The original documents are located in Box 49, folder "President - Personal Family - Christie Bloomer (3)" of the Philip Buchen Files at the Gerald R. Ford Presidential Library.

Shirley:
Please get out
Christie Bloomer
file.
P

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:
OGC
Project No. 2680
Ludington Pumped
Storage Project

Phillip W. Buchen, Esquire
Counsel to the President
The White House
Washington, D.C. 20500

AUG 5 1975

Dear Mr. Buchen:

Enclosed are two copies of the Special Inspection Report resulting from an inspection of the Ludington Pumped Storage Project undertaken by members of the Federal Power Commission Staff during this past Fourth of July weekend.

It is hoped that you will find this report useful in any further correspondence you may wish to pursue with those persons interested in the Ludington Pumped Storage Project.

At her request, a copy of this report was sent to Mrs. Roland Mallory. Mr. and Mrs. Mallory own lake shore property approximately one-half mile north of the project. Mr. Mallory is President of Summit Pere-Marquette Property Owners Association.

As noted in the report, the joint licensees for this hydroelectric project, Consumers Power Company and Detroit Edison Company, have been requested to provide the Commission with additional information regarding the possible effect of vibrations incidental to the operation of this project. The Commission Staff will continue to inspect and monitor the Ludington project.

Thank you again for the opportunity to review this matter.

Sincerely,

Drexel D. Journey
General Counsel

Enclosure No. 010612
Special Inspection Report, Ludington
Pumped Storage Project No. 2680 (2 copies)

Form No. F.P.C.-18

ENCLOSURE No. 010612

FROM

FEDERAL POWER COMMISSION

U.S. GOVERNMENT PRINTING OFFICE 16—6487-2

FFC Form 510
(1-65)

(SPECIAL INSPECTION)

OPERATION REPORT

TO FEDERAL POWER COMMISSION

For the period July 3, 19 75 to July 5, 19 75

Supervising Agency Federal Power Commission

Office of Washington, D.C.

Licensee Consumers Power Co. & Detroit Edison Co Project No. 2680-Michigan

Name of plant Ludington Pumped Storage Project

Location Adjacent to Lake Michigan, Mason County, Michigan
(Waterway or reservation)

License issued July 30, 1969 (effective 7/1/69) for 50 (State) years.
(Date)

Inspected by H.W. Chan, R.F. Hagenlock, and S. J. Occhipinti Date July 3-5, 1975

Parts of project inspected Upper reservoir and Lake Michigan shoreline

Memorandum report (attach additional sheets if necessary):

See Attached Sheets.

The statements contained in this report are those of the writers and do not necessarily represent the views of the Commission.

Enclosures:
Set of 32 photographs

Submitted July 31, 19 75

S. J. Occhipinti, for

H. W. Chan/S. J Occhipinti
(Reporting officer)

(Replaces FPC Form 10 which may be used until supply is exhausted)

SPECIAL INSPECTION REPORT

Ludington Pumped Storage Project
L.P. No. 2680-Michigan

Staff members S. J. Occhipinti, Section of Inspections and R. F. Hagenlock, Office of the General Counsel, Washington, D.C., accompanied by H. W. Chan, Chicago Regional Office, visited the Ludington Pumped Storage Project for the purpose of inspecting the project during partial unwatering of the reservoir during the July Fourth week-end.

Thursday evening from 6:00 p.m. to 9:00 p.m., we met with Mr. and Mrs. Roland Mallory and Mrs. Bloomer, who are lakeshore property owners about ½-mile north of the Ludington hydroelectric plant. Mr. Mallory is President of Summit Pere-Marquette Property Owners Association. This meeting was requested by a telephone call from Mrs. Mallory to Mr. Stout, Chief, Division of Licensed Projects, to report property damage allegedly due to the existence and operation of the pumped storage project. The property owners were aware of reported leakage from the upper reservoir of approximately 9000 gpm and that such leakage had caused a rise of water table in the general area. According to the property owners, the leakage from the reservoir has resulted in increased springs or seepage along the bluff to add to its instability. We were informed that a cherry orchard located northeast of the reservoir has become partially water-logged and that the licensee is paying damages every year for the lost crop. Hopkins Lake, which is located about ½-mile east of the east dike of the reservoir has risen over 3 feet since the initial reservoir filling in 1972. The property owners were aware of the installation of pumped wells along the dike designed to control the water table. A statement was made regarding vibration from plant operation resulting in dishes rattling at residences located near the powerplant.

Subsequent to this inspection, C. W. Wilson, Chicago Regional Office, visited the Mallory residence at 11:00 p.m. on July 17 for the purpose of observing or detecting vibration during the pumping mode of the Ludington turbines. Mr. Wilson indicated he was unable to detect any significant vibration effects at the Mallory residence during the pumping phase. Extensive investigations to monitor vibration were conducted by the power company during construction and operation of the Ludington Project. We have requested Consumers Power Company to furnish pertinent data relative to these tests.

We inspected the bluff line near Mrs. Bloomer's property (Fig. 1-5). Mrs. Bloomer's house had been razed. The house had been located close to an unstable 200 foot high bluff. The house was torn down after she lost her court suit against the joint licensees, Consumers Power Company and the Detroit Edison Company. Mrs. Bloomer indicated that the bluff had eroded some 40 feet over the past 3½ years and she was advised that it would be dangerous to continue living in her house. We also inspected the Gift Shop structure, located on the Bloomer property near Lakeshore Drive (Fig. 5). It was constructed in 1971. The structure included a front porch, the front edge of which exhibited significant settlement. An inspection inside the shop revealed no cracking. Mrs. Bloomer reported that this settlement occurred during March, 1975. Also, we noted two small depressions in the front yard. Mrs. Bloomer believes that the problems were created as a result of underground seepage since construction of the project.

We also inspected the bluff immediately north of Mrs. Bloomer's property. The area covered included property owned by Mallory (next to Bloomer) and Hull (north of Mallory). The bluffs are unstable, 200 foot high steep slopes, probably 1 on 1 or steeper. There was evidence of recent slides. Springs and general seepage were observed toward the base of the bluff (Fig. 2). Mrs. Mallory indicated that several new springs had opened up within the past few years. A band of sandy colored water was noted along the bank at the base of the bluff, indicative of active bank cutting (Fig. 3). Also, in the distance, we noted contrasting colored water adjacent to the north training jetty in front of the power-house, which may have been due to sand deposition along the jetty.

We next visited Mrs. Emma Gerhard, who is located approximately 1½-miles south of the powerhouse adjoining the bluff line. Active significant headwater erosion of a ravine, located between the house and Lake Michigan, was noted as evidenced by large fallen trees and slides (Fig. 6-8). Mrs. Gerhard was of the opinion that damage had been aggravated by the spring estimated at 60 gpm, draining into a ravine below and leading to Lake Michigan. We noted a spring and runoff in the drainage course leading from the Ludington Dike. Rate of runoff has increased as a result of the steep dike slopes and road relocations resulting from project construction. It appears that Mrs. Gerhard has a legitimate complaint regarding surface erosion. The licensee is aware of this problem and has proposed to build several holding ponds in areas adjacent to her property designed to retain some of the excess water at times of heavy runoff.

From our discussions, it is apparent that the above property owners are sincerely concerned that construction and operation of the Ludington Pumped Storage Project has had adverse effects on their property. Although the complainants admitted that the bluff area has been receding over the years, they claimed that this erosion had been accelerated in recent years due to reservoir seepage and vibration from the operation of the Ludington powerplant. It appeared that they were not particularly concerned with money settlements, but rather that the licensee should take whatever remedial measures are necessary to alleviate the problems. From past contacts with the licensee, it is our understanding that there have been several complaints of erosion and seepage damage resulting from construction and operation of the project. Some of these problems have been satisfactorily resolved by the licensee with monetary settlements or additional earth work. Remaining unsettled problems are either under litigation or are being further studied by the licensee. There are currently 16 operating pumped wells installed by the licensee, which are designed to control the water table of the area. It is our understanding that the licensee has scheduled the installation of 23 additional pumped wells at an estimated cost of $1 million. The wells will be located at critical locations in controlling seepage and the water table.

Friday morning, July 4, we inspected the bluff by boat, a six mile stretch from the marina at Ludington, including the entire bluff line opposite the upper reservoir. We were accompanied by Mr. Charles Bilby, Project Manager and Mr. Richard Sequin, Plant Superintendent of Consumers Power Company. The lake level was at elevation 580; weather was sunny and warm. General widespread erosion was evident throughout the entire bluff line. The bank slopes were unstable, generally 1 on 1 or steeper. As we approached the project area the bluff height increased from about 40 feet to over 200 feet. As shown in the attached Figures 9-20, the entire Michigan shoreline consists of steep banks. The bluff ridge is in the process of retreat caused by a combination of seeps and springs with headward erosion of ravines, slump failure of the bluffs, wave erosion and longshore transport by the waters of Lake Michigan. Seepage appeared more noticeable for the higher bluff sections. Seepage, generally, was concentrated just above clay seams. There were widespread signs of active bank cutting and slides. There was no active cutting in those areas adjacent to the training jetties. This can be attributed to the stabilizing beach created by deposition of littoral drift along the jetties.

The existing bluff line is particularly vulnerable to wave action resulting from northwesterly winds. Maximum waves of up to 14 feet have been reported. During the boat survey, it was noted that the top of the beach slope at its intersection with the near vertical bluff generally coincided with the lake level. It is believed that the rate of bluff erosion is related to the lake elevation, as higher lake levels result in undercutting of banks by wave action. Seepage forces due to groundwater flows with headwater erosion of ravines contribute to a minor degree to the instability of the bluff slopes. The major cause, however, is believed to be due to wave action. Recorded levels for Lake Michigan show a gradual 5 foot rise over the past decade. During the summer of 1973 and 1974, the lake level was within 0.8 feet of the all time high for over 100 years of record and this may account for any increase in rate of bluff erosion during recent years.

The recession rate of the bluff line is being studied by the Michigan Department of Natural Resources. Based on aerial photograph records since 1938, the rate of bluff

recession, near the north end of the project, has averged about three feet per year.

In the afternoon of July 4, we visited the Ludington powerplant and reviewed the instrumentation data and photographs relating to the bluff area. Bluff seepage is being monitored at 20 locations, eight south and twelve north of the powerplant. Also, the licensee has on file aerial photographs of the bluff line in the vicinity of the Ludington site dating back to 1951. The photographs depict bluff retreat which is characteristic of many reaches along Lake Michigan. Although no actual seepage flow from the bluffs was measured prior to the reservoir filling, the total seepage flow at the twenty locations was estimated to be about 320 gpm prior to impoundment. Since the reservoir filling, the total seepage north of the powerplant has remained basically unchanged (200 gpm); while the total seepage south of the powerplant has increased from 120 gpm to about 275 gpm. It should be noted that the Bloomer and Mallory properties are located on the north bluff while Gerhard's property is on the south bluff.

The upper reservoir was partially unwatered to elevation 860, or 10 feet below the continuous clay berm, at 5:30 a.m. Friday, July 4. We observed the installation of the vacuum well point system, which was designed to control the formation of a new bulge which had developed in the asphalt lining behind the intake structure (Figs. 21-26). The installation consists of a line of 15 well points penetrating 17 feet below the surface of the lining into the calcareous sandfill. The line of well points is located 33 feet west of the west face of the intake structure toward the north edge. The wells are spaced on 10 foot centers. The purpose of the well point system is to relieve uplift pressure in the calcareous sand underlying the asphalt lining. The well point system includes a piezometer with on and off electrodes for a vacuum pump. Well point discharges are collected in a collector can adjacent to the intake structure, then discharged into the upper reservoir using a submersible pump. Some problems were experienced with sealing the joint between the well casing and the existing asphalt slope paving. The problem was resolved by the use of bentonite to seal the joint.

The inspection of the upper reservoir revealed a failure of the asphalt lining at sta. 268 + 45 near the ramp about 2500 feet south of the intake (Figs. 27-31). The failure was a near perfect 2½ foot diameter sink hole in the outer surface of the asphalt lining. Both the outer and inner layers (the entire sandwich) of asphalt were ruptured. The failure resembled a punching shear failure, which was cone shaped. The bottom asphalt layer was sheared through a smaller 18 inch diameter circle. The elevation of the break was about 5 feet above the elevation 870 berm. (We did not view the break as we arrived at the location during the repair. We did inspect a colored photograph of the failure.) An exploratory trench disclosed a void under the lower asphalt lining into the calcareous sand zone. The exploratory trench was about 10 feet long, normal to the dike axis. The limits of the exploration trench included the upslope end of the void. On the downslope side, the void extended beyond the end of the exploratory trench at least 12 feet. This was determined by probing. With the exception of the void area, the exposed surfaces of the trenched-out area were firm. It appeared that the failure was due to piping of the calcareous sand due to pumping action created by cyclic loading of the reservoir. Apparently the calcareous sand must have piped upward through fissures or cracks in the overlying clay blanket. A localized loss of support beneath the asphalt lining resulted in the indicated failure. Repair was made by pumping chemical grout in the void beneath the asphalt lining beyond the limits of the exploratory trench; 150 gallons of chemical grout was used to fill the cavity. Initial set-up time was 15 minutes. No pressure was used. Chemical grout was placed by gravity. It was followed with cement grout to completely fill the cavity. The trench was backfilled with compacted clay material. The asphalt lining, including the drain course, was replaced to complete the repair.

A small sink hole filled with a green dye solution was observed in the sloping clay blanket in line with the failure of the asphalt layer (Fig. 32). The sink was at elevation 865 or about 75 feet from the asphalt rupture. It was reported that the sink was discovered 2 months ago during an inspection following a brief unwatering period. Two bottles of green dye were introduced into the sink hole at that time.

During this unwatering period the dye was still intact, indicating no seepage into the sink. Also, supplemental dye tests indicate no communication between the sink and the void at the ruptured asphalt lining. The sink was backfilled with compacted alternating layers of bentonite and clay.

The inspection of the upper reservoir indicated no other failures above the drawdown level of elevation 860. A complete detailed report on the above failures and repairs is being prepared by Ebasco Engineers for the licensee. It will include photographs and drawings and will be made available for our files and record purposes in the near future.

CONCLUSIONS

It is concluded that the licensee is doing a creditable job in maintenance and surveillance of the project. The instrumentation system for monitoring performance is undoubtedly more elaborate than that at any other comparable reservoir. The erratic foundation conditions and reservoir leakage have resulted in high maintenance costs. The licensee is devoting many man-hours annually to observations and analyses of data. Problems have arisen with property owners due to high water table and erosion. Some of these problems have been resolved by the licensee by paying damages for the water-logged land. Remaining unsettled problems are either under litigation or are being studied further by the licensee. The licensee is in the process of attempting to solve some of these problems by constructing additional pumped wells designed to lower the water table and by constructing ponding areas to retain and control runoff.

The Commission's staff has been reviewing performance observation data on this project since start of construction. We have kept abreast of problems associated with leakage and rising water tables. We concur with the remedial measures being undertaken by the licensee, namely, the addition of pumped wells and the construction of ponding areas. We will continue to inspect and monitor this project very carefully.

It is our view that the licensee is adequately checking project performance, and making modifications or additions, as necessary, in a systematic scheduled manner, based on

current analyses of observed data. We have no recommendations for additional work by the licensee at this time. We will, however, urge the licensee to continue its efforts to resolve problems of damages with landowners as expeditiously as possible.

Enclosures:
32 photographs

Occhipinti, S.J./Chan, H.W.:cdh
7/31/75

July 3, 1975

SPECIAL INSPECTION REPORT
Ludington Pumped Storage Project
L. P. No. 2680-Michigan

Attachments

Fig. 1 - Bluff slopes behind Mallory's property.

Fig. 2 - Same location as Figure 1 - looking down.

Ludington Pumped Storage Project
L.P. No. 2680 - Michigan

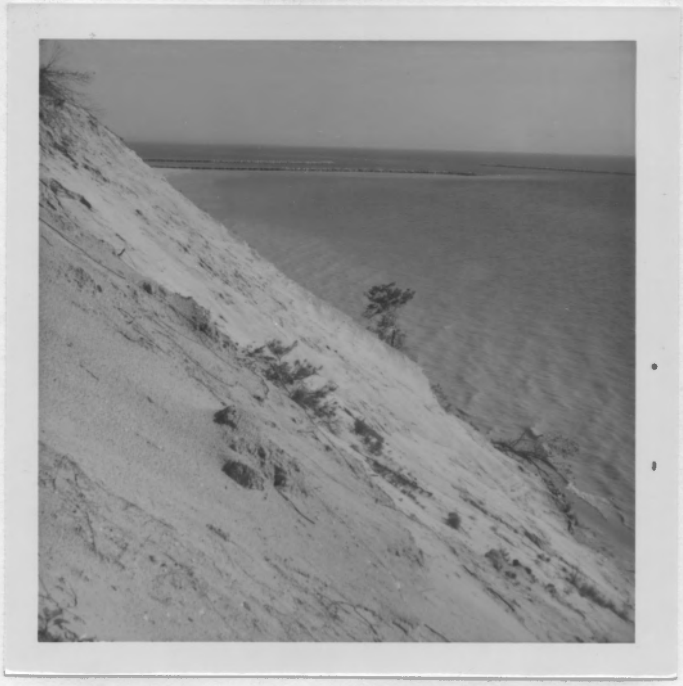

Fig. 3 - Bluff slope at Mallory's property. Photo depicts sandy nature of slope.

Fig. 4 - Drainage ditch behind Mallory's residence.

Fig. 5 - Abandoned gift shop owned by Mrs. Bloomer on west side of Lake Shore Drive about ½-mile north of Ludington Project. Owner claimed building foundation shifted by vibration from pumping operation of turbines or underseepage.

Fig. 6 - Drainage ditch in back of Gerhard house.

Fig. 7 - Ravine in bluff area of Gerhard property.

Fig. 8 - Another view of same ravine.

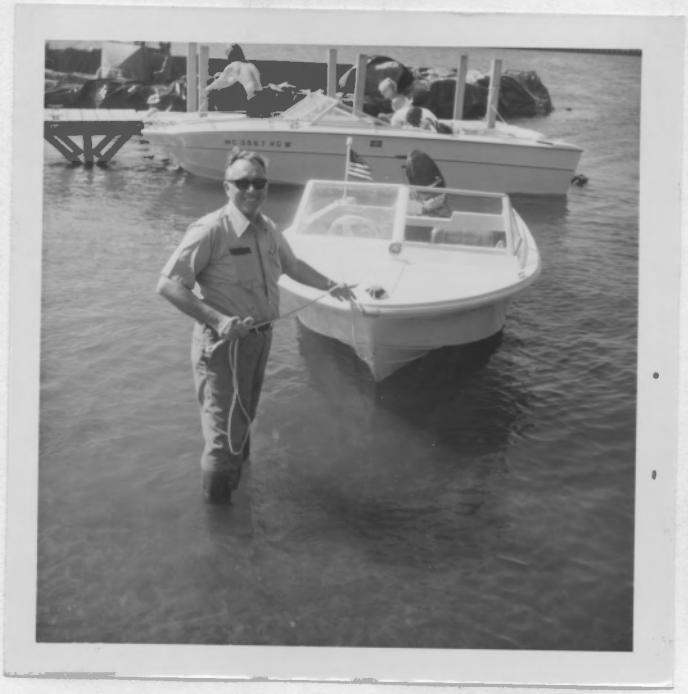

Fig. 9 - S. J. Occhipinti launching boat at Ludington Harbor, 4 miles north of Ludington Project.

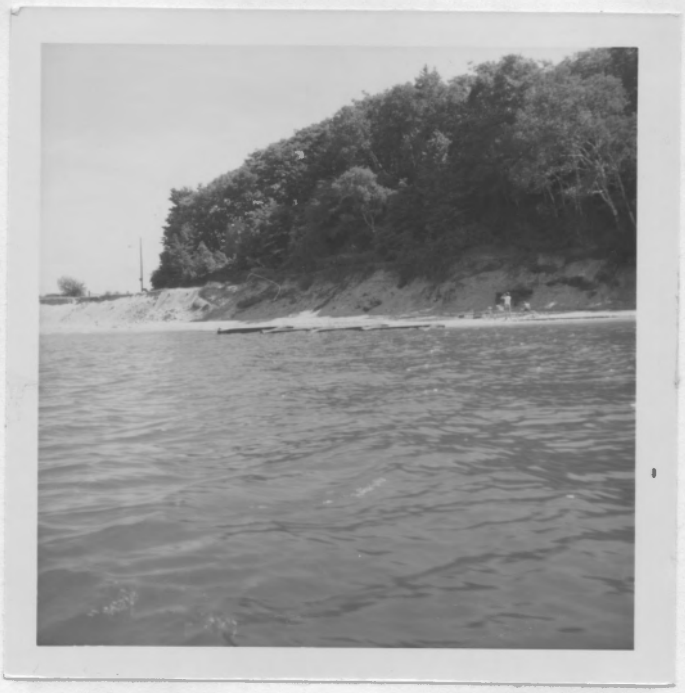

Fig. 10 - Bluff area 3½ miles north of Ludington Project

Fig. 11 - Bluff ridge about 3 miles north of Project. Ridge attains higher elevation with steeper slope as it approaches Ludington Project.

Fig. 12 - Typical slope about 2½ miles north of Ludington Project.

Fig. 13 - About 2 miles north of project.

Fig. 14 - Photo depicts instability of slope. About 2 miles north of Project. Fallen trees on narrow beach at lake level.

Fig. 15 - Photo depicts typical slope failure. Notice fallen trees in Lake.

Fig. 16 - Mallory's property.

Fig. 17 - Mallory's and Bloomer's properties. About ½-mile north of Ludington Project.

Fig. 18 - Ludington Project as viewed from boat.

Ludington Pumped Storage Project
L.P. No. 2680-Michigan

Fig. 19 - Typical bluff south of Ludington Project.

Fig. 20 - Gerhamd's property about ¼-mile south of Ludington Project.

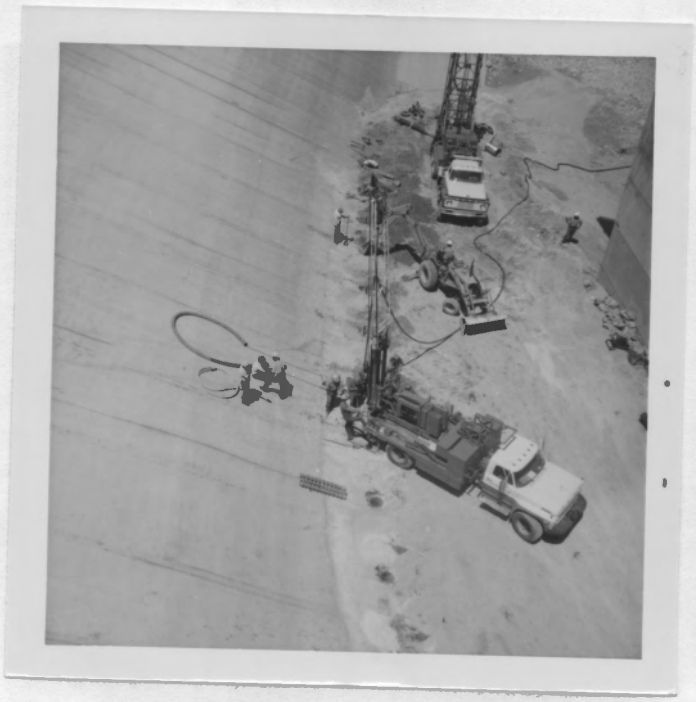

Fig. 21 - Rig drilling holes for installation of well points.

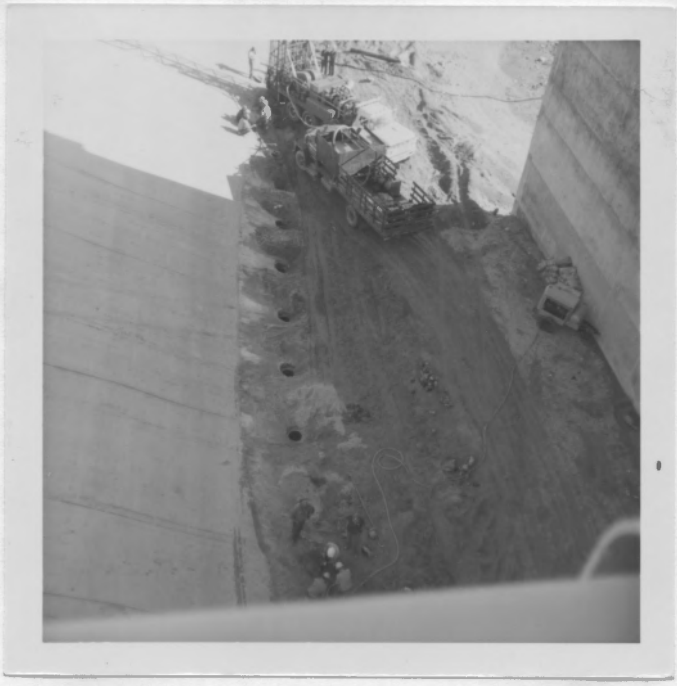

Fig. 22 - Photo depicts well point placement behind intake structure. Photo taken from top of intake.

Ludington Pumped Storage Project
L.P. No. 2680-Michigan

Fig. 23 - Same as Figure 22; one photo taken from ground level.

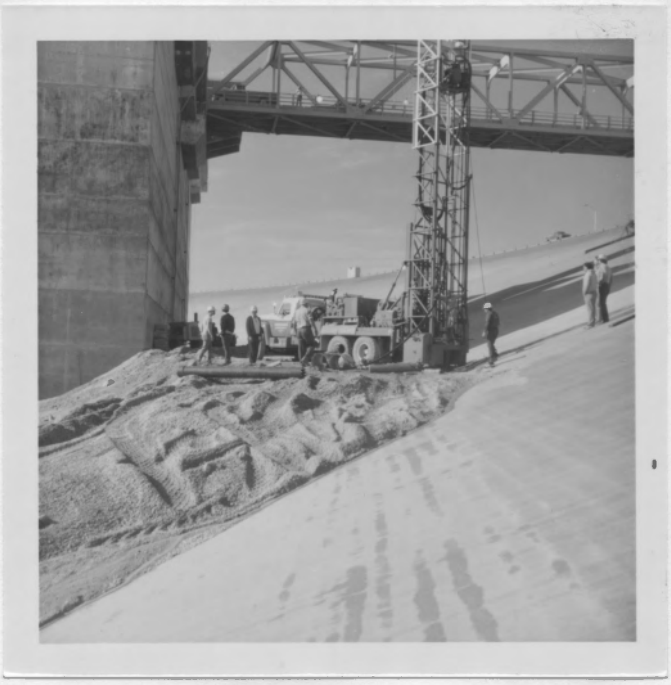

Fig. 24 - Close-up view of drilling in operation.

Ludington Pumped Storage Project
L.P. No. 2680-Michigan

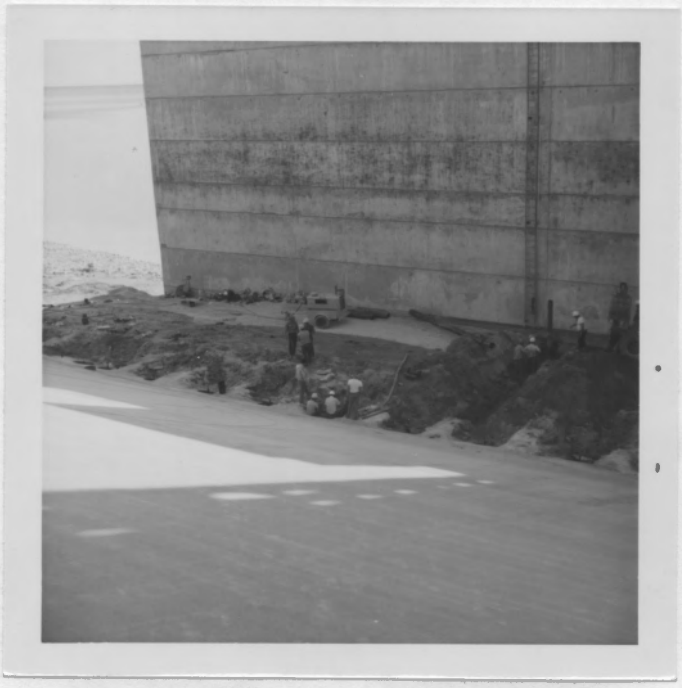

Fig. 25 - General view of well point placements taken from top of intake structure.

Fig. 26 - Close-up view of 18-inch casing at surface level of well point. Hot mastic material used to cap and seal opening.

Ludington Pumped Storage Project
L.P. No. 2680-Michigan

Fig. 27 - Workmen compacting backfill material in trenched-out area of lining failure (sta. 268 + 45).

Fig. 28 - Same as Figure 27, but looking upward toward embankment slope.

Ludington Pumped Storage Project
L/P No. 2680-Michigan

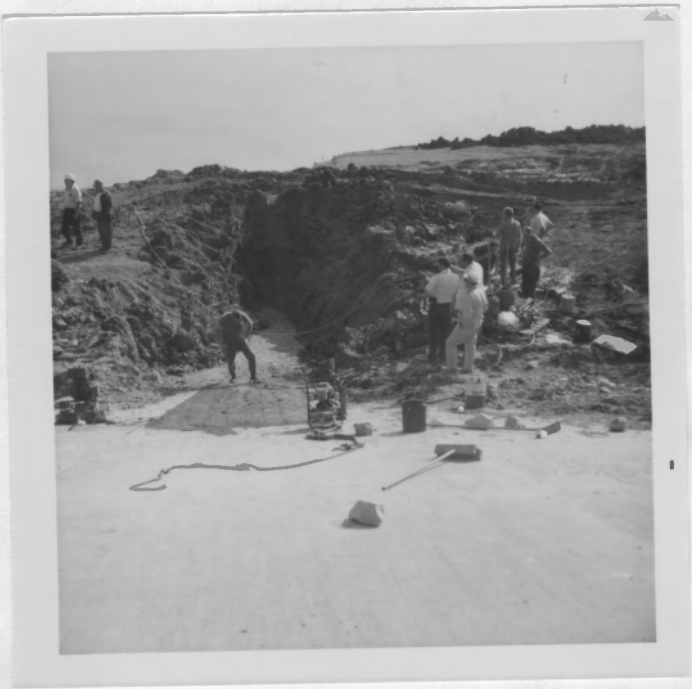

Fig. 29 - Same as Figure 28, but looking downward toward reservoir.

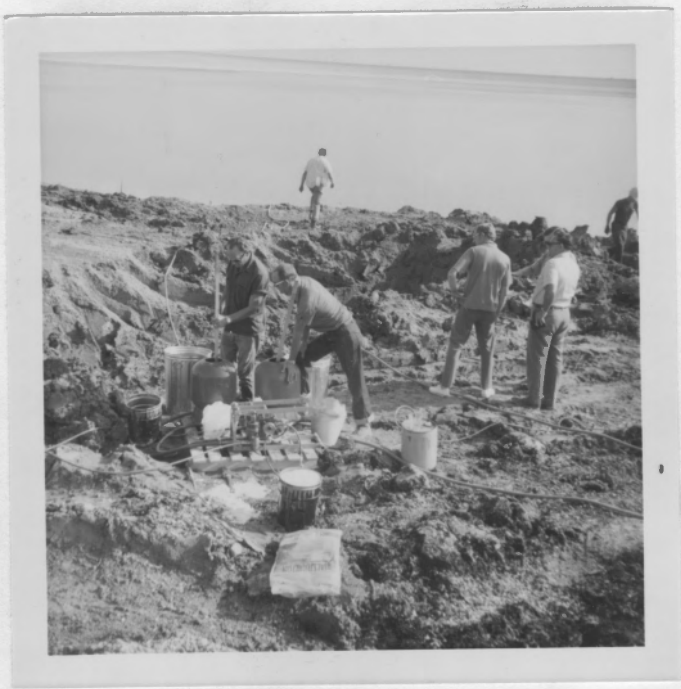

Fig. 30 - Mixing of chemical grout to fill void.

Ludington Pumped Storage Project
L/P No. 2680-Michigan

Fig. 31 - General view showing location of sink hole and area of lining failure. Photo taken from embankment crest.

Fig. 32 - Sink hole in slope at clay berm. Green dye placed in hole about 2 months ago.

Ford - Personal
Betty Ford
Bloomer, Christie

THE WHITE HOUSE

WASHINGTON

August 12, 1975

Dear Miss McKee:

At the time of your last visit here starting July 30, I had no additional information concerning the Ludington Pumped Storage Hydro-electric Plant. However, I have now received a copy of an inspection report prepared by three staff members of the Federal Power Commission and I enclose a copy for your information.

Apparently, the Commission supplied Mr. & Mrs. Roland Mallory with another copy.

Sincerely,

Philip Buchen

Philip W. Buchen
Counsel to the President

Miss Edith M. McKee, C.P.G.
Consulting Geologist
416 Maple Street
Winnetka, Illinois 60093

Enclosure

cc: Mrs. Christie Bloomer

August 21, 1975

Dear Mrs. Bloomer:

In follow-up of our telephone conversation of Tuesday, August 19, enclosed is a copy of the Federal Power Commission's report on the Ludington Pumped Storage Project.

Best wishes.

Sincerely,

Shirley A. Key
Office of Philip Buchen

Mrs. Robert Bloomer
Daybreak Cottage
8794 Glendale
Onekama, Michigan 49675

Enclosure

Philip W Buchen, Esquire
Counsel to the President

Bloomer
Christie

Stephen H. Howell
Vice President

COPY

Consumers Power Company

General Offices: 212 West Michigan Avenue, Jackson, Michigan 49201 • Area Code 517 788-0550

August 29, 1975

The Honorable John M. Murphy, Chairman
Subcommittee on Oceanography
Committee on Merchant Marine and Fisheries
2187 Rayburn Office Building
Washington, DC 20515

LUDINGTON PUMPED STORAGE PROJECT -
STATEMENT OF MS EDITH M. McKEE PRESENTED ON
JUNE 11, 1975, IN THE BEHALF OF THE AMERICAN
INSTITUTE OF PROFESSIONAL GEOLOGISTS

It has been brought to our attention that the subject statement by Ms McKee included certain misleading and erroneous statements concerning the Ludington Pumped Storage Project on Lake Michigan. We ask that you include in the subcommittee record these remarks which will correct the record on these matters.

Ms McKee has consistently attacked the Pumped Storage Project (a joint project of Consumers Power Company and The Detroit Edison Company). We are not aware of any studies or field investigations made by her, beyond casual observation of the area and a cursory review of the material made available to her by us. We hope by the following statements to successfully refute those remarks of Ms McKee now entered on your record.

When she appeared before you, Ms McKee made reference to the "unconsolidated glacial deposits" underlying the Ludington Pumped Storage Project's reservoir. In fact, the glacial sediments on which the reservoir was built are extremely consolidated, having borne the weight of several hundred feet of ice during the Wisconsin Age glaciers. Extensive subsurface exploration and laboratory work attest to this fact. One of the world's most emminent soils engineers, Dr. Arthur Casagrande of Harvard University, has been a consultant on this Project since 1962. We enclose Dr. Casagrande's letter of December 3, 1962, to the Fargo Engineering Company, in which he describes the soils as capable of supporting loads of six tons per square foot--or twice the water load--with minimal settlements and describes further loading tests on the soil up to four times the water load with no distress to the soil. Dr. Casagrande also describes tests on the material in his laboratory which indicate that the material has been preconsolidated by glacial ice loads of up to 21 tons per square foot--seven times the load imposed by the water in the reservoir. Ms McKee's statement that the soils are unconsolidated is incorrect.

Ms McKee also made reference during her presentation before the subcommittee to "high velocity discharge currents" at the Project. The offshore protection works which were built out into Lake Michigan were designed to limit the velocities of water being drawn into the Plant or discharged from the Plant to rates that would not be a danger to small boats and at the same time would not carry sand and would not be harmful to fish. These facilities were modeled at a small scale in the hydraulic laboratory at the University of Michigan and extensively tested to develop a design to hold velocities down to an average of 1-1/2 feet per second. A copy of that two-volume report is enclosed. Extensive field measurements of the actual prototype velocities were made by representatives of Michigan State University in 1974. Copies of their field notes are enclosed. These measurements show that there are no consistent eddies exceeding 46 centimeters per second (1-1/2 feet per second) and that the design configuration has been successful in that there are no high velocity discharge currents which would cause shore erosion as claimed by Ms McKee.

Ms McKee also alluded to seepage from the reservoir. Seepage from the reservoir has admittedly been somewhat higher than expected. We have conducted seepage tests on the reservoir on several occasions. Figure 1, Steady State Seepage Rate Curve, is enclosed. This curve shows the decline in seepage rate to date. All water seeping from the reservoir falls downward to the groundwater table or to perched water tables which form over clay deposits of varying size. In anticipation of this phenomenon we have installed 310 observation wells around the reservoir and monitor them twice a month. We have also installed 28 pumping wells over the period of operation since 1973 and are installing another 23 pumping wells in 1975. These pumping wells control the rise in the groundwater aquifers to reasonable levels and this capability has been demonstrated. In 1973 we engaged McClelland Engineering Company of St Louis, Missouri, as independent groundwater experts, to review our program and to recommend additional groundwater control measures they deem necessary. That firm is closely associated in these programs on a continuing basis. Our continuing program of monitoring the wells and recording the findings is reported each month. A complete copy of the report is sent to the Michigan Department of Natural Resources with a summary copy being sent to the Federal Power Commission. Enclosed is a copy of pertinent parts of our Instrumentation Manual. Also enclosed are prints of the following drawings which show the history of the groundwater levels since the Project began operation and the controlling effect of pumping wells on groundwater levels.

Instrumentation Drawing Number	Title
100	Groundwater Related Measurement Features
201	Water Level Measurements - Upper Penstock Area
301	Water Level Measurements - Sta. 200 to Sta. 290
401	Water Level Measurements - Sta. 100 to Sta. 200
501	Water Level Measurements - Sta. 2 to Sta. 100
601	Water Level Measurements - South Bluff Area
701	Water Level Measurements - North Bluff Area
801	Water Flow Measurements

(NOTE: Drawings 901, 1001, 1101, and 1201 showing the instrumentation measurements such as settlements and movements of the civil structures of the plant are included.)

Considering the control we have maintained and continue to maintain on the groundwater levels in the vicinity of the Project it is unrealistic to describe the groundwater situation as "drastic," as does Ms McKee.

During the exceptionally rainy spring of 1974, lowlying parts of three orchards nearby the reservoir were damaged by high groundwater. The damages were so slight that the orchard owners were reimbursed for the trees lost as being more economical than determining the extent of the liability of the owner companies by a subsurface investigation. These were the only instances of orchards being "drowned" (per Ms McKee) and no other claims are being made by property owners on the basis of high groundwater.

Two lawsuits have been brought against Consumers Power Company and The Detroit Edison Company for damages caused by bluff recession along Lake Michigan shores. The first has been tried, the jury determining that the plaintiff had no cause of action. The second, not yet ready for trial, is based on contentions similar to those made by the first plaintiff. Five other property owners have voiced the same claim but have not brought suit. Consequently, Ms McKee's reference to accelerated damages to private properties is out of order and not supported by the facts. (Ms McKee was the only technical witness for the plaintiff in the first case mentioned above.)

Ms McKee stated in her presentation that no environmental impact statement respecting the Project was required. It is true that at the time the Federal Power Commission granted a license for the construction of the Pumped Storage Project no environmental impact statement, as such, was required because the National Environmental Policy Act had not been enacted. However, the comprehensive use of resources licensing test of Section 10(a) of the Federal Power Act was applied by the Commission. Moreover, environmental studies have been conducted at the site since before construction began. The following list of reports or studies relating to the Ludington Pumped Storage Project attest to the interest shown in the environment by the owner companies.

Recreational Potential, Ebasco Services, July 1967
Recreational Facilities Plan, Ebasco Services, January 1968
Report to Federal Power Commission on Environmental Quality Control, July 1970
A Study of the Effects of Installing and Operating a Large Pumped Storage Project on the Shores of Lake Michigan Near Ludington, Michigan, including
(a) Multiple Regression Analysis of Yellow Perch Yields Near the Ludington Pumped Storage Project, 1974
(b) Limnological Studies, 1974
(c) Benthic Macroinvertebrate Studies, 1974
(d) Age, Growth and Good Habits of the Round Whitefish, 1973
Report on Fish Tagging Experiments Pursuant to Fish Mortality Tests During Plant Operation, Milo C. Bell, June 1972
An Evaluation of the Influence of the Pumped Storage Power Project at Ludington on the Fish and Wildlife Resources of the Area, Bardoch and Todd, January 1968
Report on Rubble Mound Fish Barriers at Intakes, Milo C. Bell

Lastly, Ms McKee made reference to "early geological reports which seem to have been ignored." Her reference is presumably to a report prepared in 1969 by Professor William R. Farrand of the University of Michigan. This report formed the basis for extensive subsurface explorations (over 1200 soil borings) and observations during construction, all of which substantially verified the suppositions made by Farrand based on his considerable knowledge of the geologic history of the region. The general agreement between Farrand's predictions and the actual findings do not support Ms McKee's comment that the report was ignored. It is apparent that Ms McKee's comment was in regard to certain assumptions that Dr. Farrand found it necessary to make at the time. However, Ms McKee has ignored Farrand's own warning to treat the assumptions with caution. A copy of Farrand's report is enclosed. The value of the report can be discovered only by comparing it with the results of later findings.

In general, Ms McKee's statements would give the impression that deficiencies in the planning for the Pumped Storage Project existed. Such is not the case. A thorough painstaking examination of the Project, its engineering feasibility and economic feasibility was begun in 1959 and culminated in successful completion of the Project in 1973. Engineering and scientific talents of the following, among others, were employed.

Design - Ebasco Engineering Company

Consultants
- Arthur Casagrande, Soils Consultant, Harvard University
- Stanley Wilson of Shannon & Wilson, Seattle, Soils Consultants
- George Bertram, formerly Head of Soils Engineering, Office of the Chief, Corps of Engineers
- E. F. Brater, Professor, University of Michigan
- Lawrence C. Neale, Alden Research Laboratory
- William R. Farrand, Professor, University of Michigan
- Harry Cedergreen, Groundwater Hydrology, Sacremento, Calif.
- R. R. Gray, Geology of Brine Wells, General Analytics, Monroeville, Pennsylvania
- J. R. Benson, Asphalt Lining
- Herbert D. Vogle, Washington, DC
- Leonard McClelland, Denver, Colorado
- S. C. Hollister, Ithaca, New York
- Charles E. Mansur, St Louis, Missouri

Engineers - All principal engineers of the owner companies assigned to this Project were Professional Engineers registered with the State of Michigan.

CC: Federal Power Commission, Washington, DC
Federal Power Commission, Chicago, Illinois
Members of Oceanography Subcommittee
American Institute of Professional Geologists
Honorable Guy VanderJagt
Drexel D. Journey, General Council, Federal Power Commission

THE WHITE HOUSE

WASHINGTON

September 28, 1975

Bloomer, Robt. (Christie)

Dear Mrs. Bloomer:

Your letter expressing sorrow and disappointment does trouble me and I am sorry that your efforts and those of Miss McKee and your neighbors have so far been futile.

You mention the possibility of going to the Attorney General, but I do not think he can be of particular assistance in this matter. More effective probably would be to have Miss McKee pursue her efforts with the appropriate Congressional Committees, and, of course, it will help to have the situation publicized through the news media.

I would like to be of further help if I can and if I get any further thoughts in that regard, I shall proceed.

Sincerely,

Phil Buchen

Philip W. Buchen
Counsel to the President

Mrs. Robert Bloomer
8794 Glendale
Onekama, Michigan 49675

9-23-75

Mr. Philip Buchen
Counsel to the President
The White House
Washington, D. C. 20025

Dear Mr. Buchen:

Thank you for your effort in my behalf. Much to my sorrow and disappointment, it was all in vain.

I guess the article in the July '75 Reader's Digest about regulatory agencies is all too true. As an American, I was so reluctant to believe it but surely, I do now. The American "system" could be basically so fine except for the people involved.

The FPC report was a mendacious fiasco. Not only did the FPC report belie the situation incredibly but they recently replied to another irate group of citizens that there <u>never</u> was a problem connected with the Ludington Hydro Plant! Consumer's Power would never be spending a million dollars to put in new pumping wells to try to correct their problem if it weren't absolutely necessary. (Incidentally, one of the workmen putting in the wells told one of my neighbors that this would no way take care of the problem.) Nor would C.P. have paid off some of the owners of damaged property. Nor would they have offered a ridiculously low and unrealistic price to two other property owners of lake front property were they not responsible for the damage.

Of course, I realized as soon as I talked the the FPC men that FPC would not incriminate themselves by declaring C. P. at fault after they licensed them to operate. One example---An FPC man sat in a private home, next to my former home, watching the cups in a china cabinet MOVE when only ONE of the six generating units was turned on. We all know cups and other things in a house do not move unless the ground under it is moving or vibrating. I asked him, "What happens to the man who inspected this plant during construction and operation and then okayed it?" His reply, "I hate to think because he is a good friend of mine." His report was "NO SIGNIFICANT VIBRATION." HM-M*M*M*M*!

No, the report came as no surprise. I also asked him if FPC employed a geologist and he said no they were looking for one. It is very apparent that they need one. The State DNR geologists were in full agreement with my geologists at a meeting she had with them a few weeks ago. The article re "our sinking land" in the Sept. Readers Digest also sheds some light on the problems.

And so, the big "rip off" goes on. The rape of the land goes on and where does it all end? In a tragedy that could have been prevented? And there seems to be no one in this country who can or will stop it. Incredible!!!!!

I guess a visit to the Attorney General, news media and an investigative reporter is my next move. Not for "consolation" but for ACTION.

The letter you received from Mr. Stephan Howell, VP with C.P. is so incredibly false that I do wonder how these people with the C.P. can face God every night, with this on their conscience, if indeed there is a conscience.

I'm sorry, really, to have troubled you, it was all so futile. But I do sincerely thank you, anyway.

Sincerely,

Christie

Christie Bloomer
(Mrs. Robert Bloomer

8794 Glendale
Onekama, Mich. 49675

AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS

GENERAL HEADQUARTERS

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Denver, Colorado 80202

November 11, 1975

The Honorable John M. Murphy, Chairman
Subcommittee on Oceanography
Committee on Merchant Marine and Fisheries
2187 Rayburn Office Building
Washington, DC 20515

Dear Congressman Murphy:

We have received a copy of Stephen H. Howell's letter of August 29, 1975 to you alleging that remarks made by Edith M. McKee June 11, 1975 in behalf of the American Institute of Professional Geologists (AIPG) before the Subcommittee on Oceanography are incorrect. Mr. Howell is Vice President of Consumers Power Company and has supported his allegation with extensive documentation.

We have now had the chance to compile supporting data for the statement made by Miss McKee and we submit them herewith. Miss McKee's memorandum to me dated October 11, 1975 painstakingly responds to each of Mr. Howell's allegations. Of particular significance is her conclusion on page 26:

> "...this lengthy discussion of problems associated with the Ludington Pumped Storage Project will demonstrate the urgent need to incorporate geologists and geological thinking into Coastal Zone Management Programs. The objective of my June 11, 1975 testimony before the House Subcommittee on Oceanography was to bring to the attention of the Congressmen the basic role geology plays in any coastal or offshore development and use program.

"We appreciate Mr. Howell's letter concerning that testimony. Without it, the geological evidence concerning the Ludington Pumped Storage Project

would never have been presented to the legislators in such detail, nor would the geological vs engineering points of view have been so clearly demonstrated.

"It is essential that geologists work with engineers, planners, shippers, environmentalists and all others planning for the Coastal Zones."

Should you wish further clarification of the points made by Miss McKee in her testimony to you, please do not hesitate to ask.

Sincerely,

Arthur O. Spaulding

Arthur O. Spaulding
President

AOS/hk

CC: Federal Power Commission, Washington, DC
Federal Power Commission, Chicago, Illinois
Honorable Charles A. Mosher
American Institute of Professional Geologists
Honorable Guy VanderJagt
Drexel D. Journey, General Council, Federal Power Commission
Philip W. Buchen, Counsel to the President

E. M. McKEE, A. I. P. G.

CONSULTING GEOLOGIST

416 MAPLE STREET. WINNETKA. ILLINOIS 60093
TELEPHONE: AREA CODE 312 - 446-6231

11 October 1975

To : Arthur O. Spaulding, President - American Institute of Professional Geologists

From : Edith M. McKee, AIPG #737

Subject: Consumers Power Company's objection to the June 11, 1975 testimony given in Washington, D.C. before the House Committee on Merchant Marine and Fisheries, Subcommittee on Oceanography

When I accepted the responsibility of testifying on June 11, 1975 on behalf of AIPG before the Committee on Merchant Marine and Fisheries, Subcommittee on Oceanography of the U.S. House of Representatives, several documents were furnished me to indicate areas where the Congressmen wished to hear technical opinion. These included:

1. STATEMENT OF THE HONOURABLE JOHN M. MURPHY ON FEB. 27,1975 WHEN INTRODUCING THE COASTAL ZONE ENVIRONMENT ACT OF 1975:

   "..... We know new power plants and new or expanded refineries are needed to provide the Nation with the energy it needs. At the same time, these facilities mean permanent commitment of land, the danger of pollution, and perhaps upsetting the social and economic fabric of rural communities...."

2. H.R. 3981 A BILL TO AMEND THE COASTAL ZONE MANAGEMENT ACT OF 1972 TO AUTHORIZE AND ASSIST THE COASTAL STATES TO STUDY, PLAN FOR, MANAGE, AND CONTROL THE IMPACT OF ENERGY RESOURCE DEVELOPMENT AND PRODUCTION WHICH AFFECTS THE COASTAL ZONE, AND FOR OTHER PURPOSES. INTRODUCED BY THE HON. JOHN M. MURPHY FEB. 27, 1975.

3. OPENING STATEMENT OF THE HON. JOHN M. MURPHY CHM. OF THE SUBCOMMITTEE ON OCEANOGRAPHY OF THE HOUSE MERCHANT MARINE AND FISHERIES COMMITTEE AT THE HEARINGS ON AMENDMENTS TO THE COASTAL ZONE MANAGEMENT ACT APRIL 29, 1975:

   "..... There are other matters relating to the Coastal Zone Management Act which require the Committee's attention. For example, should more be done to promote interstate coordination of Coastal Zone Management Programs (paticularly as they relate to energy); is there a need for quick turn-around reasearch on coastal zone matters;....

   .... The Coastal Zone Management Act must be amended to include a stronger emphasis on an energy facility planning and siting process to be incorporated in state coastal zone management programs....

   .... And we need to develop greater coastal zone capacities at the federal as well as at the state levels...."

4. LETTER FROM THE HON. JOHN M. MURPHY TO MR. RUSSELL E. TRAIN ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY DATED MAY 10,1975 AND DETAILING ITEMS TO BE DISCUSSED AT THE JUNE 11,1975 HEARINGS:

> "..... Under discussion at this hearing will be s series of legislative proposals introduced into the 94th Congress on amendments to the Coastal Zone Management Act of 1972. The Coastal Zone Management Act has assumed greater importance as a result of the energy crisis and the calls for accelerated development of the Outer Continental Shelf for its oil and gas. Coupled with this is the pressure to intensify energy siting generally which impinges on the coastal zone areas.
>
> There are a number of Members of Congress who believe that after a year of experience in implementing the CZMA, coupled with the emerging issues facing this nation's coastal resources, the CZMA should be modified

All of these documents recognize the urgent need to expanded field data and research on coastal zone matters, particularly as they relate to energy exploration and power plant siting. This is an area where the geologists can and should make basic and constructive contributions to development of optimum Coastal Zone Management Programs. In my testimony, I tried to provide field examples of problems now existing because of inadequate geological investigations, as well as examples of how increased geological investigations and advisement can expand and enhance Coastal Zone Management Programs.

The Great Lakes comprise the United States fourth coastal zone. The state of Michigan is second only to Alaska in miles of coast line. What has been the environmental impact of siting various types of energy facilities on the Michigan shore zone is certainly germane to Congressional considerations concerning the Coastal Zone Management Act of 1972, and Amendments to that Act. Included in the energy facilities on the Great Lakes are fossil fuel plants, nuclear plants and the world's largest pumped storage hydroelectric plant. Each of these plants has developed its own environmental impact on the coastal zone depending upon the site geology and how well or poorly the geology and natural systems were used when the facility was designed and is operated. Evidence gained from study of these plants should certainly be available to the Congressmen when they are deliberating about Amendments to the Coastal Zone Management Act. It is my understanding that I was asked to testify on June 11th to provide the Congressmen with this type of geological evidence.

It is unfortunate that the World's Largest Pumped Storage Hydroelectric Project at Ludington, Michigan on the shore of Lake Michigan provides such public evidence of environmental problems. The items mentioned in my testimony concerning the project are evident from newspaper reports; they are especially evident to a geologist long familiar with the local and regional surface, subsurface and offshore geology and geological systems associated with the Michigan Basin and the Lake Michigan basin. In both 1969 and 1970 I reported to the American Institute of Professional Geologists Committee on Geological

Hazards the potential hazards of the Ludington Project. My concern about ground instability and induced abnormal currents in the lake related to the proposed operation of the plant pre-dated by 5 years my being contacted by Mrs. Bloomer to give a professional opinion re her property. The remarks made during my testimony were independent of the specific problems related to Mrs. Bloomer's case, and reflected opinions of several geologists who are familiar with the area.

In his letter of Sept. 2, 1975 Mr. Stephen H. Howell, a Vice President of the Consumers Power Company, has vigorously objected to statements made as part of my June 11th testimony on behalf of AIPG before the House Subcommittee on Oceanography concerning Coastal Zone Management and including power plant siting. Because Mr. Howell does not like to hear reports of environmental problems associated with the Ludington Pumped Storage Project, this does not mean that (1) they haven't occurred, (2) they haven't been documented, (3) they haven't become public knowledge, (4) they were not anticipated by several scientists, or (5) that they were not proper items for inclusion in Congressional testimony. It would indeed have been odd and a delinquency if the geological aspects of the world's largest pumped storage plant had not been reported by a geologist speaking on behalf of geologists.

Mr. Howell made a valid statement that I acted as an expert witness for Mrs. Robert Bloomer, the first landowner to bring suit against the company. On July 27, 1973 (5 years after I first reported expected environmental trouble at Ludington to the AIPG Hazards Committee) I was asked for an opinion as to the causes of slumpage on her property located between the pumped storage reservoir and the lake; this was a 1 day conference job. A year later in August 1974 I was asked to represent her as an expert witness at the trial which was held in March 1975. Preparation for this trialentailed considerable field work as well as a study of documents obtained from Consumers Power through legal procedures. With the end of the trial in March 1975, my contract with Mrs. Bloomer was completed. Since March, I have again been acting as an observer and concerned individual geologist where the Ludington Pumped Storage Project is concerned, not in the pay of any individual or group.

Information gained from study of the company documents was not necessary to support my generalized statements to the Congressional Subcommittee. Mr. Howell has introduced some of the company records via his letter of Sept. 2nd, so I now feel free in quoting company sources in answering his charges. Mrs. Bloomer's lawyer tells me that any information secured from Consumers Power Company for the trial can be used here and quoted publicly. Some of the EXHIBITS included with this discussion are from the company, and some are from other sources.

THE FOLLOWING DISCUSSION COVERS POINT BY POINT

MR. HOWELL'S OBJECTIONS

I. Mr. Howell: "....We are not aware of any studies or field observations made by her (Ms. McKee) beyond casual observations of the area and a cursory review of the material made available to her by us...."

Miss McKee: Mr. Howell and his associates choose to be unaware of the geological work I have done in Lake Michigan, under Lake Michigan, in the Lake Michigan coastal zone, and specifically in the Ludington area. Apparently they have not taken the trouble to read the depositions taken for the Bloomer trial, nor have they reviewed the evidence presented during the trial.

Also ignored are the many public discussions and presentations of the geological exploration work I've done locally between 1967 and the present. My work in the Lake Michigan basin and coastal zone areas has been reported at technical meetings, in the newspapers, on radio and TV, at public meetings, and specifically in the depositions taken by Consumers lawyer for the Bloomer trial in March 1975 and as part of the testimony during the trial.

My work related to Lake Michigan and Ludington can be described as general studies and local studies:

A. GENERAL STUDIES by E.M. McKee 1943-Present
   1. On shore reconnaisance of landforms and geomorphology of Michigan, Wisconsin, Illinois and Indiana.
   2. Developed paleogeomorphic series of maps showing the development of the Great Lakes Region over some 600,000,000 years (pre-Cambrian - Present). EXHIBIT IA
   3. Bedrock and subsurface stratigraphy and structures around Lake Michigan.
   4. Detailed mapping of the bottom terrain and associated geology of Lake Michigan basin.
      a. This project was done in cooperation with Dr. Hough of the Univ. of Michigan and supported in part by grants from NSF and USGS.
      b. Data included in the study were:
         (1) Study by McKee of 30 years collection of lake bottom sediment cores and bedrock dredged samples.
         (2) Study by McKee of unpublished Lake Michigan data sheets from the US Lake Survey. Contoured data.
         (3) Study by McKee of additional thousands of miles of fathometer surveys run by Hough.
         (4) Study by McKee of lake bottom pictures obtained from underwater photography and observations from the STAR II Research Submarine.

(5) 1,000 miles bathymetric survey of Mid-Lake High McKee chief-of-party.
(6) Study by McKee of 200 oil well logs from Michigan (including Ludington area) to select logs for constructing subsurface cross-sections
(7) Study by McKee of water well records in Wisconsin to incorporate into subsurface cross-sections.
(8) Study of bedrock geology map of Michigan (Mich. Geol. Survey)
(9) Study by McKee of glacial drift map of Michigan (Mich. Geol. Survey).
(10) Study by McKee of various reports from Mich. Geol. Survey and Mich, Basin Geol. Society.

c. Results of this study are:
(1) Compilation and drawing by McKee of first detailed, 3-dimensional, scale-controlled map of the bottom terrain of Lake Michigan. EXHIBIT I-B.
This serves as a valuable base map for studying currents throughout the entire lake, to map fish migrations, and to ennable precise search-and-retrieval efforts in the lake.
(2) Compilation and drawing by McKee of first detailed, 3-dimensional, scale-controlled map of the Mid-Lake High; this ridge separates the north basin of the lake from the south basin and concerns circulation patterns in the lake and fish migrations. EXHIBIT I-C.
(3) Compilation and drawing first bedrock and subsurface cross-sections beneath Lake Michigan. EXHIBIT I-D.
(4) Compilation and drawing of first bedrock map beneath Lake Michigan. EXHIBIT I-E.
This map shows offshore extensions of onshore bedrock geology, and includes the Ludington area.

5. Similar detailed bottom terrain maps with associated geology and currents of Lake Superior, by McKee. Included 1,000 miles of bathymetric survey in Lake Superior.
6. Detailed nearshore and shore erosion studies and current studies by McKee involving another 1500 miles fathometer surveys 1970-Present.
a. St. Joseph, Michigan - Gary, Indiana.
b. Onshore reconnaisance entirely around Lake Michigan including Ludington area.
c. Local studies for clients in Illinois and Michigan including shore erosion and bluff instability. These involved offshore fathometer surveys, nearshore current surveys (bottom to surface), shore and bluff stratigraphy and groundwater, and recognition of causes for erosion-deposition features.
d. In all cases, excessive erosion of shores and dunes or bluffs has resulted from construction of some structure or from mis-use of the land mass itself. Where only the high water levels have existed with normal longshore currents operating, there has not been evidence of excessive rates of erosion 1967-Present. This is true on the Michigan side of Lake Michigan where the till has a very high sand content, as well as on the Illinois shore where the till has a high clay content.

B. LOCAL STUDIES by E.M. McKee of LUDINGTON AREA AND PUMPED STORAGE PROJECT

1. Site reconnaisance
   a. Observation of surface landforms for 10 miles north, south and east of Pumped Storage Project.
   b. Observation of shallow subsurface stratigraphy as shown in:
      road cuts
      along banks and in quarry along Pere Marouette River south of Scottville
      face of bluffs along lake
      pictures of the bluff in the area of the powerhouse site taken during construction
      shallow auger test samples on Bloomer property
      along eroded gorge on Gebhard property
   c. Observation on 10 occasions of surface currents and sediment drift related to discharge from the reservoir
      (1) Turbulence over the discharge area easily seen
      (2) Rapid surface current flow seen between jetties, and between jetties and breakwater
      (3) Strong current flow to north (against normal and long term established lake currents) and south seen by outward bulge of "boat barrier" floats between jetties and breakwater
      (4) Surface textures of water showing gyre to north as discharge water shears along mass of Lake Michigan water, and then swings north and east against the shore.

   d. 1973-1975 made at least a dozen visits to individual properties that were, and are, experiencing accelerating erosional problems. These site visits included the climbing up and down of lake bluffs, inspection of zones of seepage and springs, climbing down the Gebhard Gorge from top of bluff to lake level, the inspection of progressive development of ground subsidence near bluffs and away from the bluffs near the road, inspection of vibration patterns on pools at bottom of erosion sinks which were protected from winds and without heavy wave impact.

2. Subsurface studies done for Bloomer trial
   a. Studied 261 oil well logs going into bedrock from wells located in Mason County.
   b. Studied 131 water well logs, some going to bedrock, from water wells in Mason County.
   c. Studied 1,000 boring records from within the reservoir area. None going deeper than the upper till layers; none going to bedrock.
   d. No electric log or neutron logs available, or even run apparently, to determine water bearing formations.

e. Correlated well records with Bedrock Map of Michigan and Glacial Drift Map of Michigan prepared by the Michigan Geological Survey.
f. Correlated bedrock and glacial drift onshore maps with Bedrock Map of Lake Michigan prepared by E.M. McKee in 1968.
g. Contoured at 1 foot interval Lake Survey Chart #77 Point Betsie to Little Sable Point showing bottom terrain influencing open lake and longshore normal currents. This study also indicated offshore extensions of remaining glacial drift and the bedrock.

3. Planned offshore studies for Bloomer trial which could not be done because:
   (1) extremely windy season Sept.-Dec. 1974 made offshore work impossible since we need a flat calm to work close to the shore and get accurate data.
   (2) Consumers Power objected to delay of the trial until the offshore work could be done
   (3) In January 1975 Judge Wickens ruled that the offshore terrain and currents data was not so important as to cause him to delay the trial. It was held in Ludington in March 1975.

   Planned studies:
   a. Fathometer survey nearshore covering beach to depths of 50 feet, and running from 2 miles north of the Ludington harbor to 5 miles south of the Pumped Storage Project.
   b. Current meter studies along the same stretch of coast, and including readings at bottom-mid depth-surface at all stations.
   c. Display of fathometer data as contour maps drawn at a 1 foot interval to show scour-deposition landforms and sand bars.
   d. Correlate current data with bottom terrain and shore erosion-deposition patterns.

   These studies would have shown how each stretch of the coastal zone was reacting to structures such as jetties and breakwaters, was being affected by natural and induced currents, and then remedial actions could have been programmed.

II. Mr. Howell: ".... Ms McKee made reference to the "unconsolidated glacial deposits underlying the Ludington Pumped Storage Project reservoir. In fact, the glacial sediments on which the reservoir was built are extremely consolidated, having borne the weight of several hundred feet of ice during the Wisconsin Age glaciers..... Ms McKee's statement that the soils are unconsolidated is incorrect."

Miss McKee: Mr. Howell is unfamiliar with the difference in the geologist's use of the word "unconsolidated" and the engineer's use of the word. On June 11th I spoke as a geologist, on behalf of geologists, and used the word "unconsolidated" in the sense given in the GLOSSARY OF GEOLOGY published by the American Geological Institute:

> " UNCONSOLIDATED MATERIALS
> A. Sediments loosely arranged or unstratified, or where particles are not cemented together, occurring either at the surface or at depth.
>
> B. Soil material that is in a loosely aggregated form."

This definition certainly describes the uncemented sands, sandy clays, gravels and clays which form the glacial outwash and till layers on which the Ludington Pumped Storage Project is built.

A further explanation of the different meanings given to the terms compaction and consolidation is given in the reprint of GEOLOGIC SETTINGS OF SUBSIDENCE by Alice S. Allen, reprinted from Reviews in Engineering Geology II and published by the Geological Society of America. It is offered with this report as EXHIBIT II (this quote is labled II-A):

> "Among geologists, the term compaction connotes "Decrease in volume of sediments, as a result of compressive stress, usually resulting from continued deposition above them, but also from drying and other causes".... For essentially the same concept, the term consolidation is used by soil engineers; they (engineers) reserve the term compaction for the "process by which the soil paricles are artificially rearranged and packed into a closer state of contact by mechanical means...." ....Rolling, tamping, or vibration provide artificial compacting mechanisms...."

This report uses the geologic definition of the term compaction. Under natural geologic conditions, the rate of compaction decreases rapidly with length of time after burial of sediments. Subsidence due to natural compaction, therefore, is most likely to become appreciable in areas where recent sediments have accumulated rapidly. Subsidence is more commonly found where the rate of compaction has been artificially accelerated by man's engineering activities that involve loading, drainage, vibration, hydro-compaction, and the pumping of fluids from subsurface formations.

Consumers Power has been extremely proud of the number and types of massive compacting machines developed and used in preparing the reservoir area.

In the Ludington area, wherever the slopes are unconfined as along the lake bluffs, the high percentage of sand in the sediments makes them very weak and unstable when subjected to abnormal stresses. According to Dr. William R. Farrand who did the 1969 and 1970 Geological Report and Rate of Recession of the Lake Michigan Bluff Along the Ludington Pumped Storage Project and furnished by Mr. Howell to the recipients of his Sept. 2nd letter,

> "The highland south of Ludington and north of Bass Lake is an upland morainic tract of glacial drift underlain by a succession of till layers and sandy, gravelly outwash. Till is a direct subglacial deposit ....Glacial outwash includes all kinds of waterlaid sediments deposited by meltwater streams issuing from a glacial front.....and moraines are ridges of glacial drift formed parallel to glacier margins. Festoons of the morainic ridges loop across the Southern Peninsula of Michigan, and the Ludington project site is located upon one such morainic ridge that formed some 11,000 to 13,000 years ago....."

Contrary to Mr. Howlett's understanding, the long time weight of tons of glacial ice did not "consolidate" geologically the upper 200-300 feet of sediments at the Ludington project site. The glacial outwash was not even laid down under the ice. Today the release of pressures and groundwater at the bluff face, and the daily loading and offloading of up to 17½ billion gallons (or 93,106,250 tons) of water from the reservoir tends to loosen the bluff sediments quite independtly of the piping related to excessive groundwater flow.

It is recognized that Dr. Casagrande is an emminent soils engineer, and that various loading tests were performed in his laboratory. It is apparent from various company references that the materials tested by Dr. Casagrande were obtained from bore holes drilled within the reservoir area, and at a distance from the unconfined lake bluffs. The results do not reflect true load strengths closer to the bluffs. Quoting from the July 1969 Geological Report by W.R. Farrand, we learn that:

> "....In some places Till D appears to occur in two distinct layers and the uppermost of these has been labelled D' in some sections.... The occurrence of a small but significant amount of clay in a unit that would otherwise be called a "red sandy outwash" is sufficient evidence for calling it a "till". In addition this till appears to have a rather high degree of (geol.) compaction as witnessed by the relatively great number of blows per foot needed

to drive a split spoon sampler through in contrast to the low penetration resistance of the underlying sands...."

Leary and Swan of the University of Wisconsin have discussed Earthwork Quality Control for Ludington Pumped Storage Reservoir portions of their report being included with this report as EXHIBIT III. They discuss earthwork density and compaction on pgs. 267-272:

"... Density tests are required to meet criteria concerning depth, distance from unconfined slopes, and soil conditions....

Because of the surficial effects of (eng.) compactor vibrations and sheepsfeet and the additional densification resulting from the compaction of overlying drifts, density increases with depth below the compactor working surface. Therefore, tests made too near the surface give low and unrepresentative results....

Because of lack of confinement, densities are lower near unconfined slopes (lake bluffs) of a zone and increase with distance from the unconfined slope (as in the reservoir area)....

If the excavated soil is nonhomogeneous, i.e., it consists of sand and clay lumps or pockets or lenses of sand of different gradation, the test (for strength and density) is abandoned...."

Heavy truck traffic along the road near the lake, before special access roads were built inland, has contributed to bluff problems. Special comoaction equipment used in the reservoir area included a number of 13-wheeled rollers and 5 ton pneumatic rollers (max. gross weight 100,000 pounds) in addition to such standard equipment as sheepsfoot rollers.

III.A. Mr. Howell: "Ms McKee also made reference....to "high velocity discharge currents" at the project. The offshore protection works which were built out into Lake Michigan were designed to limit the velocities of water being drawn into the Plant or discharged from the Plant to rates that would not be a danger to small boats and at the same time would not be harmful to fish...."

Miss McKee: Mr. Howell has neglected to correlate geological information re currents and shore erosion with the engineering studies, the Michigan Department of Natural Resources fish studies, and the case of a boat being dragged along by the strong currents as water was being drawn into the plant. Several items should be considered here:

1. In January 1968 a preliminary report proposing an offshore research program was submitted to Consumers by Dr. John E. Bardach (presently Director of the

School of Oceanography at Univ. of Hawaii) and John H. Todd of the Univ. of Michigan. It stated:

"....Surf (in the area of the Pumped Storage Project) breaks 600-700 feet offshore at a depth of 12 feet....

....The jetties extending out into the lake will create eddies and backwaters along the shoreline....It is hard to estimate the extent to which the piers will alter the normal current patterns of the lake...."

THE PROPOSED CURRENT STUDIES WERE NOT CARRIED OUT.

2. By personal communication from biologists working for the Michigan Department of Natural Resources I have learned that (a) the biologists have opposed operating the Pumped Storage Project because it would interfere with fish migrations - and spawning for some species.
   (b) when tagged fish have been allowed to be drawn into the reservoir and then hopefully discharged, a few have made it into the reservoir but apparently only some larger bones and the metal tags have survived the round trip.

3. By personal communication from one of the Pumped Storage Project workmen, one evening in mid-July 1973 a private boat 30-35 foot size approached the jetty-breakwater system from the north and anchored outside the breakwater for the night. The weather was calm. About 11:30 P.M. the pumps began filling the reservoir when the watchmen saw the anchored boat being drawn inside the jetties toward the intakes. By immediate and loud emergency signals the boat's crew was finally awakened, the engines were started, the anchor hauled up and the boat fled the scene. This incident was not reported to the Coast Guard, but is only one of a series of public near-accidents discussed by various people who worked on the Project. It was after this incident, I am told, that the boat barriers were put between the jetties and the breakwater.

III.B.Mr. Howell:"....These facilities (jetties and breakwaters) were modeled at a small scale in the hydraulic laboratory at the University of Michigan and extensively tested to develop a design to hold velocities down to an average of 1½ feet per second. A copy of that two-volume report is enclosed...."

Miss McKee: In preparation for the Bloomer trial, on Dec. 17, 1973 a letter from Mrs. Bloomer's attorney John C. Ruck was sent to Consumers Power requesting copies of specific data and specific information. On Jan. 16,1974 Consumers Power's attorney John D. Tully replied. Copies of both letters are

included with this report as EXHIBIT A and B.

Request #3 was: Copies of the lake bottom charts made of the area in the vicinity of Ludington and the pumped storage project.

Answer #3 was: None

Request # 5 was: Copies of all offshore depth and bottom studies done before, during and after the construction work.

Answer # 5 was: There are voluminous records of bottom samplings and borings available. An on-going fish study is summarized quarterly to the Federal Power Commission.

NOTE ; 1. BOTTOM SAMPLES AND BORINGS ARE NOT DEPTH OR BATHYMETRIC STUDIES.

2. FISH STUDIES ARE NOT DEPTH AND BOTTOM SEDIMENT OR LANDFORM STUDIES.

Without offshore geological and fathometer studies to provide detailed nearshore bottom terrain data to use in modeling flow characteristics in the hydraulic laboratory, realistic flow data re currents and gyres and shore erosion COULD NOT HAVE BEEN DEVELOPED.

During the Bloomer trial, it was determined that the material used in the hydraulic laboratory to simulate the lake bottom and the shore was either plaster or plastic, both of which are solid. In no way did they simulate the easily moved sand grains which comprised the offshore sandbars and the sand beach.

Mr. Howell admits that the operation was designed to create average current velocities between jetties and breakwater of about 1.4 feet per second when pumping into the reservoir and about 1.5 feet per second when discharging. These rates are attained as shown by the records of the current studies submitted to you by Mr. Howell. THESE ARE EXTREMELY HIGH VELOCITY CURRENTS FOR THIS PART OF LAKE MICHIGAN, AND VERY EROSIVE TO SANDBARS AND BEACHES. The following data comparisons are offered:

1. Consumers Power current generation ranges:
   1.4'/sec. (16.8"/sec.) = 84'/min. = 5,040'/hr.

   1.5'/sec. (18"/sec.) = 90'/min. = 5,400'/hr.

2. Currents of .5'/sec. (6"/sec.) move sand

   Currents of 1'/sec. (12"/sec.) move gravel

   The sand beach and sandbars along the shore of Lake Michigan south of Ludington is mainly sand and easily eroded by currents exceeding 6 inches per second.

3. Real currents measured at St. Joseph, Mich. south of Ludington, but where the same type of offshore sandbars, sand beach and high sandy bluffs exist, show that:

   North of the piers where shore erosion is not a problem, bottom currents where the water is in contact with the lake bottom sediments measured

   .041'/sec. (.6"/sec.)=2.46'per min. (29.52"/min.)

   1,000 feet south of the piers where shore erosion is a severe problem bottom currents were found to be:

   .168'/sec.(2.016"/sec.)=10.13'/min.(121.6"/min.)

   As the currents moved out and around the piers, they accelerated 4 times and cut rip channels through the sandbars so the beach was vulnerable to open lake waves and their great energy.

4. COMPARED TO THE INDUCED CURRENTS AT LUDINGTON PUMPED STORAGE PROJECT, IT IS FOUND THAT THE LOWEST PLANNED CURRENTS OF 1.4'/SEC. ARE 8.3 TIMES FASTER THAN THE CURRENTS ERODING THE ST. JOSEPH SHORES; THEY ARE 33.6 TIMES FASTER THAN THE NORMAL LONGSHORE CURRENT WHICH MAINTAINS BEACHES AND SANDBARS.

5. In the Kohler and Moore report SCOUR AND DEPOSITION CHANGES IN SEDIMENTATION AROUND A NUCLEAR PLANT Univ. of Wisconsin Sea Grant College Program, Tech. Report #223 of Sept. 1974, on page 234 they give a table of longshore current measurements taken off Point Beach Nuclear Power Plant on the Wisconsin side of the lake. These currents are creating scour erosion patterns:

DATE	BUOY NO.	CURRENT VELOCITY	DIRECTION
7/19/72	7	2.65"/sec.	S to N
7/19/72	2	1.65"/sec.	S to N
7/20/72	7	2.45"/sec.	S to N
7/20/72	2	1.67"/sec.	S to N

ALL WELL BELOW THE LUDINGTON PROJECT PLANNED CURRENTS OF 1.4'/SEC. OR 16.8"/Sec. AND 1.5'/Sec. OR 18"/SEC.

III.C.Mr. Howell:"....Extensive field measurements of the actual proto type velocities were made by representatives of Michigan State University in 1974. Copies of their field notes are enclosed (with Mr. Howell's letter). These measurements show that there are no consistent eddies exceeding 46 centimeters per second (1½ feet per second) and that the design configuration has been successful in that there are no high velocity discharge currents which would cause shore erosion as claimed by Ms McKee...."

Miss McKee: Between 1959 when planning for the project started, and 1974 when a court case involving, among other issues, currents and shore erosion was scheduled for trial in 1975 - Consumers Power did not bother to conduct current studies nearshore or in the deeper water. In Aug.-Oct. 1974 the Michigan State crew working primarily on fish studies were asked to do some current studies within the jettie-and-breakwater system. These records have been provided to you already by Mr. Howell. Within these field records is a letter to which I specifically draw your attention; it is addressed to Dr. John Reynolds, Environmental Surveillance Coordinator, Consumers Power Company. It is enclosed with this report as EXHIBIT V. In this letter Charles R. Liston reports that:

1. The current meters were set on the bottom directly between the jetties and between the north jetty and the breakwater:

   No current readings were taken outside the jetties and breakwater, so no normal longshore or deep water data were collected to contrast with the company currents. No currents had been studied there prior to construction of the project, so no comparison could be made with the before and after data.

2. The current meters were set on the bottom. From page 6 of the Ludington Pumped Storage Project Brochure which is EXHIBIT VI with this report, we see that the intake and discharge from the pump-power station are directed toward the surface of the water and not toward the bottom. Current meters placed on the bottom would not record true current data generated in the near surface zone.

   Observation of the turbulence caused by discharge or pumping clearly shows the flow at and near the surface. It is assumed that the system was designed to draw from (and discharge to) the surface zone so as to avoid drawing sand and silt into the reservoir where it would severely erode the pumps, pipes, etc. and in time fill the reservoir.

3. Even though placed on the bottom at a comparatively sheltered spot, interesting current readings resulted:

   (a) Highest reading during pumping approx. 1½'/sec. (18"/sec.) about what the engineers designed for.

   (b) Highest reading during generation sometimes exceeded the capability of the meter to record - greater than 2.7'/sec (32.4"/sec.) - considerable higher even than what the engineers had designed for. The occasional very high readings appear to be randon turbulent surges that descended to the bottom.

   These extremely high currents were headed in a northerly

direction. This indicates that, when discharged into the lake waters, they were moving in a northward direction against the normally southward flowing lake currents. They would also entrain the longshore currents being deflected lakeward by the jetty, and so accelerate as they formed a gyre (circular eddy) swinging in again toward the shore north of the jetties. On a calm day this gyre can be seen from the shore bluffs; it erodes sand bars and cuts rip channels through which open lake waves can attack the beach.

4. Even though these records were obtained by current meters, we draw your attention to Charles Liston's own qualifications:

> "....However, these instruments (current meters) have been in longer than necessary because of our boat problem (including winds, rough water and bad weather), and of our concern(ed) for their fate (rough water). The meters should not be left in for over two weeks...."

5. Mr. Hoewll is correct in claiming there are no "consistent eddies exceeding 46cm. ($1\frac{1}{2}$')per second....". When a daily pumping and discharge program is carried out, the currents generated by each part of the program induce reversible local current patterns. They create discharge currents for so many hours, then reverse everything and create pumping currents for so many hours.

   (a) In a fragile environment such as sand beach and longshore sand bars, any current greater than $\frac{1}{2}$ foot per second will be erosive.

   (b) In such an environment the periodic reversal of induced high energy currents and/or eddies is abnormally disturbing to sands. They loosen the individual sand grains from both directions and tend to pluck them from the bottom and carry them in suspension.

   (c) The effect of several years erosion of the nearshore zone within 1 mile north of the Pumped Storage Project north jetty is shown by the erosion of much of the original sand bar system, the steep drop-off near shore (over 6' only 15' from shore at Kirker property), the rapid removal of material slumped onto the beach from the bluffs, the direct acces to the beach by large waves, and the narrow band of solid ice which now forms along the beach in winter.

6. Since Consumers Power obviously creates the currents during both pumping and discharge operations, these currents react with waves approaching the shore and change them. This phenomenon is reported by Chi C. Tung and Norden C. Huang in their paper STATISTICAL PROPERTIES OF WAVE-CURRENT FORCE in the Aug. 1973 edition of the Journal of the Waterways, Harbors and Coastal Engineering Division, ASCE, Vol. 99, No. WW3. Proc. Paper 9931:

"INTRODUCTION

When a wave encounters a current, its characteristics change. If the current is in the direction of wave propagation, the wave amplitude decreases and its length increases, but if the current opposes the wave, the wave steepens and shortens. These changes are due to the interactions between current and wave....In a random wave field, the component wave amplitude and the wave length experience similar changes resulting in the modification of frequency and wave number spectra of surface waves...."

The amplitude and steepness of a wave as it approaches a shore is important to the amount of energy that wave has as it impacts against the shore. At Ludington the currents go across the waves, go in the direction of the waves, or oppose the waves depending upon the pumping or discharge phase and wind direction. Direct effect of this on the shore erosion has not yet been studied by Consumers Power.

IV. Mr. Howell: "Ms McKee also alluded to seepage from the reservoir. Seepage from the reservoir has admittedly been somewhat higher than expected...."

Miss McKee: EXHIBIT VII consists of the Minutes of the February 21, 1974 Seepage Update Meeting attended by representatives from Consumers Power, Detroit Edison and their consultant firms Ebasco and McClelland. Of special interest is the paragraph 2 on page 1:

"The deeper (water) tables will continue to grow until they reach equilibrium with inflow from the reservoir. When that will happen can not be calculated accurately due to lack of detailed geology under the reservoir coupled with the simplistic assumptions which must be made to use the available equations...."

On pg. 2, in the section titled Pumped Relief Wells, the second paragraph reads:

"....Mr. Kessler then reviewed the charging program which has just been completed on all of the deep ground water wells....Result of the program showed that several of these wells are not functional...."

On pg. 2 the section titled Surface Flows reports:

> "..... the Orchard Weir has risen substantially. In investigating this rise it was found that some seepage was appearing downstream of the Weir.... The new surface seepage at Brunson Road has not yet stabilized and is approximately 60gpm (these are north and east of the reservoir in the area where cherry orchards have been)...."

On pg. 2 the section titled Bluff Piezometer Wells refers to a synclinal geologic structure beneath the reservoir area and "....preventing any reservoir seepage from reaching the Bluffs...." EXHIBIT VIII is a copy of Dr. Farrand's map showing how this syncline beneath the reservoir is a re-charge area for groundwater draining in all directions, including westward toward the lake bluffs. Therefore, seepage from the reservoir IS a major factor in accounting for the increased flow from long established small seeps and springs along the bluff and ravines, as well as the accelerating development of new springs, seeps and bluff slippage. All of these contribute to the quickening rate of bluff erosion and sink holes in this area.

It is interesting to note that as recently as March 18,1974 a Long Term Surveillance Program was proposed consisting of

1. Ground documentation and mapping
2. Land use mapping
3. Stream monitoring
4. Installation and monitoring of selected observation wells.

During the Labor Day 1974 pumping of the reservoir, a major collapse cavern was found in the reservoir. This was filled and sealed, but should have indicated that other leakage problems were developing.

In January 1975 at a meeting with the Summit-Pere Marquette Township Property Owners Association, a Consumers Power spokesman said that they knew of 9,000 gals./min. leaking from the reservoir. Pumped relief wells were returning 1800 gals./min. to the reservoir, leaving 7200 gals./min (432,000gals./hr. or 10,368,000 gals./day) recharging the groundwater system.

During the July 4, 1975 pump down of the reservoir, the Federal Power Commission observers report on pg. 6:

> "....The inspection of the upper reservoir revealed a failure of the asphalt lining at sta.268+45 near the ramp about 2500 feet south of the intake....The failure was a near perfect 2½ foot diameter sink hole in the outer surface of the asphalt lining. Both the outer and inner layers (the entire sandwich) of asphalt were ruptured. The failure resembled a punching shear failure, which was cone-shaped. The bottom asphalt layer was sheared through a smaller 18" diameter circle. The elevation of the break was about 5' above the elevation 870 berm. (We did not view the break as we arrived at the location during repairs. We did inspect a colored photograph of the failure). An exploratory trench disclosed a void under the asphalt lining into the calcareous sand zone. The exploratory trench was about 10' long normal to the dike axis. The limits of the exploration

trench included the upslope end of the void. On the downslope side, the void extended beyond the end of the exploratory trench by at least 12 feet. This was determined by probing. With the exception of the void area, the exposed surfaces of the trenched-out area were firm. It appeared that the failure was due to piping of the calcareous sand due to pumping action created by cyclic loading (and unloading) of the reservoir. Apparently the calcareous sand must have piped upward through fissures or cracks in the overlying clay blanket. A localized loss of support beneath the asphalt lining resulted in the indicated failure...."

PIPING, and this official description of the failure and void seen in the reservoir is a good updip description of the process, is thoroughly discussed by Alice S. Allen in her report GEOLOGIC SETTINGS OF SUBSIDENCE (EXHIBIT II-B) with this report. The phenomenon of underground movement of sediments via groundwater flow, with eventual development of surface subsidence and sink holes, has been known and discussed by geologists for over 50 years. Allen describes the process:

"....The creation of subsurface cavities by mechanical transportation of sediment below ground has been recognized as the cause for collapse of the ground surface at only a few localities, but the process may occur more frequently than has been recognized. Many hydrologists and engineers refer to this process as "piping". If the following explanation is correct, the collapse is only the last step in a process that is concealed below the ground and that proceeds slowly over a long period of time. The place of discharge of the particles (lake bluff) is located at some distance from the site of the collapse (Pumped Storage Reservoir). Furthermore, the particles seldom form a recognizable accumulation near their discharge point (Gebhard Gorge). The particles mingle with similar products of surface erosion and move downslope or downstream, farther away from the site of collapse. Because of the difficulties in recognizing such an underground process, instances of subsidence due to this cause may have been attributed to other causes. For example, subsidence of loess is attributed commonly to compaction (geol.def. - "consolidation" eng. def.), but the irregularity of the ground surface in some areas suggests a combination of the processes of compaction (geol.) and underground erosion.

Three conditions appear to be required for the process of underground transportation of sediments (1) An easily erodable, pervious bed (sandy and silty-sand layers at Ludington) must be overlain by material sufficiently competent to maintain a roof, at least temporarily, over a cavity (asphalt lining and clay layers at Ludington). The common easily erodible materials are loess, water-laid silt, and sand or sandstone that is uncemented, incompletely cemented, or decemented. (2) A source of water (elevated reservoir) with sufficient head to transport grains of silt and sand must have access to erodible bed (FPC report of reservoir cavity failure). Access of water rarely occurs under natural conditions and then usually in areas of dry climate; it is more commonly induced by man's engineering activities. (3) An outlet must

serve both as a discharge point for the flowing water and as a disposal area for the transported silt and sand grains. Gully walls and the rims of plateaus (or lake bluffs) naturally provide outlets. Excavation and drilling of boreholes (1,000 boreholes in Ludington reservoir) provide additional outlets that have the probability of initiating a process whose natural occurrence is restricted....

....Sinkholes appear near steep slopes along main gullies and at the terrace front (observed in the Ludington area). The sinks are circular at the top....and funnel-shaped in section. Most of the sinks have near-vertical outlets that connect with almost horizontal underground passageways.... Buckham and Cockfield (1950), in consultation with H.S. Bostock, outlined the mechanism for developing tunnels. The water which has percolated downward through the sediments is directed more nearly horizontally at the temporary water table. Water carrying silt particles emerges from the saturated body of silt where the near-horizontal zone intersects a gully wall. A saturated block of silt falls off, starting a tunnel which is propagated back into the body of silt. A free face is believed necessary to start the process. Once a passage is opened, water flows through like a stream, carrying additional silt in suspension. The underground channel is enlarged until the roof is unnable to support the overlying material, which falls in to form a sinkhole. This process is recognized as similar to one postulated by Rubey (1928), who observed evidences of ground sinking in Tertiary and Triassic sand and shale in northern Texas and in Wyoming. Close to tributary gullies, Rubey observed small elliptical depressions (similar to those observed on Bloomer property near road and described by FPC men) and cracks along which the sod had been displaced vertically downward, forming miniature scarps (as seen all along the lake bluff west of Ludington reservoir)....."

With the recent upsurge in dam and reservoir building, the reports of observed problems with piping, reservoir leakage and groundwater control are rapidly increasing. In addition to the bibliography given in the Allen report, interested parties can refer to the Association of Engineering Geologists Bulletin for Spring 1969, Vol.6, No.1 titled RESERVOIR LEAKAGE AND GROUNDWATER CONTROL.

At the Ludington Pumped Reservoir Project groundwater seeps and springs have been known since people began using the bluffs. Consumers Power et al knew about these seeps and springs from Dr. Farrand's reports of 1969 and 1970. He described the groundwater re-charge area beneath the proposed reservoir site. He described seeps and springs along the lake bluffs and the headward erosion of the ravines by "spring cupping". He advised monitoring programs which would have given warning of dangerous changes in the groundwater system.

Information furnished by Consumers Power for the Bloomer trial provide some interesting quotes:

1. Summary of Subsurface Investigation Data 1962-1969 Vol.I, Section I-4 C.A. Hunt Dec.3,1962:

   "....Reservoir design loads up to 6 tons per sq. ft. so it is advisable to establish beyond doubt the competence of foundation soils to carry such loads without developing objectionable settlements...."

2. Ebasco Engineering Corp. File S-35 Aug.24,1970 memo to:C.F.Whitehead re Penstock and Powerhouse Excavation:

   "....Groundwater problem now essentially controlled by horizontal drains in perched aquifers above 600' elev. and educator wells below 600'. Small amount of water still seeping from east slope (of lake bluff cut back for penstocks) below elev. 540'.....

   Moisture in the bottom is being encountered in silt and sand soils that appear to be trapped in the materials..."

   NOTE: RESERVOIR NOT FILLED UNTIL OCT. 1972 SO NORMAL GROUNDWATER SEEPS AND MOVEMENT TO LAKE BLUFF AREA KNOWN BEFORE PROJECT STARTED.

3. Ebasco Engineering Corp. File S-35 July 13, 1970 letter over July 8,1970 report re Penstock and Powerhouse excavation:

   pg.2 "....Springs, originating from a perched water table have been encountered in foundation undercuts upstream of station 65+00. Collective flows are on the order of 108 gallons per minute. When the undercutting is complete, a topographic map will be made showing the location of the seeps and will be forwarded to New York for appraisal....

   pg.3 .... Powerhouse Excavation - A deep well, educator type dewatering system has been installed on the north, south and west sides of the Powerhouse excavation within the cofferdam. Pumping from the wells, located at 15' centers (locally on 7.5' centers) is continuous and piezometers located in aquifers fed by Lake Michigan are dropping. Landside water however is not being intercepted by the present system and Powerhouse excavation is wet. The 3 exposed landside aquifers occur as perched seepages at elev. 650', 605' and 580' on the face of the existing Penstock slope. Flows from

the lower aquifer will be somewhat greater. Closure of the dewatering system on the landside appears to be somewhat greater. Closure of the dewatering system on the landside appears to be required...."

NOTE: APPARENTLY CONSIDERED ONLY AS ENGINEERING PROBLEM WITHOUT NEED FOR GEOLOGICAL ADVISEMENT.

4. Ebasco Engineering Corp. File S-34.1
Sept.5, 1972 memo to D. Ruotolo from J.R.Benson re Integrity and Maintenance Factors Relating to the Asphalt Slope Lining:

"....Cracking due to subsidence or heaving of the subgrade have not been considered in the maintenance analysis being discussed because such actions are considered as being governed by factors not intimately connected with design and construction of the asphalt containing portion of the slope lining...."

NOTE: SUBSIDENCE AND HEAVING OF THE SUBGRADE ARE GEOLOGICAL IN NATURE. THERE SHOULD HAVE BEEN CLOSE COOPERATION BETWEEN GEOLOGISTS AND ENGINEERS.

5. Minutes of Feb.21,1974 "Seepage Update Meeting" File S-8.
To C.R.Billy from J.L.Ehasz:

"....The deeper water tables will continue to grow until they reach equilibrium with inflow from the reservoir. When that will happen cannot be calculated accurately due to a lack of detailed geology under the reservoir coupled with the simplistic assumptions which must be made to use the available equations...."

NOTE: FARRAND HAD ADVISED SUBSURFACE AND GROUNDWATER STUDIES BEFORE THE RESERVOIR WAS COMPLETED.

Considering the leaks discovered in the reservoir (and there must be others in the deeper parts of the reservoir which have not been uncovered during a "pump down" to account for a loss of 9,000 gals./min.) and the yearly increase in the number of dewatering wells being installed after drastic erosion has been observed, Consumers Power did not fully appreciate the local site geology. Mr. Howell doesn't consider this extra charging of the groundwater system from reservoir leakage as drastic; property owners with springs developing under their homes, with free-flowing seeps in the lake bluffs and an erosion rate of the bluffs up to 10 times greater west of the reservoir than in nearby lakefront areas, and canyons developing across their property DO CONSIDER the seepage problem as drastic. So do the state geologists who have seen the area.

V. Mr. Howell: "During the exceptionally rainy spring of 1974, low lying parts of three orchards nearby the reservoir were damaged by high groundwater. The damages were so slight that the orchard owners were reimbursed for the trees lost as being more economical than determining the extent of the liability of the owner companies by a subsurface investigation. These were the only instances of orchards being "drowned" (per Ms McKee) and no other claims are being made by property owners on the basis of high groundwater."

Miss McKee: It appears that Mr. Howell agrees with the orchard owners that a groundwater table elevated by surface run-off from the steep reservoir walls plus seepage from the reservoir contributed to the drowning of the orchard trees. The tree roots need a certain amount of air as well as water in the soil. When the air is replaced by extra water, trees drown. Particularly north and east of the reservoir, where Hopkins Lake has risen over 3 feet (not attributable just to the 5" extra rainfall) orchards are seen to be having troubles.

The Federal Power Commission observers report that during their July 3-5, 1975 visit to the area "....We were informed that a cherry orchard located northeast of the reservoir has become partially water-logged and that the licensee (Consumers Power) is paying damages every year for the lost crop....."

VI. Mr. Howell: "Two lawsuits have been brought against Consumers Power Company and the Detroit Edison Company for damage caused by bluff recesssion along Lake Michigan shores. The first has been tried, the jury determining that the plaintiff had no cause of action. The second, not yet ready for trial, is based on contentions similar to those made by the first plaintiff. Five other property owners have voiced the same claim but have not brought suit. Consequently Ms. McKee's reference to accelerated damages to private properties is out of order and not supported by the facts. (Ms McKee was the only technical witness for the plaintiff in the first case mentioned above)...."

Miss McKee: The fact that Consumers Power is paying, or has paid, for damage claims to neighboring property owners for damage ranging from dead cherry trees to vibration damage indicates it feels some degree of responsibility.

The fact that 2 lawsuits for property damage have been filed against the company for property damage indicates that such damage has been noted and documented in some cases.

The fact that 5 other property owners have voiced the same complaint about accelerating property damage indicates such is occurring

The fact that the Federal Power Commission observers in their July 3-5,1975 report say:

"....We next visited Mrs. Emma Gebhard, who is located approximately 1½ miles south of the powerhouse adjoining the bluff line. Active significant headwater erosion of

a ravine, located between the house and Lake Michigan, was noted as evidenced by large fallen trees and slides. Mrs. Gebhard was of the opinion that damage had been aggravated by the stream estimated at 60gpm, draining into a ravine below and leading to Lake Michigan. We noted a spring and runoff in the drainage course leading from the Ludington Dike. Rate of runoff has increased as a result of the steep dike slopes and road relocations resulting from project construction. IT APPEARS THAT MRS. GEBHARD HAS A LEGITIMATE COMPLAINT REGARDING SURFACE EROSION. The licensee is aware of this problem and has proposed to build several holding ponds in areas adjacent to her property designed to retain some of the excess water at times of heavy runoff...."

NOTE: THE RESERVOIR LEAK FOUND JULY4,1975 WAS IN THE SOUTHERN PART OF THE RESERVOIR. IT SEEMS POSSIBLE THAT THE "PIPING" DESCRIBED BY THE FPC HAD SOME EFFECT ON THE LEAK AND SPRING CONTRIBUTING TO THE GEBHARD RAVINE PROBLEM.

Mrs. Bloomer, the first property owner to bring suit against the company recognized early in 1972 that there was accelerating damage to her property: excessive slippage along the lake bluff, shifting of earth and foundations of buildings, "piping" from rear of home toward side of ravine and lake bluff, cracks in walls of the house, vibration of house and grounds as heavy trucks moved along the road, vibration of small objects in house (cups and saucers, pictures, etc.). Unnable to get satisfaction from the company, she eventually filed suit. Mrs. Bloomer is a widow, and does not have unlimited financial backing. Because the problems she was experiencing were primarily geological in nature, I acted as her technical witness. She could not afford an extensive geological-seismic-engineering research program. The trial was held in March 1975, and the jury found in favor of Consumers Power.

VII.Mr. Howell: "Ms McKee stated in her presentation that no environmental impact statement respecting the Project was required...."

Miss McKee: EXHIBIT IX is a 3 page memo from C.R. Bilby to M.P. Shrontz on the subject of Ludington Environmental Review Outline. The introductory paragraph reads:

"The following outline assumes that the content of any environmental statement would be limited to matters associated with the impact of operations and/or outstanding construction items. The possibility exists, of course, that we would be required to go back to "day one", as for the AEC, but such a report would be practically impossible to complete in time for preoperational deliberations."

The proposed preliminary outline for a Ludington Project Environmental Impact Statement recognizes the need for a thorough study of:

1. Topography and geological information
2. Groundwater (geological study)
3. Climate
4. Terrestrial Ecology
5. Aquatic Environment and Biota

There is a very interesting note on this Review Outline which says "....(Each of the preceding sections would be merely descriptions of known information with compilations of existing data)....".

We have already shown that the company has NOT DONE offshore bathymetric surveys, or lake current surveys. They DO NOT HAVE adequate geological information beneath the reservoir to predict what will happen with reservoir leakage. They HAVE NOT studied ground heave or subsidence. They KEEP ADDING TO THEIR SYSTEM OF DEWATERING WELLS AND COLLECTION PONDS AS ADDITIONAL LEAKS SHOW AROUND THE DIKES.

In short, Consumers Power and The Detroit Edison Company have not done basic geological studies even though Dr. Farrand reported on the potential problems in 1969 and 1970. Dr. Walden of the Michigan Geological Survey told the companies in the 1960s that the site geology would not naturally support the heavy usage of a pumped storage project. Today the Michigan Geological Survey geologists are deeply concerned about the Ludington Project groundwater and soil stability situations.

The various reports and studies cited by Mr. Howell as showing the environmental interest of the owner companies conspicuously avoid geology. Recreation, and fish make up the major areas of concern without basic water quality-currents-erosion-groundwater-ground stability data to support the biota and recreation programs. It is interesting to note in at least one report cited by Mr. Howell the company was told of the need for basic current studies, which have not yet been consucted:

> An Evaluation of the Influence of the Pumped Storage Power Project at Ludington on the Fish and Wildlife Resources of the Area by John E. Bardach and John H. Todd, January 1968:
>
> pg. 10 "....The jetties extending out into the lake will create eddies and backwaters along the shore.....It is hard to estimate the extent to which the piers will alter the normal current patterns of the lake...."

Dr. Bardach, now Director of the School of Oceanography at the University of Hawaii proposed a research program for the Ludington area in 1968 which was not supported by the companies.

VIII.Mr. Howell:"Lastly, Ms McKee made reference to "early geological reports which seem to have been ignored...."

Miss McKee: This entire discussion would seem to support the statement that the companies paid slight attention to the various geological reports available to them. Today they are still trying to explain sizeable leaks in the reservoir, seepage from the reservoir which recharges the water table, the Gebhard ravine, subsidence in various locales, bluff erosion along the lake west of the reservoir 10-15 times that of the historical rate and that of nearby areas. Many of these problems could have been avoided if geologists had regularly been included with the engineers and company officials at all stages of the planning, designing and operation for the Project.

Proposed geological research and monitoring studies have not been carried out, or only partially done. These include some subsurface studies recommended by Dr. Farrand. No evidence has been presented that any part of the Ludington Project is anchored to or supported by bedrock - just glacial till and glacial outwash. No ev idence has been shown that electric logs or neutron logs were run to get information of subsurface strata and water content of strata. No eveidence has been presented to indicate load bearing tests were run on the lake bluffs.

A great deal of geological expertise was available, but does not seem to have been seriously considered.

IX. Mr. Howell: "In general, Ms McKee's statement would give the impression that deficiencies in the planning for the Pumped Storage Project existed. Such is not the case. A thorough painstaking examination of the Project, its engineering feasibility and economic feasibility was begun in 1959 and culminated in successful completion of the Project in 1973...."

Miss McKee: A thorough engineering feasibility and economic feasibility study of the Project was undoubtedly done. They just as obviously paid little attention to the local site geology which either will or will not support the engineered structures and the reservoir loading and offloading. The FPC observers attribute reservoir leaks to the shifting of enormous weights of water to and from the reservoir.

It is interesting to note that Mr. Howell says the engineering and economic feasibility studies were started in 1959. It wasn't until 10 years later in 1969 and 1970 that Dr. Farrand prepared his reports: 1. Geological Report on the Ludington Pumped Storage Project (20 June 1969)
2. Rate of Recession of the Lake Michigan Bluff Along the Ludington Pumped Storage Project (13 March 1970)

No additional geological reports are mentioned as having been done for the Project in spite of the documented seepage and property problems.

CONCLUSION

It is hoped that this lengthy discussion of problems associated with the Ludington Pumped Storage Project will demonstrate the urgent need to incorporate geologists and geological thinking into Coastal Zone Management Programs. The objective of my June 11, 1975 testimony before the House Subcommittee on Oceanography was to bring to the attention of the Congressmen the basic role geology plays in any coastal or offshore development and use program.

We appreciate Mr. Howell's letter concerning that testimony. Without it, the geological evidence concerning the Ludington Pumped Storage Project would never have been presented to the legislators in such detail, nor would the geological vs engineering points of view have been so clearly demonstrated.

It is essential that geologists work with engineers, planners, shippers, environmentalists and all others planning for the Coastal Zones.

Bloomer, Christie (Backup C. files)

THE WHITE HOUSE

WASHINGTON

January 3, 1977

Dear Mrs. Bloomer:

After receiving your letter of November 5, our office made further inquiry of the Federal Power Commission and received back a staff report dated December 14, a copy of which I enclose.

I am sure this report will not give you much satisfaction, although it does indicate that the matter is not closed and a reference is made to some studies being conducted by the University of Michigan.

I wish I could do more on this matter before we all have to leave here, but as you know, the Federal Power Commission is an independent regulatory agency and therefore beyond control or direction by the President. At the same time, I know of no other office in the Federal Government which could assume jurisdiction of the matter to make a further investigation. The only other private recourse you had was, of course, before the Michigan courts, and as you have reported to me in the past, your efforts before the court did not succeed.

I know you have been conducting a long and courageous fight in regard to the damage done to you, and I would give anything to see your efforts rewarded, and yet I feel most helpless.

Sincerely,

Philip Buchen

Philip W. Buchen
Counsel to the President

Mrs. Christie Bloomer
c/o Mrs. William Hunzel
2408 Westwood Road
Muskegon, Michigan 49441

1-9-77

Dear Mr. Buchen:

Thank you for your efforts. You have been very kind and if you knew how I innately detested imposing on any one, you'd know how much I've hated my imposition on you and how much I appreciate your kindness.

The FPC report is incredulous!!! How they can issue the report they did a year ago, explicitly saying that C. P. Co. was responsible for the damage and ordering C. P. Co. to spend over a million to prevent further damage and admit to me, in person, that high water could not possibly cause that kind of bluff erosion; then issue a report like this, well, God alone knows what "lurks in the hearts"of the FPC. Apparently, C. P. Co. controls FPC rather than the other way around, as it was meant to be. It would seem these regulatory agencies are a joke. How the FPC men and C. P. Co. executives can live with them selves and one day face God, I cannot imagine. Like the C. P. Co. Exec. who ordered me to vacate my home immediately and then turned to me and asked for what I'd settle. They know what they've done and God help them.

I guess if I could justify in my own mind how our country can allow a crime like this and do nothing to help the victim when our country helps criminals, aliens,illegal aliens, people in government who commit crimes , etc., I might be able to feel better about it.

Shortly before my husband died, he said, "Honey, if I died tomorrow, you would , at least, not have to worry financially, and that makes me feel better." And, I wouldn't have had to had this not happened. I've had a loss of over $262,000.00 and now, there's nothing left, not even a home. C.P. Co. walks home free and I'm helpless. 'Tis most discouraging to believe that crime DOES pay in this country.

I apologize for the typing-never was a typist and I'm using a borrowed typewriter which must be the second one ever made. It's terrible!

I profoundly thank you for your efforts, your time, and patience with me. I know I've been a nuisance, but I so felt that someone could help. Wrong again, Christie!

I wish I could return your kindness but I do not know how. If you're planning on returning to G. R., I'd really like to stop in one day for a minute to thank you in person. (I can see you cringing and saying, "Oh, no, not that, Dear God. What have I ever done to deserve that?)

Seriously, an enormous thank you!

With deep gratitude,

Sincerely,
Christie V. Bloomer.
Christie Vincent Bloomer
(Mrs. Robert Bloomer)
2408 Westwood Rd.
Muskegon, Mich. 49441