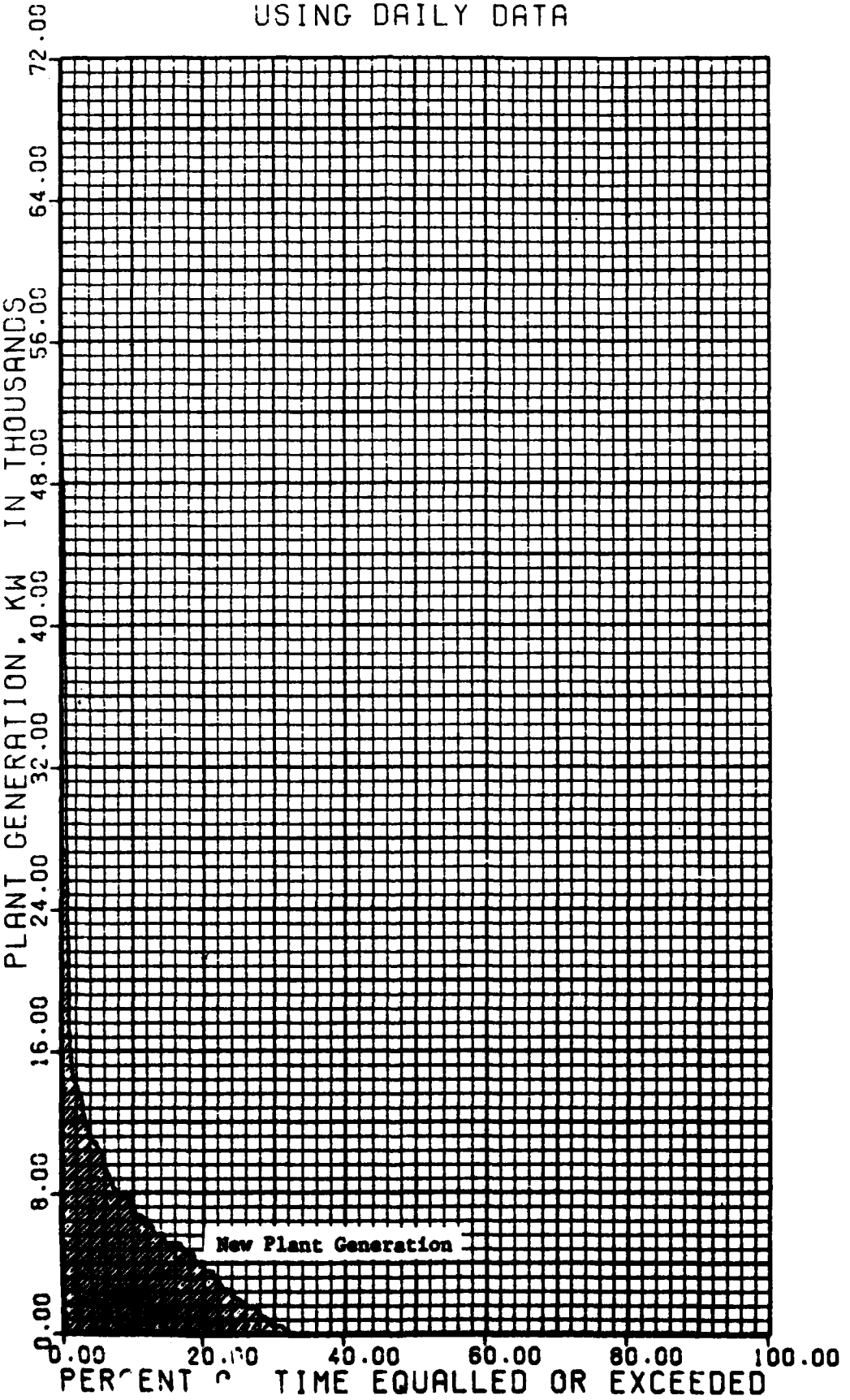
ST. ANTHONY - LOWER FALLS
POWER DURATION CURVE FOR DEC
USING DAILY DATA



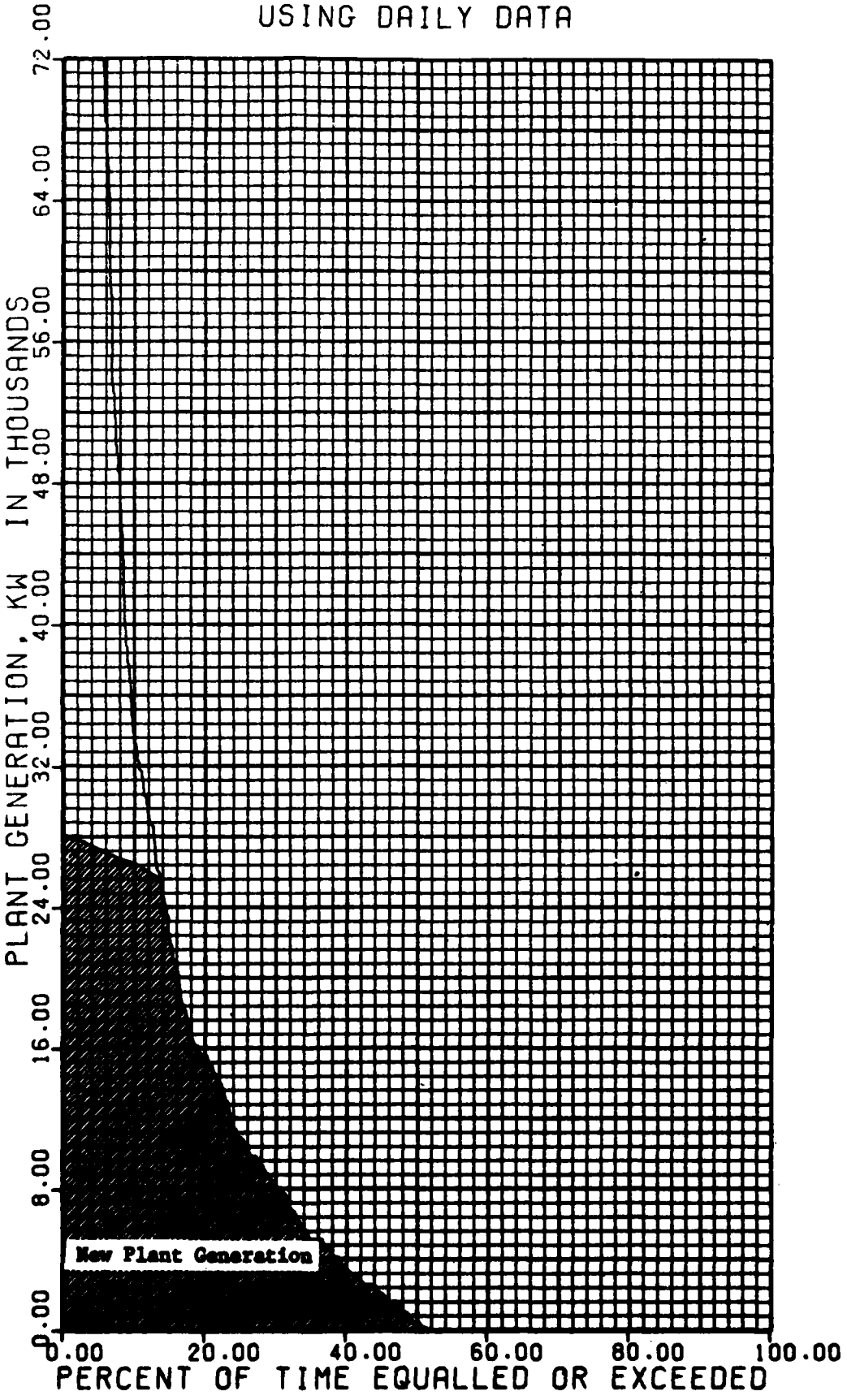
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR JAN
USING DAILY DATA



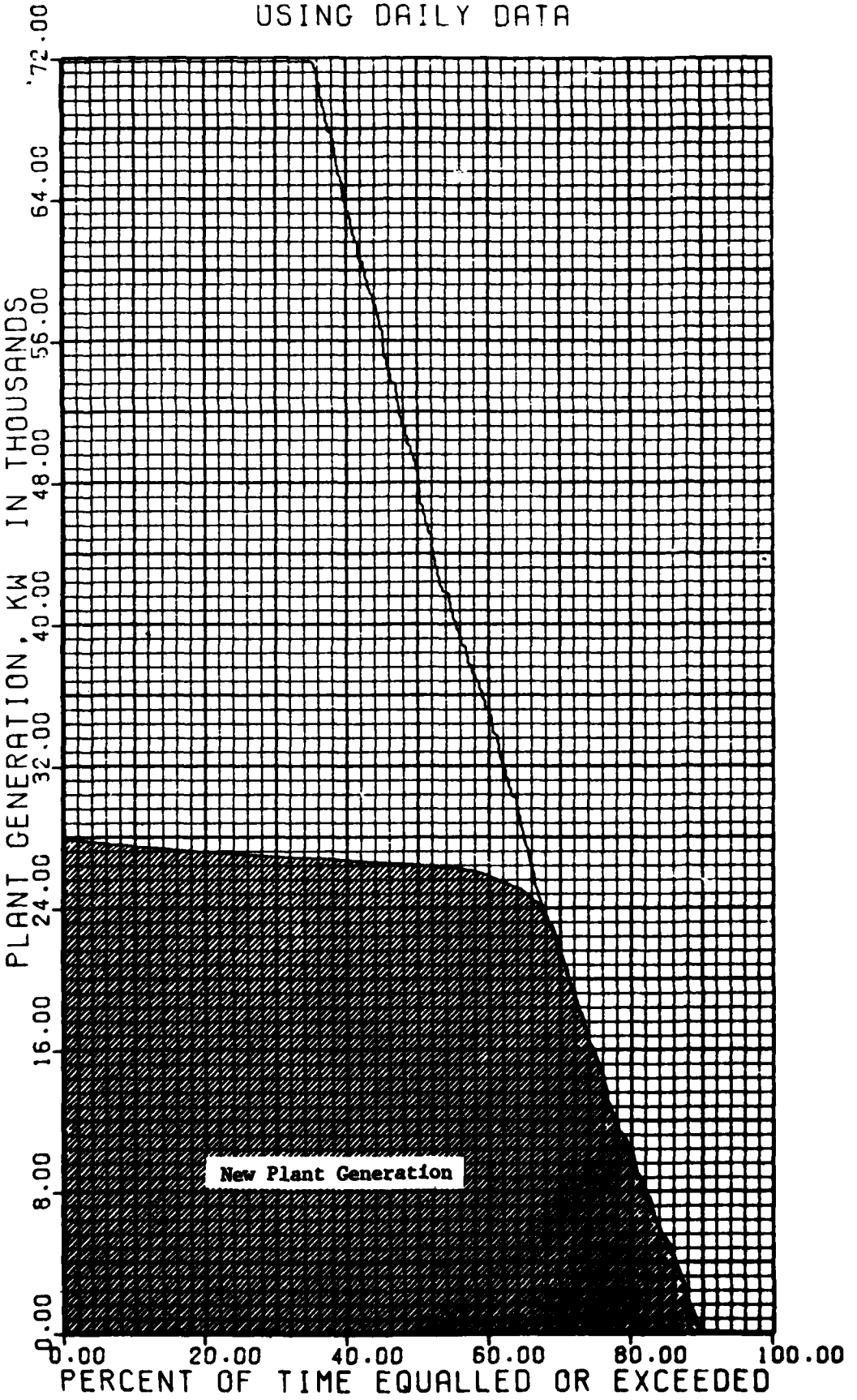
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR FEB
USING DAILY DATA



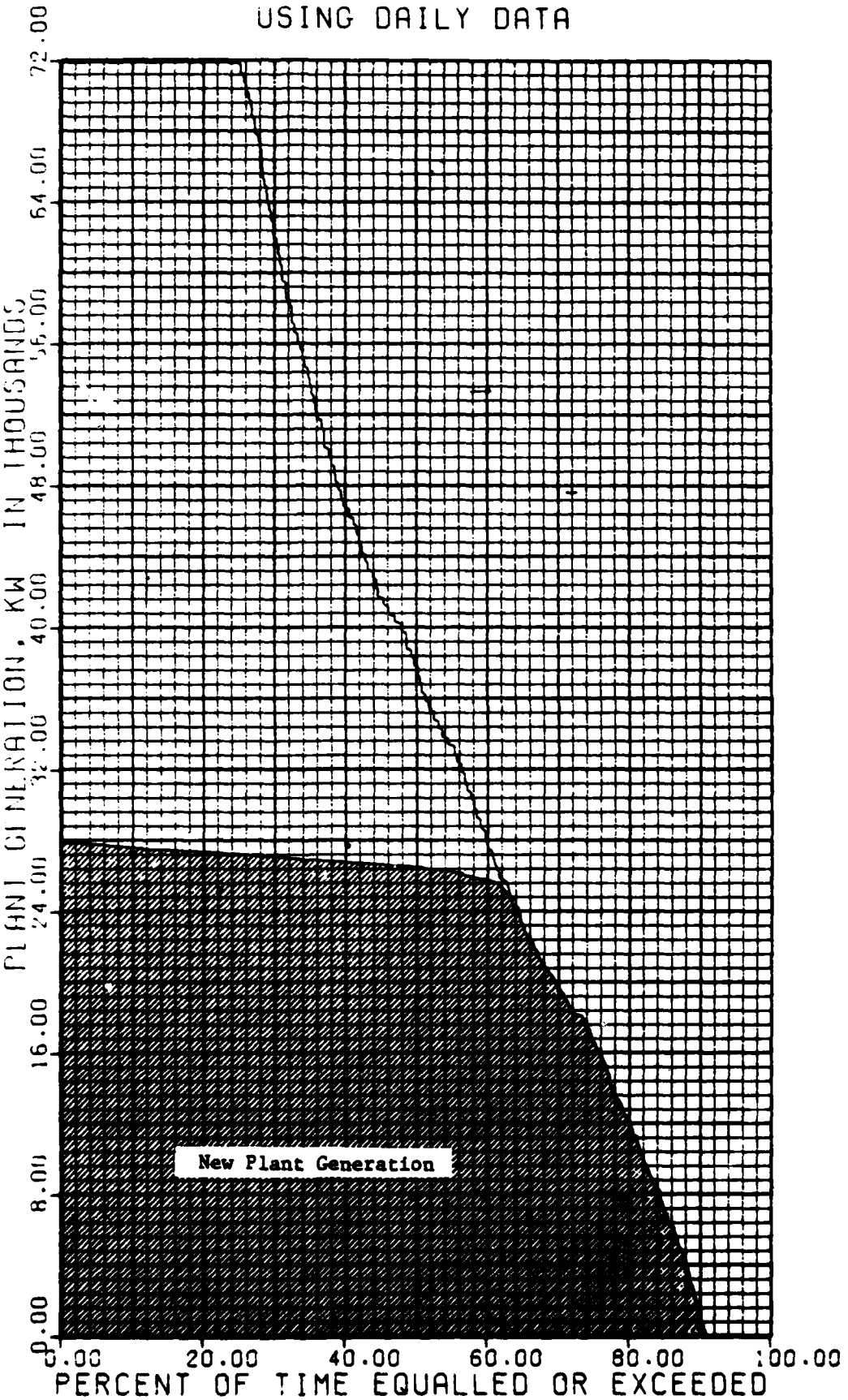
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR MAR
USING DAILY DATA



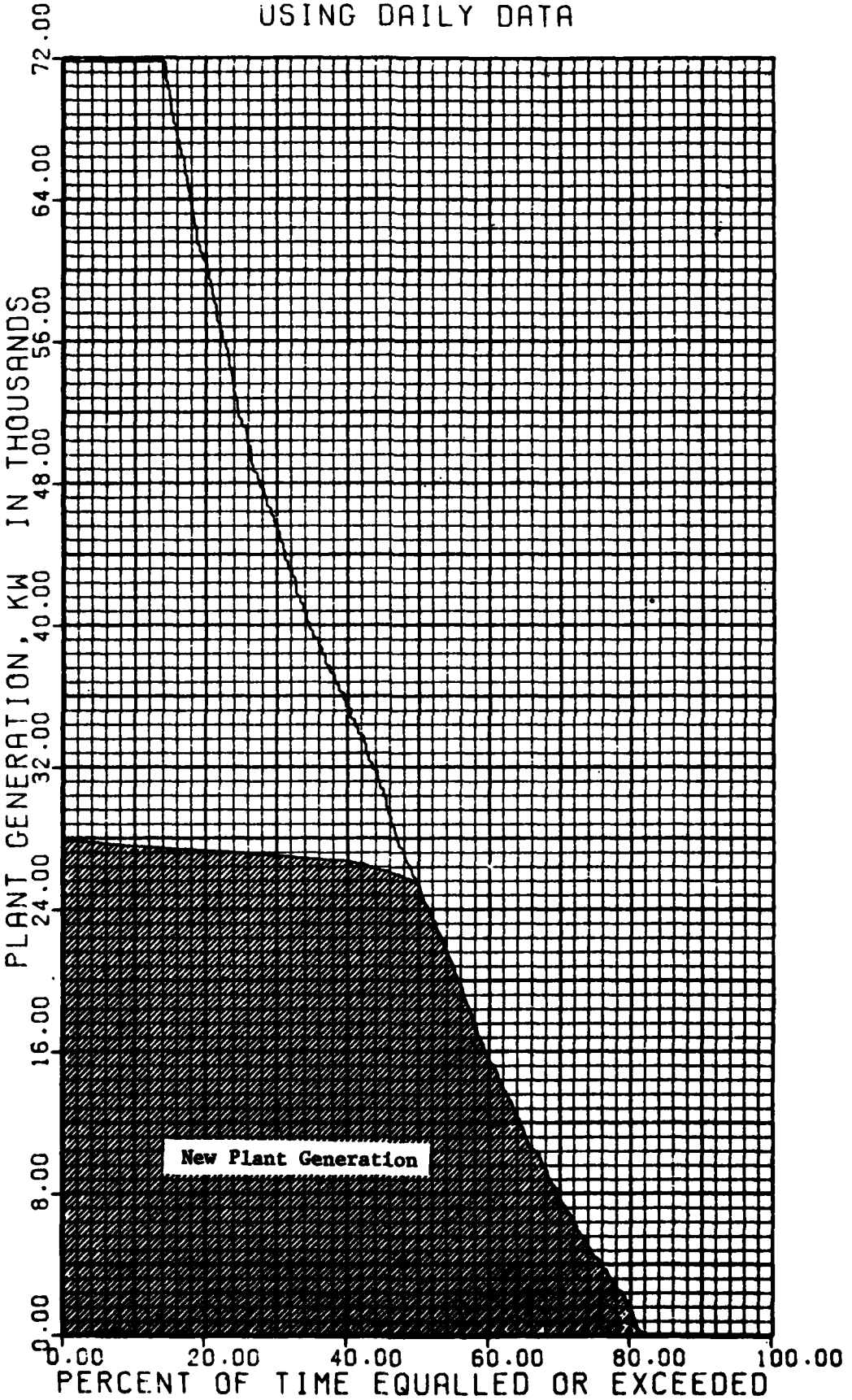
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR APR
USING DAILY DATA



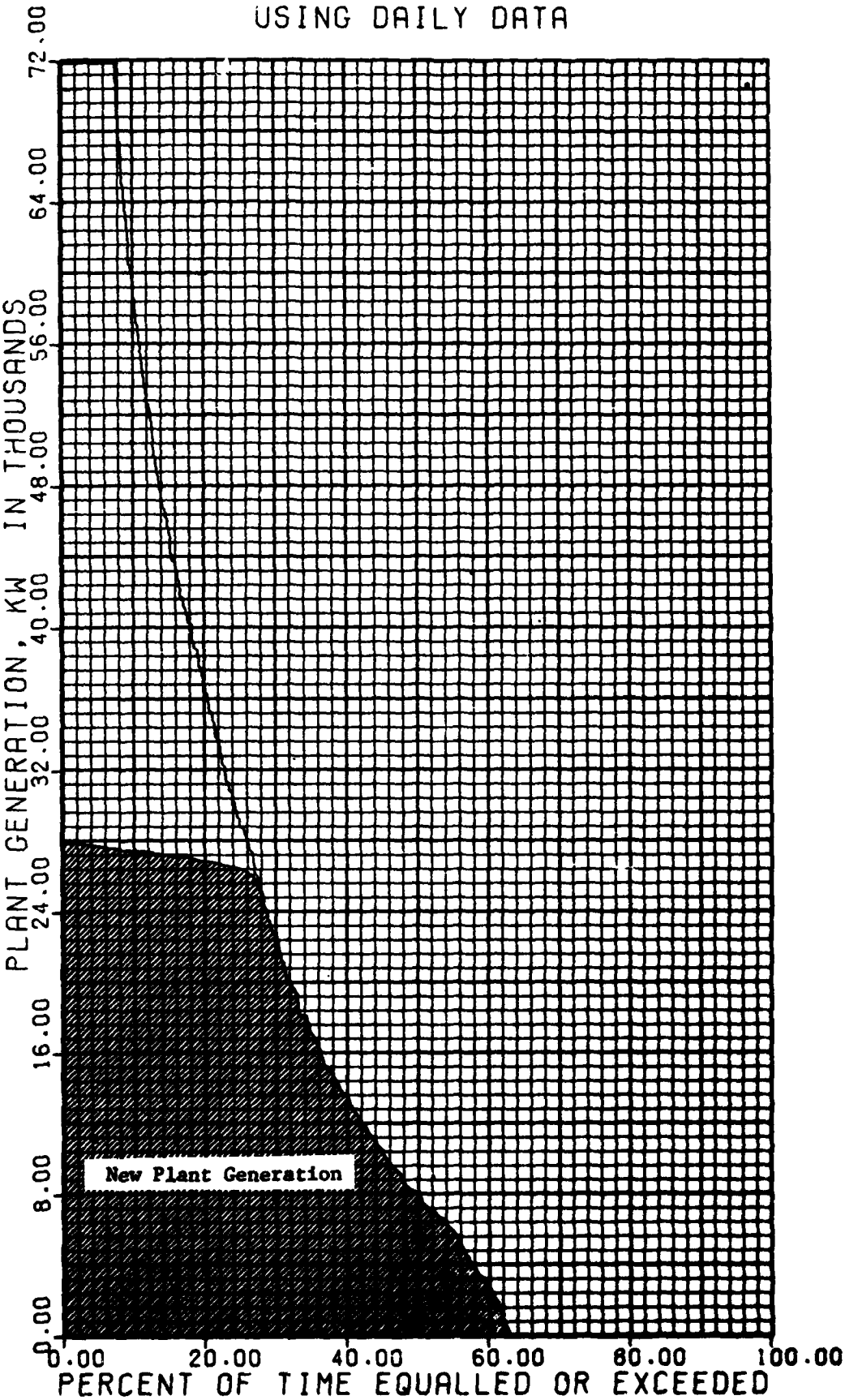
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR MAY
USING DAILY DATA



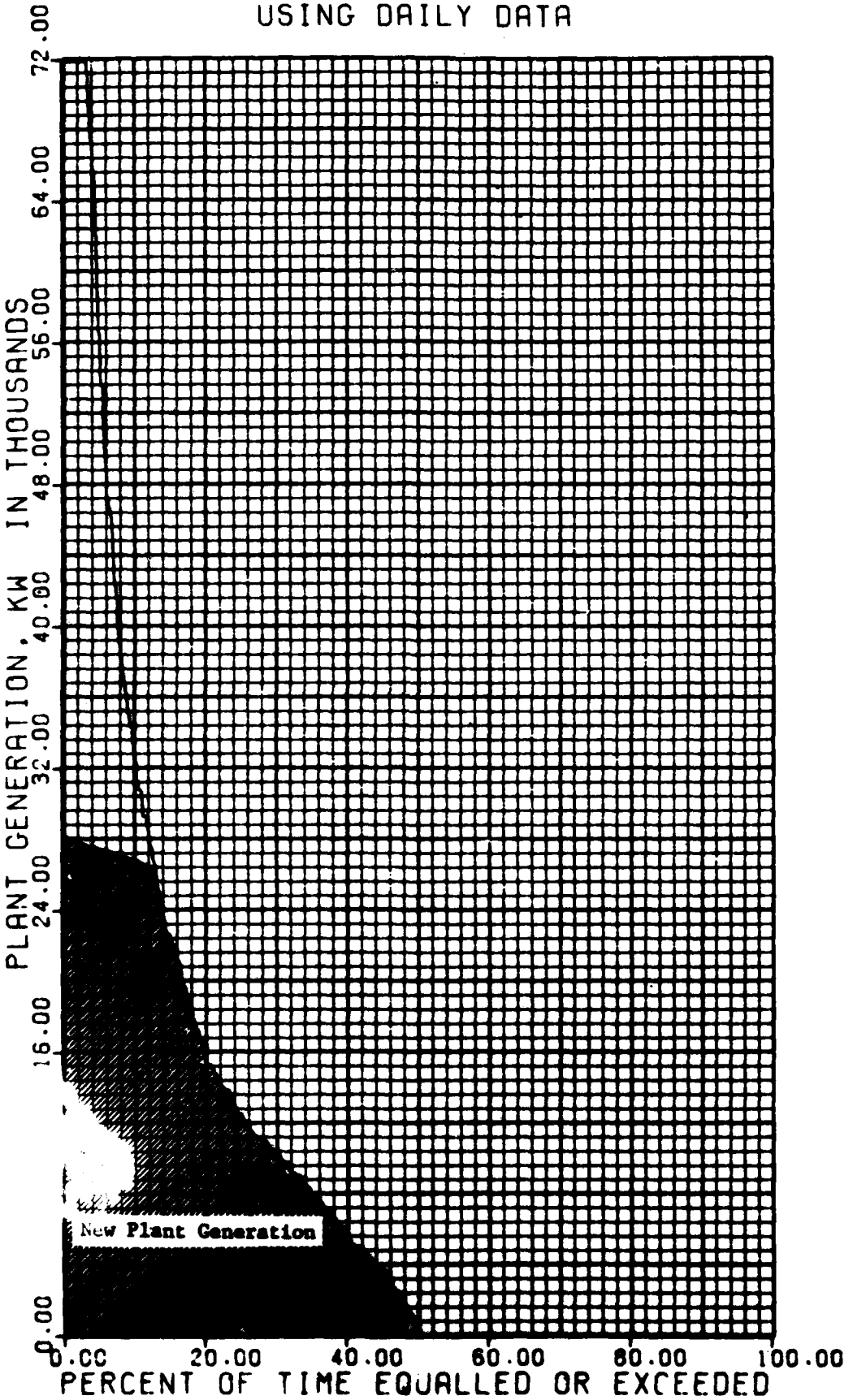
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR JUN
USING DAILY DATA



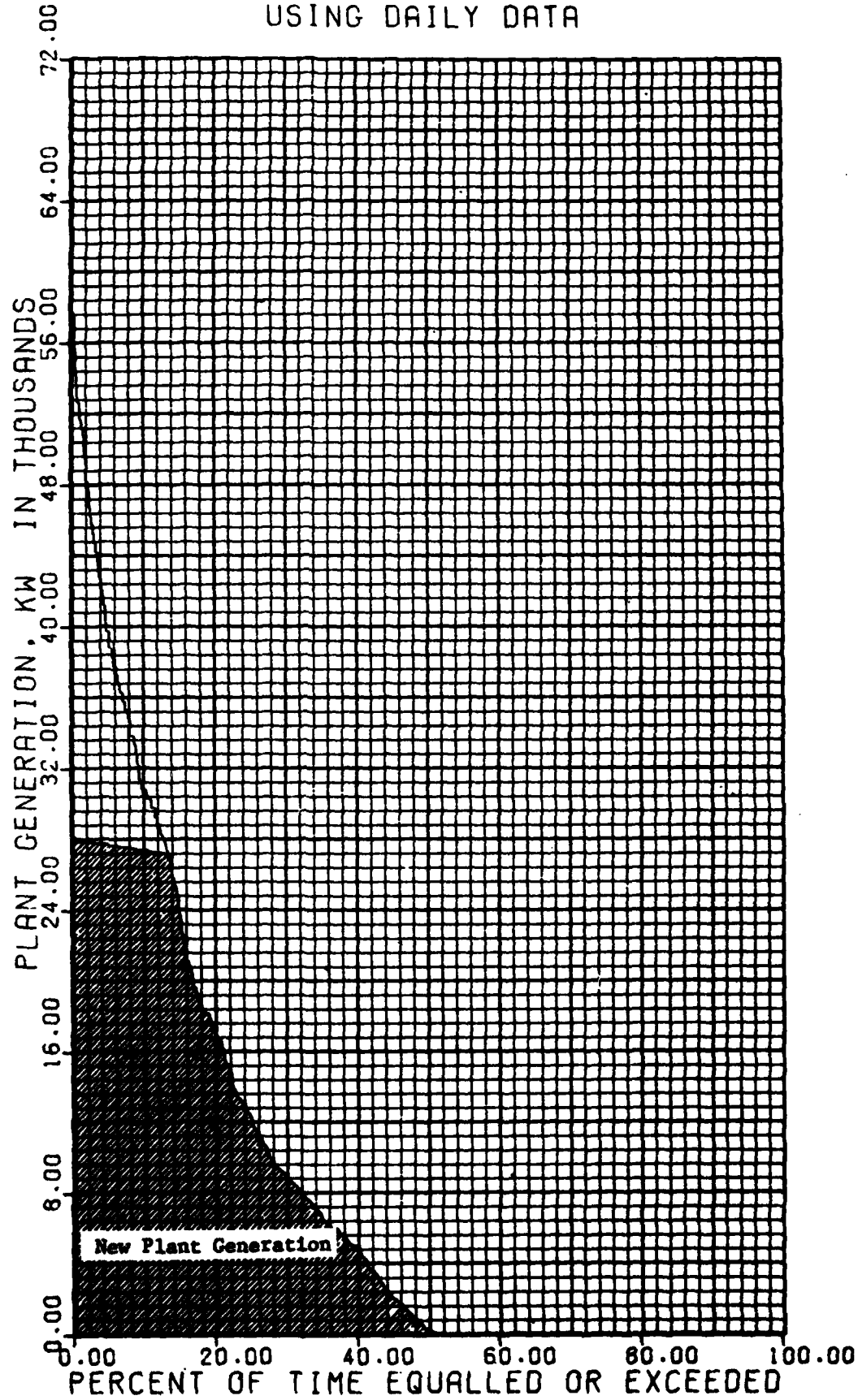
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR JUL
USING DAILY DATA



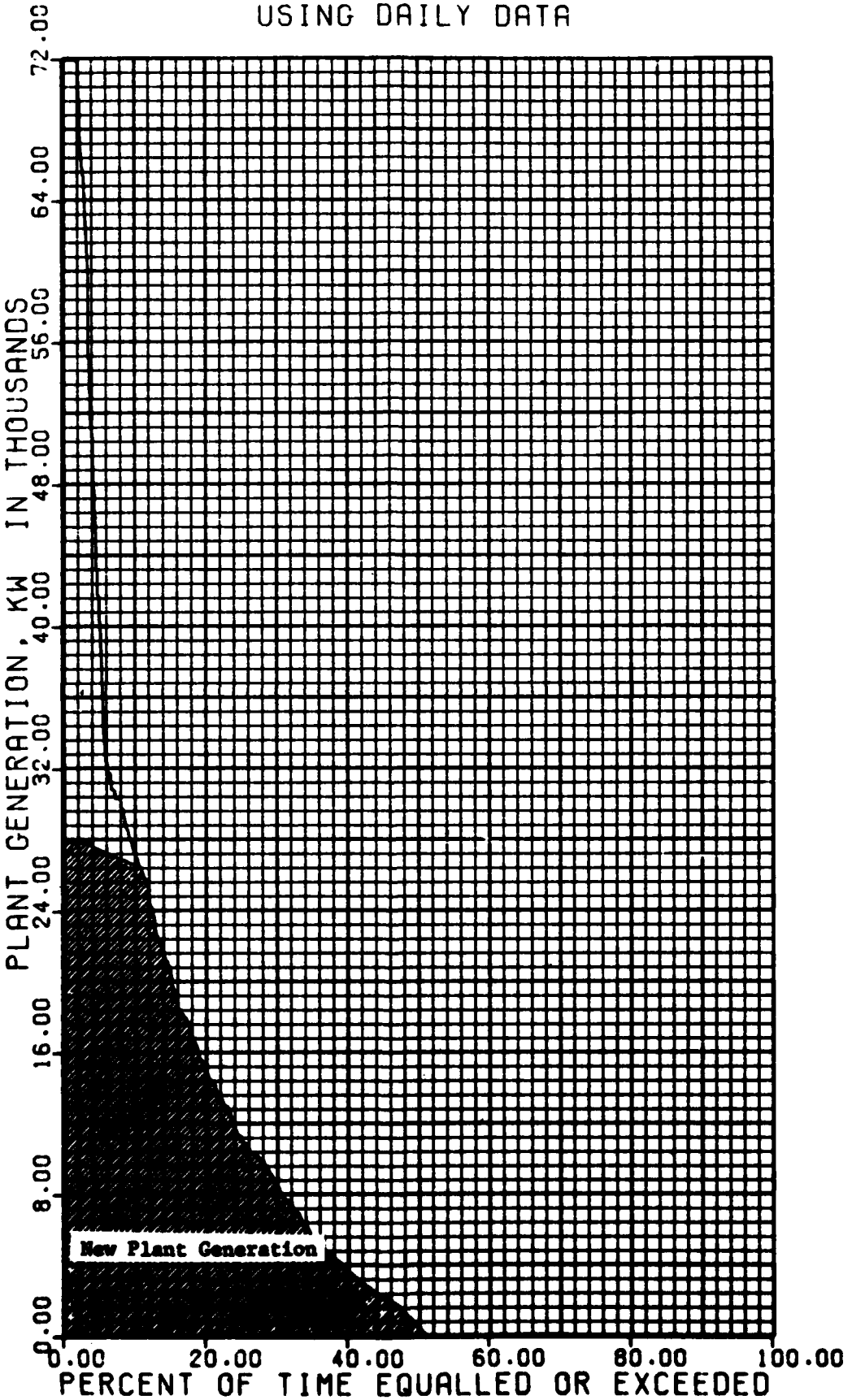
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR AUG
USING DAILY DATA



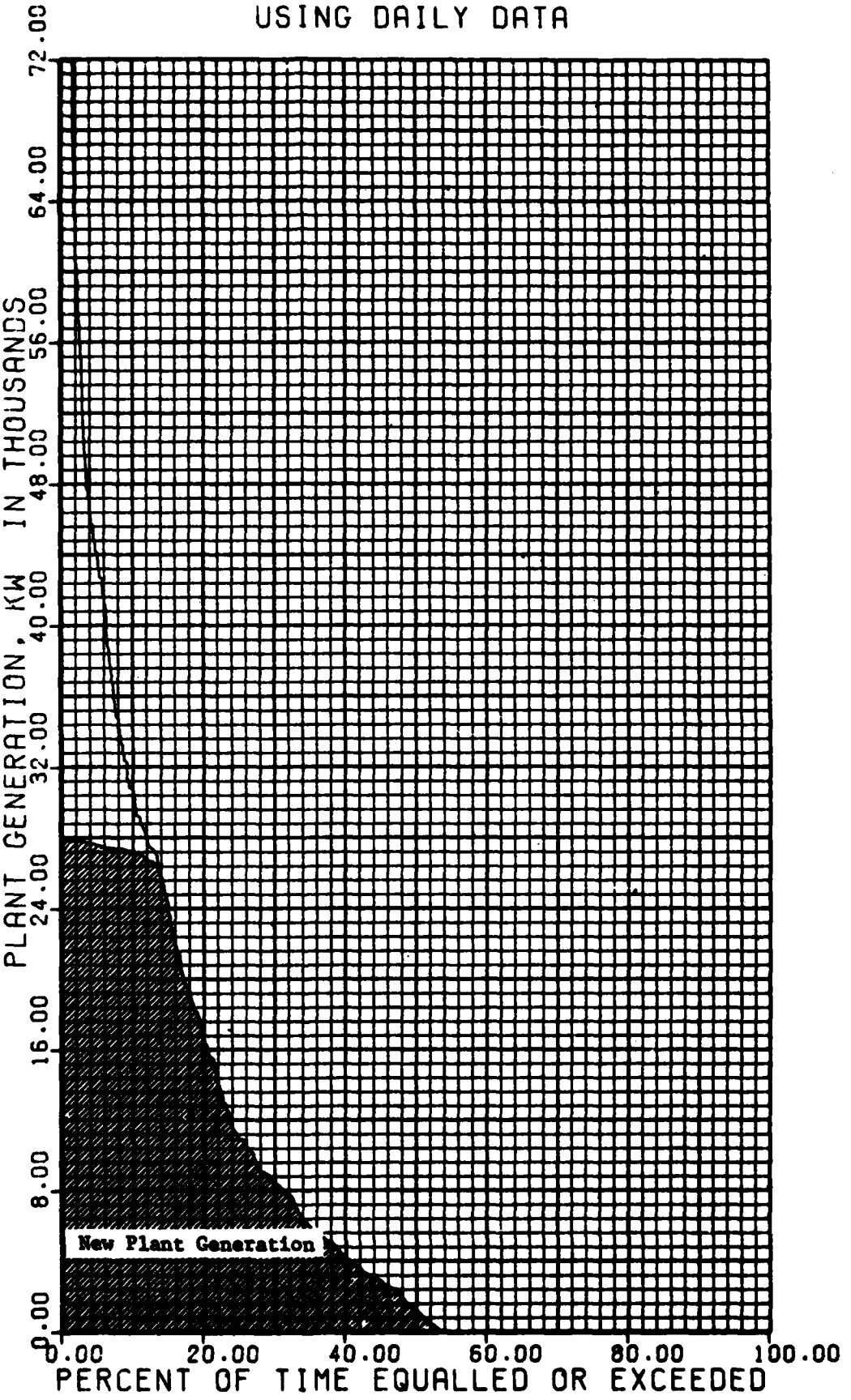
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR SEP
USING DAILY DATA



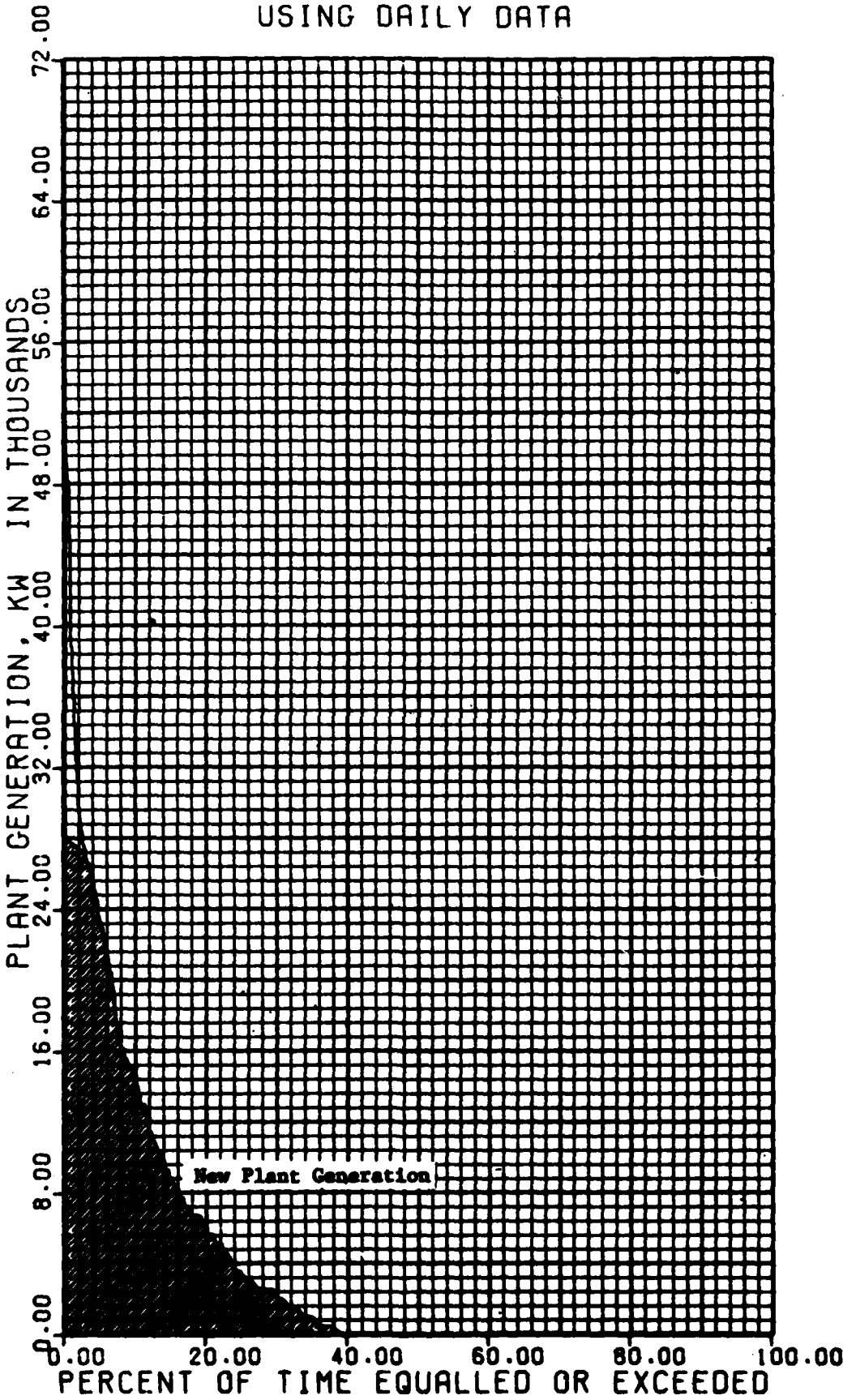
ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR OCT
USING DAILY DATA



ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR NOV
USING DAILY DATA



ST. ANTHONY - COMBINED FALLS
POWER DURATION CURVE FOR DEC
USING DAILY DATA



APPENDIX C

PERTINENT CORRESPONDENCE

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
Orv Bruton	NPDEN-WM Power	FTS 423 3752
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**
Dave Simon	FERC Chicago	FTS 353 6701

SUMMARY OF CONVERSATION

1. Benefits for St. Anthony Falls hydropower study will be derived based on October 1982 cost levels, as directed by St. Paul District. Two interest rates will be used: 7 7/8 percent will be used for the primary economic analysis and a second rate of 14 percent will be used for a sensitivity comparison.

2. A call was placed to Mr. Simon of the Chicago FERC office requesting the value of power based on 14 percent interest and 1982 cost levels. In their 11 Oct 83 letter FERC supplied a value based on 14 percent, but at 1983 cost levels.

3. Adjustments to the originally submittal 1983 level power values were made as follows.

Cost levels	Intr. rate	Coal Plant Inv. cost	Rate of increase
Oct 82	8 1/8%	$1,166 /kw	-
Oct 83	8 1/8%	$1,370 /kw	8.2%

assume 8% decrease in cost for coal plant for either 8 1/8% or 14% interest rates.

Then for 14 percent and 82 cost levels:

Capacity value=$259.20 kw x 0.92=$238.46 kw (unadjusted value)
Assume no change in energy value

Energy Value = 38 mills kwh

4. The above power values will be used for computing benefits for the published report

ORV BRUTON, P.E.
Power Study Coordinator

TELEPHONE OR VERBAL CONVERSATION RECORD For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.	DATE 12 October 1983

SUBJECT OF CONVERSATION

St. Anthony Falls Hydropower Study

	INCOMING CALL	
PERSON CALLING Carl Stephan	ADDRESS St. Paul District	PHONE NUMBER AND EXTENSION FTS 725-7472
PERSON CALLED Orv Bruton	OFFICE NPD Power Section	PHONE NUMBER AND EXTENSION FTS 423-3752
	OUTGOING CALL	
PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
PERSON CALLED	ADDRESS	PHONE NUMBER AND EXTENSION

SUMMARY OF CONVERSATION:

1. Carl called to request that we complete the report (incorporating NCS comments submitted earlier) using October 1982 cost levels and 7 7/8 percent interest rate that was originally used in the draft report. The draft report, dated 13 May 83, was submitted to the District, their comments were received and reviewed at the 2 August 83 meeting in St. Paul. At that time, the District wanted new 1983 level power values; we have been waiting for these values to be prepared by the Chicago FERC office. To date the values have not been received.

2. St. Paul District now plans to publish the hydropower report based on the original October 82 levels. Then, they will prepare a supplement updating the published report. This new schedule will be more compatible with their plan of public release and public meeting schedule.

3. NPD will now revise the draft report to incorporate St. Paul District's comments and publish a Technical Report as soon as possible.

ORV BRUTON, P.E.
Power Section Study Coordinator

C.F. Ken Laumand HEDB

DA FORM 1 APR 86 751 REPLACES EDITION OF 1 FEB 80 WHICH WILL BE USED. *U.S.GPO:1984-0-765-045/1035

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 9 May 1983

SUBJECT OF CONVERSATION

St. Anthony Falls Hydropower -- Marketability

INCOMING CALL		
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION

OUTGOING CALL		
PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
Orval W. Bruton	NPDEN-WM-Power Section	FTS 423-3752
PERSON CALLED	ADDRESS	PHONE NUMBER AND EXTENSION
Truman Price	Director Division of Water and Power Resources, DOE	FTS 633-8336

SUMMARY OF CONVERSATION:

1. A call was placed to Mr. Price to discuss marketing of the new generation at the St. Anthony Falls project.

2. Mr. Price said that the Corps' generated power could be marketed to any of the 800 public entities in the region. There is an apparent need for this type of relatively low cost generation in the region. Informally, he gave assurance that the power can be marketed through the Department of Energy. Appropriately, a formal request for a marketability statement will be made by St. Paul District, Corps of Engineers.

Orval W. Bruton

ORVAL W. BRUTON, P.E.
Power Section NPD

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 58 WHICH WILL BE USED. ☆U.S.GPO:1981-0-705-045/1088

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 7 April 1983

SUBJECT OF CONVERSATION

Power Values St., Anthony Falls and Lock & Dam No. 1

INCOMING CALL		
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**

OUTGOING CALL		
PERSON CALLING Orv Bruton Dick Mittelstadt	OFFICE North Pacific Division - WM-PWR	PHONE NUMBER AND EXTENSION FTS 423-3752
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**
Dave Simon	FERC Chicago	FTS 353-6701

SUMMARY OF CONVERSATION:

1. A call was placed to Chicago FERC Office to clarify the value of energy alternative for the project. FERC letter of 11 March 1983 states that the escalated energy value should be 38.0 mills per KWh.

2. Earlier FERC supplied power values, at St. Paul District's request (Oct 1982 lttr.) These values had variable energy costs because at that time the hydro plant was assumed to have daily peaking. These power values are no longer valid because the new hydro plants will be assumed to operate without daily peaking capability -- strictly run-of-river.

3. For this study a constant escalated energy value of 38.0 mills per KWh will be used for the entire plant capacity range and for all alternative plant locations (Upper Falls, Lower Falls and combined). No other energy adjustment will be required.

Orv Bruton

ORV BRUTON, P.E.
Power Section

Dick Mittelstadt

RICHARD MITTELSTADT
Power Section

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 58 WHICH WILL BE USED. *U.S.GPO:1981-0-705-048/1688

TELEPHONE OR VERBAL CONVERSATION RECORD For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office	DATE 14 March 1983

SUBJECT OF CONVERSATION

St. Anthony Falls and L&D No. 1 Hydropower Studies; Power Values

	INCOMING CALL	
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**

	OUTGOING CALL	
PERSON CALLING Orv Bruton Sue Philp Dick Mittelstadt	OFFICE NPDEN-WM-PWR	PHONE NUMBER AND EXTENSION FTS 423-3752
PERSON CALLED Dave Simon	**ADDRESS** FERC - Chicago	**PHONE NUMBER AND EXTENSION**

SUMMARY OF CONVERSATION:

1. A call was placed to Mr. Simon of the Federal Energy Regulatory Office in Chicago. Mr. Siman's office had prepared the power values for St. Paul District. (28 Oct 82 and letters).

2. Because it was not possible to correlate between the power values received for St. Anthony Falls and L&D No. 1 (5.5 miles downstream), a request was made for the "unadjusted" values. The Chicago office of FERC included adjustments for hydrologic availability, based on flow data submitted to them by St. Paul District. The FERC procedures for computing the values do not use daily flows to compute the hydrologic availability. More appropriately, NPD should compute the adjustment independently, based on power-duration curves developed by the DURAPLOT program.

3. Mr. Simon stated that the following information was used in their original calculations:

   a. An unadjusted capacity value of $145.22/KW-yr., based on 7 7/8% interest. This value also includes a 5% hydro flexibility adjustment.

   b. Mechanical availability of steam plant (coal) was 80%.

   c. Mechanical availability of hydro plant 97.5%.

   d. July and August critical load months.

   e. FERC computed hydrologic availabilities were:

Plant Size	Availability
5 MW	78%
7.5 MW	77%
10 MW	77%
15 MW	66%
20 MW	55%

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 56 WHICH WILL BE USED. *U.S.GPO:1981-0-765-048/1088

4. NPD will compute new hydrologic availabilities and recompute new capacity values for the project.

ORV BRUTON, P.E.
Power Section

FEDERAL ENERGY REGULATORY COMMISSION
CHICAGO REGIONAL OFFICE
230 SOUTH DEARBORN STREET, ROOM 3130
CHICAGO, ILLINOIS 60604

March 11, 1983

Mr. Louis Kowalski
Chief, Planning Division
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Kowalski:

Your letter dated March 1, 1983 requests power values, developed at a 7.875 percent interest rate, for the combined Upper and Lower St. Anthony Falls sites.

Using the power, duration and weekly generation data furnished with your August 4, 1981 letter, a capacity value of $87.10 per kilowatt year and an energy value of 26.0 mills per kilowatt-hour has been calculated for the combined operation of these sites. The escalated energy value would be 38.0 mills per kilowatt-hour. All cost assumptions are the same as used in developing the individual Upper and Lower site values previously furnished with our October 28, 1982 letter.

If you have any questions regarding these power values, please contact Mr. David L. Simon of my staff at (FTS) 353-6701, and he will assist you.

Sincerely,

Lawrence F. Coffill

Lawrence F. Coffill, P.E.
Acting Regional Engineer

TELEPHONE OR VERBAL CONVERSATION RECORD For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.	DATE 14 December 1982
SUBJECT OF CONVERSATION Upper Mississippi Critical Load Months -- St. Anthony Falls and L & D No. #1 Projects	

INCOMING CALL		
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION

OUTGOING CALL		
PERSON CALLING Orv Bruton	OFFICE NPDEN-WM-PWR	PHONE NUMBER AND EXTENSION FTS 423-3752
PERSON CALLED Jim Kolak	ADDRESS FERC - Chicago Office	PHONE NUMBER AND EXTENSION FTS 353-6701

SUMMARY OF CONVERSATION:

1. A call was placed to the Chicago Federal Energy Regulatory Commission Office to discuss the critical load months for the subject projects.

2. The area power load, currently served chiefly by Northern States Power, has two periods of critical demand:

   a) Summer months July - August
   b) Winter months December - January

3. Mr. Kolak said that his office uses only the two summer months (July-August) for their critical peak load determination. While the winter months also represent high demand months, they are not as critical as the summer months.

4. For St. Anthony Falls and Lock & Dam No. #1 studies, the two summer months will be used to determine dependable capacity.

Orv Bruton, P.E.
Study Coordinator

DA FORM 1 APR 66 751 REPLACES EDITION OF 1 FEB 56 WHICH WILL BE USED. *U.S.GPO:1981-0-705-042/1088

FEDERAL ENERGY REGULATORY COMMISSION
CHICAGO REGIONAL OFFICE
230 SOUTH DEARBORN STREET, ROOM 3130
CHICAGO, ILLINOIS 60604

October 19, 1982

Mr. Louis Kowalski
Chief, Planning Division
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Kowalski:

Your September 17, 1982 letter requests updated power values for use in the feasibility study for addition of hydropower at Upper and Lower St. Anthony Falls Locks and Dam. Proposed development would consist of adding 5,000; 7,500; 10,000; 15,000 or 20,000 kilowatts to the 12,500 kilowatts already installed at the Upper Site, and 2,800, 5,600, 8,400 or 11,200 to the 8,000 kilowatts already installed at the Lower Site.

Power values, based on a coal-fueled steam-electric plant as the most likely alternative to each of the proposed hydroelectric developments, are summarized in the attached table. These are "at-market" values; no transmission line costs for the hydroelectric development have been included.

The energy value for the hydroelectric development is determined by the difference in total system operating cost between a system utilizing the proposed hydroelectric installation and one using an equivalent sized alternative steam-electric generating plant. Operating costs for the hydroelectric project and its equivalent alternative were simulated using a probabilistic production costing computer model. The POWRSYM Version 48 model was used for this analysis. Operation of the system was simulated over the period 1980-2010 based on projected load and energy requirements for the Northern States Power Company system.

Northern States Power Company was used as a "typical" system to measure the annual production cost differences between future operation with the added hydroelectric capacity and its equivalent alternative.

The capacity values given in the attached table are based on the annual fixed costs to install the alternative electric generating plant. A 5.0 percent credit has been given to the hydroelectric capacity to reflect its greater operating flexibility. In addition, the capacity value for the hydroelectric plant has been adjusted to reflect relative value based on its availability in comparison with the availability of the alternative steam plant. Accordingly,

the capacity value given is applicable to the installed capacity of the proposed hydroelectric plant and already incorporates the consideration of dependable capacity.

Energy values are also given in the attached table which recognize the real fuel cost increases associated with multi-year operation of the system. Real fuel cost escalation factors were taken from Department of Energy data published in the November 18, 1981 Federal Register. Discount rates, as specified in your letter, were used to levelize these costs over the 100-year period requested.

If you have any questions regarding these power values, please contact Mr. David Simon of my staff at (FTS) 353-6701 and he will assist you.

Sincerely,

for Lawrence F. Coffill, P.E.
Regional Engineer

Enclosure:
As stated

ST. ANTHONY FALLS LOCKS AND DAMS AT MINNEAPOLIS, MN ON THE MISSISSIPPI RIVER

Power Values at October 1, 1982 Cost Levels and 7-7/8 Percent Cost of Money:

New Capacity Added (MW)	Additional Generation (MWH)	Capacity Value $/KW-Yr.	Energy Value Current $/MWH	Energy Value Escalated $/MWH
Upper Site				
5.0	23,700	113.30	23.7	38.7
7.5	33,100	111.80	24.1	39.4
10.0	40,000	111.80	24.5	40.0
15.0	53,500	95.80	25.1	41.0
20.0	63,800	79.90	26.5	42.8
Lower Site				
2.8	9,600	116.20	24.5	40.0
5.6	16,500	88.60	25.9	42.3
8.4	21,400	58.10	27.3	44.6
11.2	25,300	50.10	29.2	47.7

TELEPHONE OR VERBAL CONVERSATION RECORD For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.		DATE 24 November 1982
SUBJECT OF CONVERSATION St. Anthony Falls Project and Lock & Dam No. #1 Project		
	INCOMING CALL	
PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	OFFICE	PHONE NUMBER AND EXTENSION
	OUTGOING CALL	
PERSON CALLING Orv Bruton	OFFICE NPDEN-WM-PWR	PHONE NUMBER AND EXTENSION FTS 423-3752
PERSON CALLED Carl Stephen	ADDRESS St. Paul District	PHONE NUMBER AND EXTENSION FTS 725-7472

SUMMARY OF CONVERSATION:

1. A call was placed to verify the use of the flashboards on the subject projects. Flashboards, two-feet high are used on the Upper Falls of St. Anthony project and on Lock and Dam 1 project. These flashboards are manually raised every year after the spring runoff and the flashboards go down as the river flow and ice flows increase in early spring. The flashboards automatically drop by shear-pin failure when the flow reaches a certain point (see regulation manual). In certain low flow years the flashboards do not go down at all -- while in other years (such as 1982) they go down as early as October.

2. For the hydropower studies at both projects assume the following:

Flashboards Up	1 July - 28 February
Flashboards Down	1 March - 30 June

3. Power Section will modify the Duraplot program to reflect the 2-foot increase in generating head for the months shown above.

Orv Bruton

ORV BURTON, P.E.
Study Coordinator

DA FORM 1 APR 86 751 REPLACES EDITION OF 1 FEB 80 WHICH WILL BE USED. *U.S.GPO:1981-0-705-042/1088

Northern States Power Company

414 Nicollet Mall
Minneapolis, Minnesota 55401
Telephone (612) 330-5500

November 8, 1982

Mr Orval W Bruton
Power Section, North Pacific Division
Corps of Engineers
P O Box 2870
Portland, Oregon 97208

Dear Mr Bruton:

ST ANTHONY FALLS HYDRO REDEVELOPMENT E-80DZ
Turbine-Generator Data

In answer to your request, we enclose copies of the performance curves for the turbine-generator at St Anthony Falls Hydro. There are two curves for Units #1 through #4, and one curve for Unit #5 at the Hennepin Island Hydro Plant, and one curve for the units at the Lower Dam Hydro Plant.

In addition, we are enclosing a copy of the report on an index test conducted in 1956 on both types of units operating at the Hennepin Island Hydro Plant.

If you have any questions or need further information, please call.

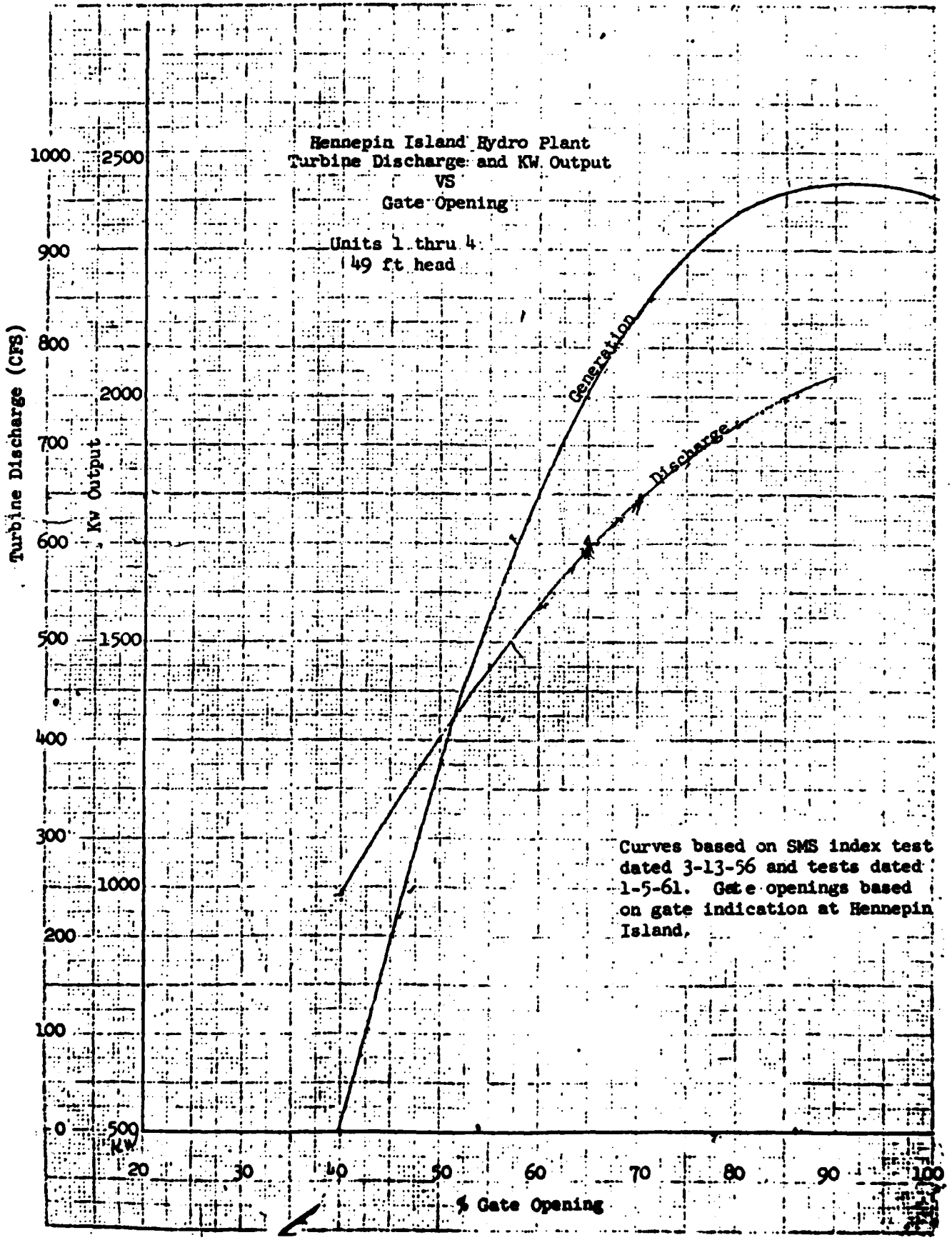
Sincerely,

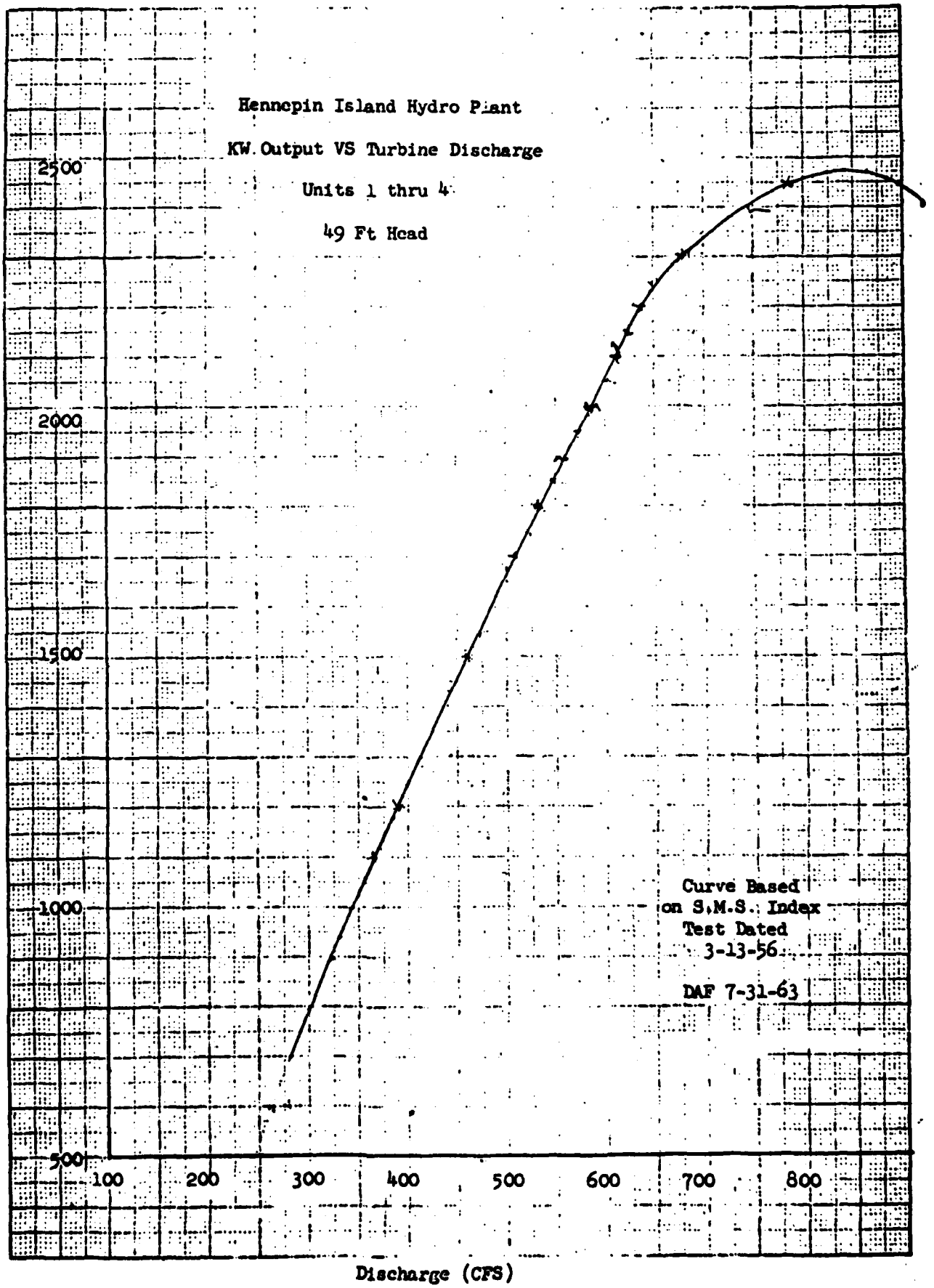
R L Hertzberg
Special Hydro Projects
(612) 330-5949

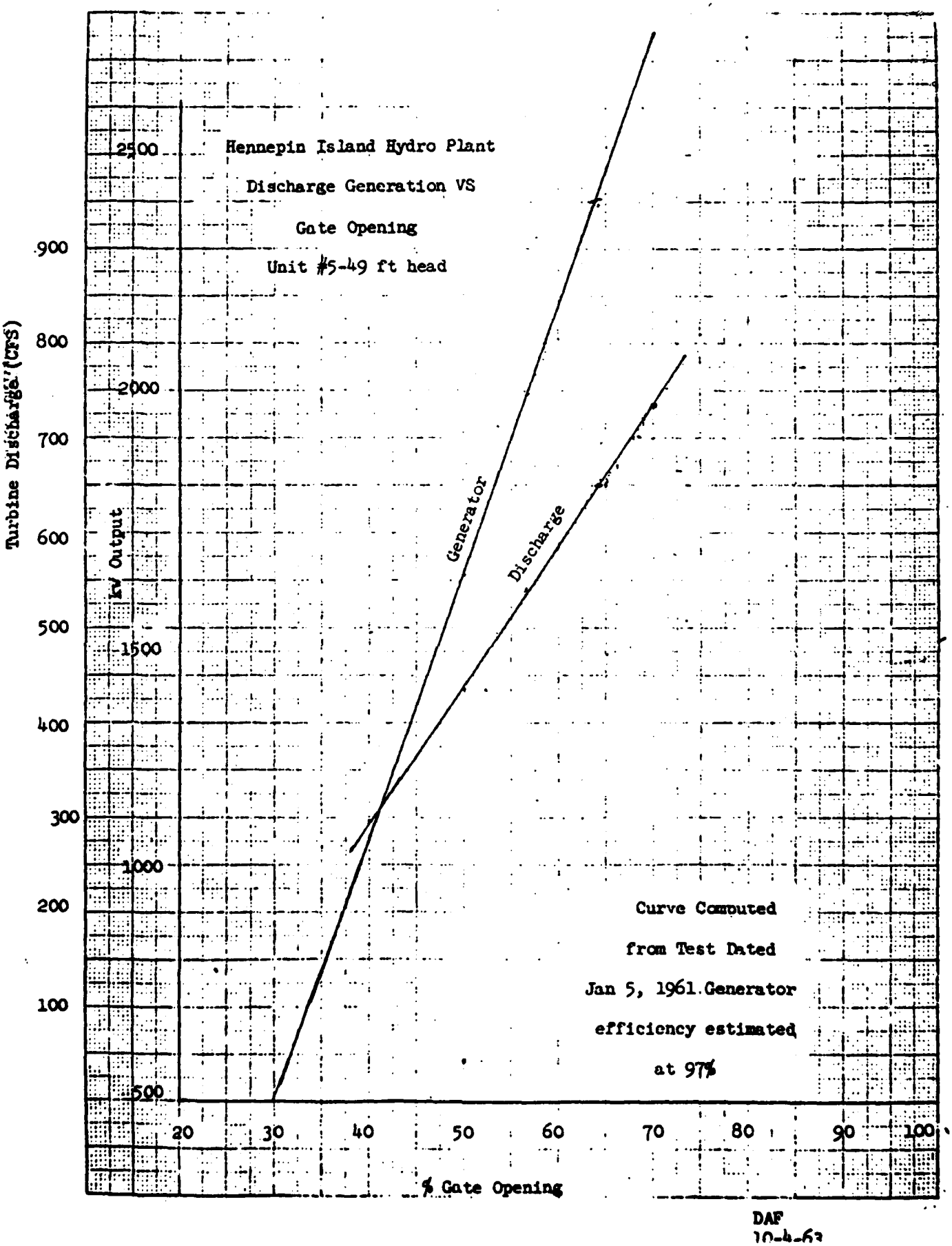
Encls.

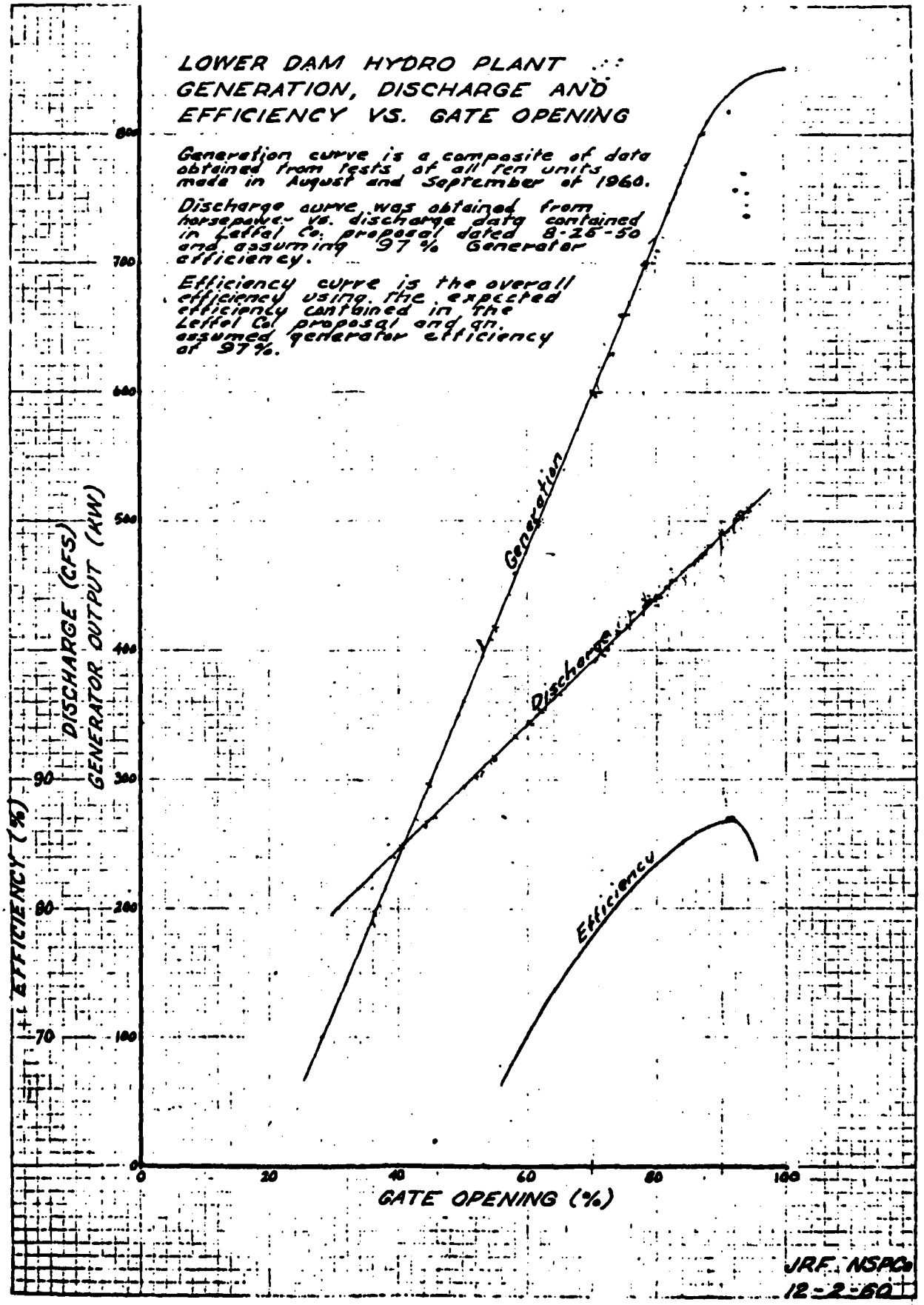
cc Carl Stephan, St Paul District
Corps of Engineers
1135 U S Post Office & Custom House
St Paul, MN 55101

S D Caskey
W E Lundquist


Hennepin Island Hydro Plant
Turbine Discharge and KW Output
VS
Gate Opening
Units 1 thru 4
49 ft head
Generation
Discharge
Turbine Discharge (CFS)
Kw Output
% Gate Opening
Curves based on SMS index test dated 3-13-56 and tests dated 1-5-61. Gate openings based on gate indication at Hennepin Island.
DAF
10-4-63


Hennepin Island Hydro Plant
KW Output VS Turbine Discharge
Units 1 thru 4
49 Ft Head
2500
2000
1500
1000
500
100
200
300
400
500
600
700
800
Curve Based on S.M.S. Index Test Dated 3-13-56.
DAF 7-31-63
Discharge (CFS)


Hennepin Island Hydro Plant
Discharge Generation VS
Gate Opening
Unit #5-49 ft head
Turbine Discharge (CFS)
KW Output
2500
2000
1500
1000
500
900
800
700
600
500
400
300
200
100
Generator
Discharge
Curve Computed
from Test Dated
Jan 5, 1961. Generator
efficiency estimated
at 97%
20
30
40
50
60
70
80
90
100
% Gate Opening
DAF
10-4-63


LOWER DAM HYDRO PLANT
GENERATION, DISCHARGE AND
EFFICIENCY VS. GATE OPENING
Generation curve is a composite of data obtained from tests of all ten units made in August and September of 1960.
Discharge curve was obtained from horsepower vs. discharge data contained in Leffel Co. proposal dated 8-26-50 and assuming 97% Generator efficiency.
Efficiency curve is the overall efficiency using the expected efficiency contained in the Leffel Co proposal and an assumed generator efficiency of 97%.
Generation
Discharge
Efficiency
EFFICIENCY (%)
DISCHARGE (CFS)
GENERATOR OUTPUT (KW)
GATE OPENING (%)
0
20
40
60
80
100
70
80
90
100
200
300
400
500
600
700
800
JRF. NSPCo
12-2-60

Mr. Stephan/ss/7472
17 September 1982

Mr. Lawrence L. Coffill
Regional Engineer, Chicago Regional Office
Federal Energy Regulatory Commission
230 South Dearborn Street
Chicago, Illinois 60605

Dear Mr. Coffill:

We are preparing a feasibility study for adding hydropower generation to the Upper and Lower St. Anthony Falls Locks and Dams. The St. Anthony Falls project is located on the Mississippi River in Minneapolis, Minnesota. We would like your office to provide us with power values that we can use to compute the benefits for the St. Anthony Falls project.

The information on power, net head, and flow duration curves; tabulated flow duration analysis; and weekly generation schedules previously furnished with our 4 August 1981 letter is still valid. Please refer to that information in deriving power values for both the upper and lower St. Anthony Falls sites. We would like to have power values for this project based on the cost of the most likely thermal alternative powerplant.

We are not able to provide the minimum levels of weekly generation requested by Mr. David Simon. This information is not readily available or easy to develop. Generally speaking, the lowest hourly generation value for each week would not be meaningful because of periodic activities such as lockages, machine breakdown, trashrack cleaning, etc., at the two St. Anthony Falls sites. The two sites are run of the river and have more flow than they can use most of the time.

The St. Anthony Falls project would operate in a run-of-river mode with added installed capacities of 8 to 18 megawatts and 3 to 10 megawatts at the upper and lower sites, respectively. The operating range of annual plant factors for the total combined upper site would be from 60 to 70 percent. At the total combined lower site, the annual plant factors would range from 50 to 65 percent. Items that should be considered in preparing the power values are real fuel cost escalation, a plant on-line date of 1990, a 100-year life of the project, and October 1982 price levels at a 7 7/8 percent Federal interest rate.

We would like to obtain the power values by 18 October 1982 to allow us to meet our expected study schedule. If you have any questions, please contact Carl Stephan of my staff at FTS 725-7472. We greatly appreciate your assistance in this study.

Sincerely,

LOUIS KOBALSKI
Chief, Planning Division

HEALE PD-R
KRUCHTEN PD-R
STEPHAN PD-P
HAUBENSAK PD-P
NORTHRUP PD__
KOWALSKI PD__

NPDEN-ED 3 September 1982

SUBJECT: St. Anthony Falls Lock and Dam Hydropower Study

U.S. Army Corps of Engineers
St. Paul District
ATTN: NCSPD-PF
1135 USPO and Custom House
St. Paul, MN 55101

Gentlemen:

Reference your letter dated 5 May 1982 to NPD.

This letter is to confirm previous telephone conversations between NCSPD and NPD personnel regarding the subject studies.

After a visit to the powerhouse sites and meetings with St. Paul District personnel, NPD proposed, and is proceeding with a technical report at the feasibility report level for adding hydropower.

Two scheme will be investigated, an upstream scheme located near the main dam producing approximately 10 MW of power at a head of 49 feet and a downstream scheme that would generate about 5 MW of power at 22 feet of head. Both predesigned and custom designed units will be considered in arriving at the most optional plant size.

optimum

It should be noted that both schemes represent additional hydropower development of their respective sites. Northern States Power (NSP) currently operates power plants at each location; therefore, any new generation would take on a "last added" benefit. This concept is similiar to the treatment done in the Troy Lock and Dam Hydropower Study produced for the New York District by NPD, copy inclosed. The level of detail will be as required for a feasibility report.

All costs for the powerhouse including the switchyard, but excluding excavation costs will be developed by NPD. All other costs, including excavation, will be done by St. Paul District. For NPD to optimize the plant size all costs need to be considered; therefore, close coordination will be required between our offices.

We have received funds from your office in the amount of $50,000 and believe this to be adequate. Our intent is to complete a rough draft of the report by mid-October. Funds remaining after completion of our work will be returned.

Sincerely,

1 Incl
as

STEVEN R. BROCKSCHEIK, P.E.
Acting Chief, Hydro-Electric Design Branch

Steve
ASC St. M.

STEPHAN/bq/7472

NCSPD-PF

17 August 1932

Mr. Daniel Ogden
Director
Office of Power Marketing Coordination
Resource Applications
Department of Energy
Washington, D.C. 20461

Dear Mr. Ogden:

Inclosed is a copy of our September 1981 Reconnaissance Report for hydropower, St. Anthony Falls Locks and Dams, Minneapolis, Minnesota. The Upper and Lower St. Anthony Falls sites are under the joint ownership of Northern States Power Company (NSP) and the Federal Government. The power company owns the powerhouse and dam, and the Federal Government owns the lock system at each site.

We are now engaged in a more detailed feasibility study of the two sites. Our North Pacific Division is providing technical assistance in turbine selection and evaluation because of a higher head differential (50 feet) at the Upper St. Anthony Falls site.

We would appreciate any assistance or guidance you can provide our office in the area of power marketing for the Upper and Lower St. Anthony Falls sites (especially since NSP, the current licensee, apparently would not qualify as a preference customer).

We have a copy of your January 1981 Draft Power Marketing Report for the Great Lakes Area, but we never received the final, which was scheduled for publication in April 1981. If they are available, please forward a copy to Mr. Carl Stephan, project manager, at the address shown above.

Sincerely,

1 Incl
As stated

LOUIS KOWALSKI
Chief, Planning Division

HENKE PD-RC
KRUCHTEN PD-RC
STEPHAN PD-PF
HAUTAMEN PD-RF
NORTHRUP PD
KOWALSKI PD

cc. Orum Barton NPD

NPDEN-WM 4 August 1982

MEMORANDUM FOR THE RECORDS:

SUBJECT: St. Anthony Falls Hydropower Study
St. Paul District

1. On 29-30 June Messers Glenn Meloy, Lou Mroczkiewiez, and Orv Bruton visited St. Paul District to discuss study and design procedures for the St. Anthony Falls hydropower study. A field inspection of the site was also made.

2. St. Anthony Falls is an existing hydro complex, located on the Mississippi River within the Minneapolis-St. Paul metro area dating back to the 1800's. The Corps owns and operates two locks (about 10 years old) within the site. Northern States Power (NSP) Company owns and operates two generating facilities, at the site, originally built about the Turn-of-the Century. There appears to be some additional hydropower potential that can be developed.

3. In 1981, St. Paul District published a reconnaissance level report on the hydropower potential. The report described some 10 optional sites and alternative plans for added hydro development. At this time there appears to be two possible schemes for development -- each scheme is independent of the other.

SCHEME	LOCATION	APPROX. HEAD	APPROX. SIZE
I	Upstream (near Main Dam)	49 feet	10 MW
II	Downstream (near Lower Lock)	22 feet	5 MW

It should be noted that both schemes represent additional hydropower development of their respective sites. NSP currently operates power plants at each location; therefore, any new generation would take on a "last added" benefit. The design concept would be similar to the Troy Lock and Dam hydropower study produced for New York District by NPD in 1981.

4. At the meeting it was agreed that NPD would study only the two describes schemes and prepare a technical report, (feasibility level) on the hydropower potential. The District will then prepare a final feasibility report. HEDB will prepare a letter to the District defining the project study scope of work and an estimate of our costs to prepare the report. A draft report to the district is scheduled for completion by 15 October 1982.

ORV BRUTON, P.E.
Power Section

CF: Ch, HEDB
Ken Laumand, HEDB

INTRA-ARMY ORDER FOR REIMBURSABLE SERVICES

For use of this form, see AR 37-108 and AR 37-110; the proponent agency is USAFAC.

1. RECEIVING OFFICE CONTROL NUMBER

☐ FUNDED ☐ AUTOMATIC

2. ORDER
a. NUMBER NCS-IA-82-86-PD-PF
b. DATE

3. CHANGE ORDER
a. NUMBER
b. DATE

ORDERED BY (Command, Installation or Activity), ADDRESS (Include zip code), AND AUTOVON NUMBER

St. Paul District, Corps of Engineers
ATTN: NCSDC-B/NCSPD-PF
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

TO BE PERFORMED BY (Command, Installation or Activity), ADDRESS (Include zip code), AND AUTOVON NUMBER

North Pacific Division, Corps of Engineers
ATTN: Orval Bruton
P.O. Box 2870
Portland, Oregon 97209

6. DESCRIPTION OF SERVICES TO BE PERFORMED

Provide engineering services and assistance to the St. Paul District in connection with a proposed feasibility study and eventual Definite Project Report (DPR) for the St. Anthony Falls, Minnesota, site. This sum is necessary to provide initial coordination, recommendations for future work, to include an inspection of the site, and a related meeting with St. Paul District personnel.

St. Paul District contact person: Mr. Carl Stephan (FTS 725-7472).

21 JUN 1982

0982-0034

ADDITIONAL INSTRUCTIONS: UPON ACCEPTANCE TWO COPIES WILL BE RETURNED TO ADDRESS LISTED IN ITEM ATTN: NCSDC-B. THE AMOUNT AUTHORIZED BY THIS ORDER MAY NOT BE EXCEEDED WITHOUT PRIOR APPROVAL OF THIS OFFICE. BILLING WILL BE ON SF 1080 MONTHLY, AND WILL CITE THE ORDER NUMBER [illegible] AS ABOVE INDICATING EITHER A PARTIAL OR FINAL BILLING. [illegible] ENG FORM BILLING WILL CONSTITUTE CERTIFICATION OF THIS ORDER [illegible] AUTOMATIC WITHDRAWAL OF ANY UNUSED BALANCE.

14082

7a. NAME AND TITLE OF ORDERING OFFICER	b. SIGNATURE	c. DATE
LOUIS KOWALSKI Chief, Planning Division		

ORIGINATING FINANCE AND ACCOUNTING OFFICE APPROVAL

8a. ACCOUNTING CLASSIFICATION	b. AMOUNT
96K 3121 G I AB208 03 2010 0SAF	$5,000

c. CHANGE

INCREASE AMOUNT _____ DECREASE AMOUNT _____ REVISED AMOUNT _____

9. Services to be performed pursuant to this order are properly chargeable to the appropriations or other accounts indicated above until 30 September 1982 (Day - Month - Year) the expiration date of this order.

10a. TYPED NAME AND TITLE OF APPROVING OFFICER	b. SIGNATURE	c. DATE
FRED W. VOGELE Finance & Accounting Officer	Fred W. Vogele	21 June 82

ACCEPTING OFFICER

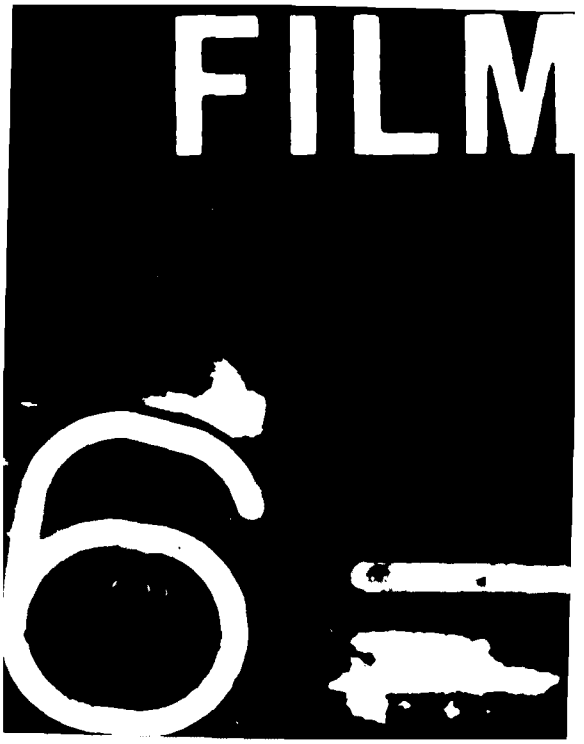
11. THE ABOVE TERMS AND CONDITIONS ARE SATISFACTORY AND ARE ACCEPTED.

a. TYPED NAME AND TITLE OF ACCEPTING OFFICER	b. SIGNATURE	c. DATE ACCEPTED

DA FORM 1 JUN 77 2544

EDITION OF 1 DEC 75 WILL BE USED UNTIL EXHAUSTED.

U.S. GPO: 1979-298/RRB


FILM