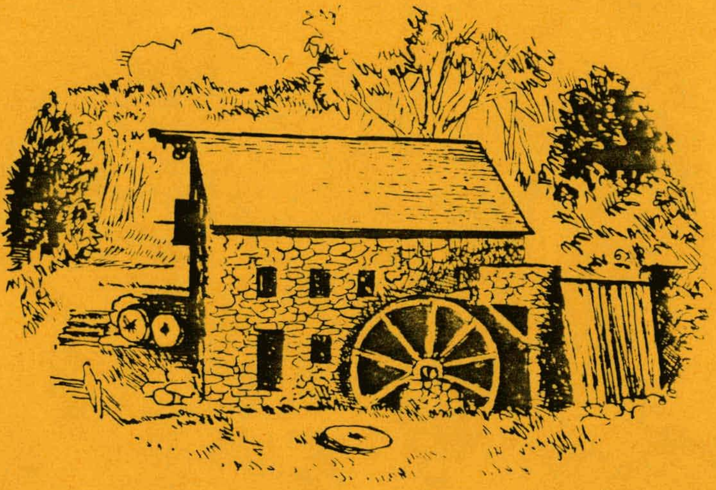
THE ROAD AHEAD IS THE ROAD BACK...



A Feasibility Study of Recommissioning a Low-Head Hydro Dam for Producing Energy and Food

PRDA ET-78-D-07-1706

Final Report for
Research Proposal
submitted to the Department of Energy
Idaho Operations Office

Program Research and Development Announcement
ET-78-D-07-1706

FEASIBILITY DETERMINATION OF LOW-HEAD HYDROELECTRIC POWER DEVELOPMENT AT EXISTING SITES

DOE Contract Number EW-78-F-07-1759

Name of Organization (including branch, title, if any): Bethlehem Mink Farm

Organizational Classifications (for organizations that have not received a previous DOE award):
Small Business

Address of Organization: Box 348, Littleton, N.H. 03561

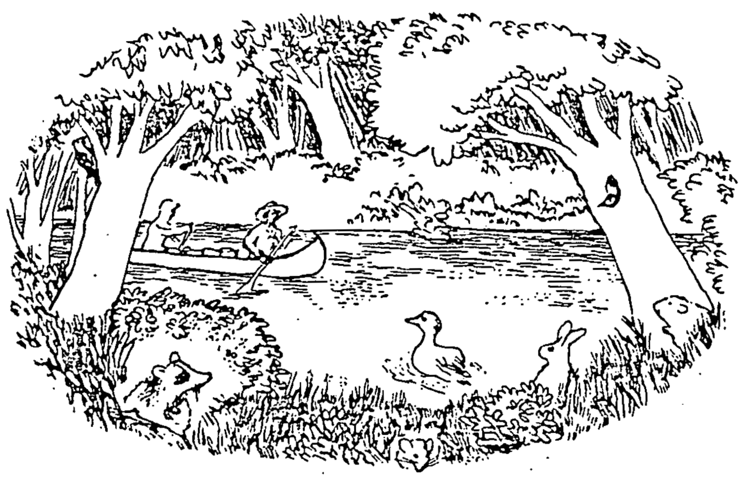
Title of Proposed Project: Feasibility Study of Bethlehem Dam Hydroelectric Project

Location of Existing Dam Site: Bethlehem, New Hampshire

Power Potential of Existing Dam Site: 750KW

Name of Principal Investigator: Richard Polonsky

Position and Title: Vice President



Abstract

This report contains the feasibility study, economic analysis and information relevant to reactivation of the dam in Bethelehem, NH.

It outlines a plan of development which calls for sale of the power to a local utility for the first few years of the project and then predominately on-site use of the power in an innovative plan for controlled environment agriculture.

The economic analyses indicate that reactivation of the dam would be a successful venture based on the present market value of 4.5¢/KWH. The success of the second phase in the dam's use rests on the increasing financial attractiveness of locally grown produce in a state that currently imports over 90% of its food and is experiencing the spiraling costs of food - energy - inflation.

The best suited turbine package for the site is an Ossberger 750 KW unit which would provide 4,014,000 KWH per year with a plant factor of 61%. The total capital costs of the project are $827,935.

HOWARD M. TURNER
CONSULTING ENGINEER
12 PEARL ST.
BOSTON, MASS.

October 1, 1925

Mr. Samuel Lord,
Public Service Commission,
Concord, N.H.

Dear Sir:—

I was up at Bethlehem yesterday where I was sorry not to find you.

Mr. Robb of the Ambursen Construction Co. and I went over the concrete situation as the figures of cement consumption show that the amount of cement used is still running very high. As you know they tried to use one third purchased stone with the run-of-bank gravel but found that this gave them too stony a mix. They are, therefore, continuing to use straight run-of-bank for the heavy mass concrete in the mat. It is running very good, with a very fair amount of stone in it.

The mixture which they were using for the concrete in the mat was as follows: 2 bags of cement to 4 wheelbarrows of gravel for each batch. Measurement in the concrete hopper and bucket showed, however, that the wheelbarrows were not being loaded full, as 3 batches made only about 1 cu. yd., making 1 ½ barrels of cement to the yd., or the equivalent of a 1-2-4 mixture. This, of course, is too rich for the mass concrete, 1-3-6 being what would ordinarily be used, and 1-2 ½-5 more than strong enough to take into account any possible excess of sand in the gravel.

The wheelbarrow method of measuring aggregate is not very accurate, and we have arranged to have the material hopper above the mixer marked so that it will be possible to put in it exactly 12 cu. ft., the equivalent of four fully loaded wheelbarrows. This with two bags of cement per batch will give us about 1 ¼ yd. of concrete for 3 batches, or a cement content of 1.2 bbls. per cu. yd. or just about the equivalent of a 1-2 ½-5 mix.

For the abutment walls which are reinforced we are using run-of-bank gravel with approximately 1 ½ bbls. to a cu. yd. or the equivalent of a 1-2-4 concrete.

The buttresses are specified as 1-2 ½-5. The way they have been mixing these has been giving a mixture of about 1-2-4. I instructed Mr. Batchelder to make perfectly certain that the 1-2 ½-5 mixture was being used as there is no need of using 1-2-4 for these, no allowance above the specified mix being necessary with the materials that are being used.

Mr. Batchelder is keeping careful track of the gravel and will see that these mixtures are obtained, but I am writing you because the method of measuring is somewhat different than what was used when you were there last.

If you have the results of any compression tests of the concrete samples that you took, I should be very glad to have them as all information of this sort, particularly of concrete as it comes from the mixer under field conditions is valuable.

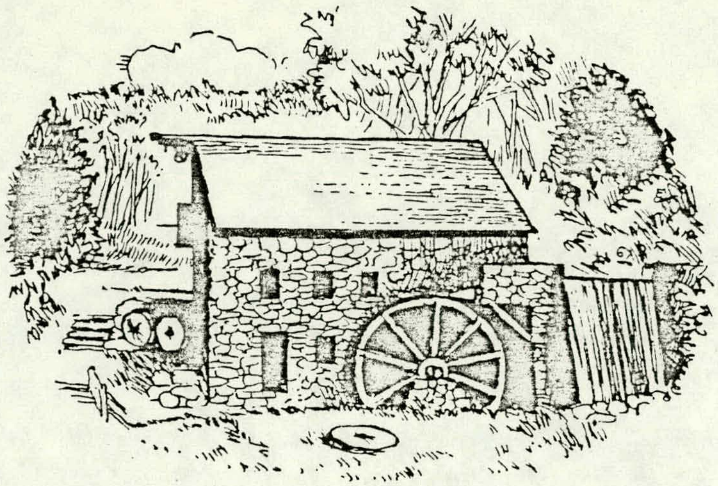
Yours very truly,

Howard M. Turner

Howard M. Turner

HMT/R

Contents



Site History

The history of the present dam at Bethlehem is typical of the development of New England hydropower on run-of-the-river locations. The property has been associated with agricultural and lumber operations for over a century and a half; the site produced mechanical power for 95 years and hydroelectric power for another 63 years.

The Abenaki Indians first followed the "narrow fishing river" or Ammonoosuc River through the White Mountains from the Saco River in Maine to the Connecticut River in Vermont. The high altitude, harsh climate, and short growing season of the mountains discouraged early settlement. Then fur traders from coastal towns explored the North Country in the 1600's. It was not until the mid 1700's, however, that the first settlements grew up along the lower valley.

The original grant of 23,000 acres for the town of Bethlehem was made to Lloyd Hills. The first settlers arrived in 1781 and by 1800 one hundred and seventy people were homesteading in the township. In order to facilitate East-West travel a bridge was constructed across the Ammonoosuc at Bethlehem Hollow.

Between 1800 and 1895 Bethlehem Hollow was the center of agricultural and commercial activity for the town. On the hydro property (now owned by Bethlehem Mink Farm) there were five mills producing: flour, starch, lumber, wool and chairs. According to the Agricultural Census of 1850, Bethlehem had 136 farms which raised or produced:

> "360 milk cows, 226 oxen, 432 cattle, 924 sheep, 172 swine and 105 horses; 31,845 lb. butter, 8,663 lb. cheese, 4,051 lb. wool; 2,835 bu. Indian corn, 35,785 bu. potatoes, 418 bu. buckwheat, 6,150 lb. hops, 217 lb. flax, 11,160 lb. maple sugar, 2,271 tons hay, 518 lb. honey. Additionally, orchard products amounted to a value of $1,474; market garden products, $1,108; and home-made manufactured products, $10,076."

In the 1870's the main commercial activity in Bethlehem shifted from agriculture to tourism. Four thousand tourists were spending their summers in the town's hotels and boarding houses. Each year more hotels and summer residences were being built to accommodate the growing number of summer visitors.

To accommodate the swelling need for services, five men formed the Bethlehem Light Co. in 1895:

> They built a wooden penstock from a mill dam and constructed a generator. Houses and hotels were wired and the current, which was on from dusk to midnight, was available at the annual rate of $3.00. In 1896 the powerhouse was increased and the town replaced the kerosene lamps with electric lights which they kept on all night. In 1908 electric meters were installed. *(Bethlehem, New Hampshire, edited by Gregory Wilson.)*

The Bethlehem Light Company was reorganized after 1917 into the Bethlehem Electric Company. The major stockholder was John Glessner, a vice president of International Harvester Company and owner of a large area farm called "The Rocks." The new company replaced the crib dam with the present concrete dam in 1927.

The Company hired Howard M. Turner of the Ambursen Construction Company of Boston to build a new dam. The crib dam was used as a coffer dam during construction of the new reinforced concrete structure. The new impoundment was built to provide slightly more head and to be more structurally sound.

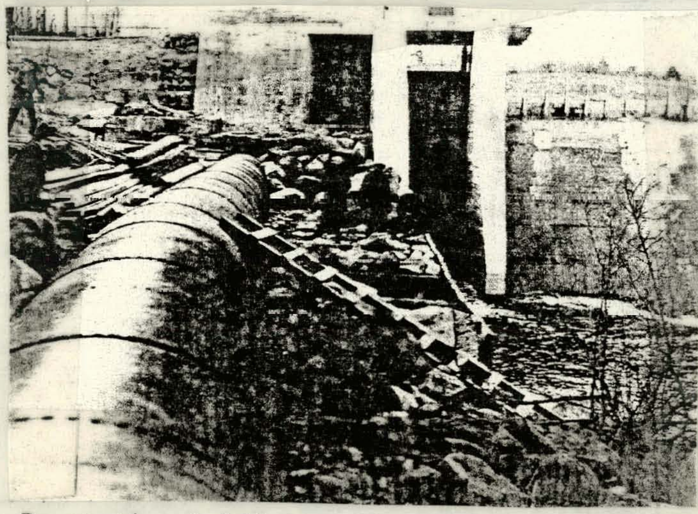
The steel penstock was left, but the powerhouse was upgraded to match the dam. The 300 KW Francis Turbine plus generator and 1,500 feet of 6-foot steel penstock which were part of the original crib dam were incorporated into the new facility.

In 1930, shortly after Mr. Glessner's death, the Bethlehem Electric Company was purchased by Public Service Company of New Hampshire which operated the dam until 1958. Public Service improved the site as a substation by adding diesel generating capacity to the powerhouse.

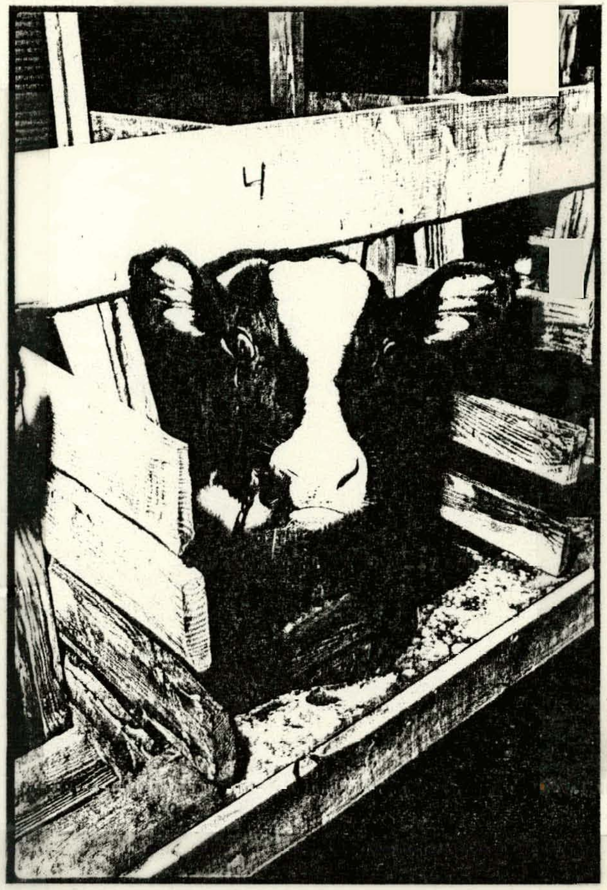
The site was retired in 1958 along with many other small

BEFORE AND AFTER

Circa 1925



Present gatehouse in finish stages of construction. circa 1926.



BMF raises 1300 bull Holstein calves a year. Calves weighing 100 pounds are purchased at 2 to 3 days of age and raised for 15 weeks until they weigh 330 lbs. Veal is the most efficient converter of feed to growth of any livestock raised. A veal calf requires 1.65 pounds of feed to produce a pound of growth.

hydro facilities in the state.

The hydro property was sold, less the generator and turbine, to Dr. Arnold Polonsky, President of the Bethlehem Mink Farm. This included:

> All right, title, and interest of the grantor in and to the land and rights to land situated in Bethlehem, in the county of Grafton, and the state of New Hampshire, which were conveyed by the following deeds, together with any and all buildings, structures, machinery, and other personal property now located on said land.

The Bethlehem Mink Farm, a third generation family business, was started in 1937 as a hobby of "Grandpa" Joseph Polonsky (a retired pharmacist from New York City). His son Arnold, after graduating from veterinary school in 1945, took over management of the farm and over the next 26 years built it into the largest mink ranch on the East Coast. A million-dollar-a-year aggregate business, the Bethlehem Mink Farm was a totally self-sufficient operation which:

—Raised 18,000 mink a year.

—Purchased 6 million pounds of ingredients a year and manufactured finished feed for 100,000 mink on 35 other ranches in the East and Midwest. BMF also sold ingredients to trout hatcheries in Maine, New Hampshire and Rhode Island.

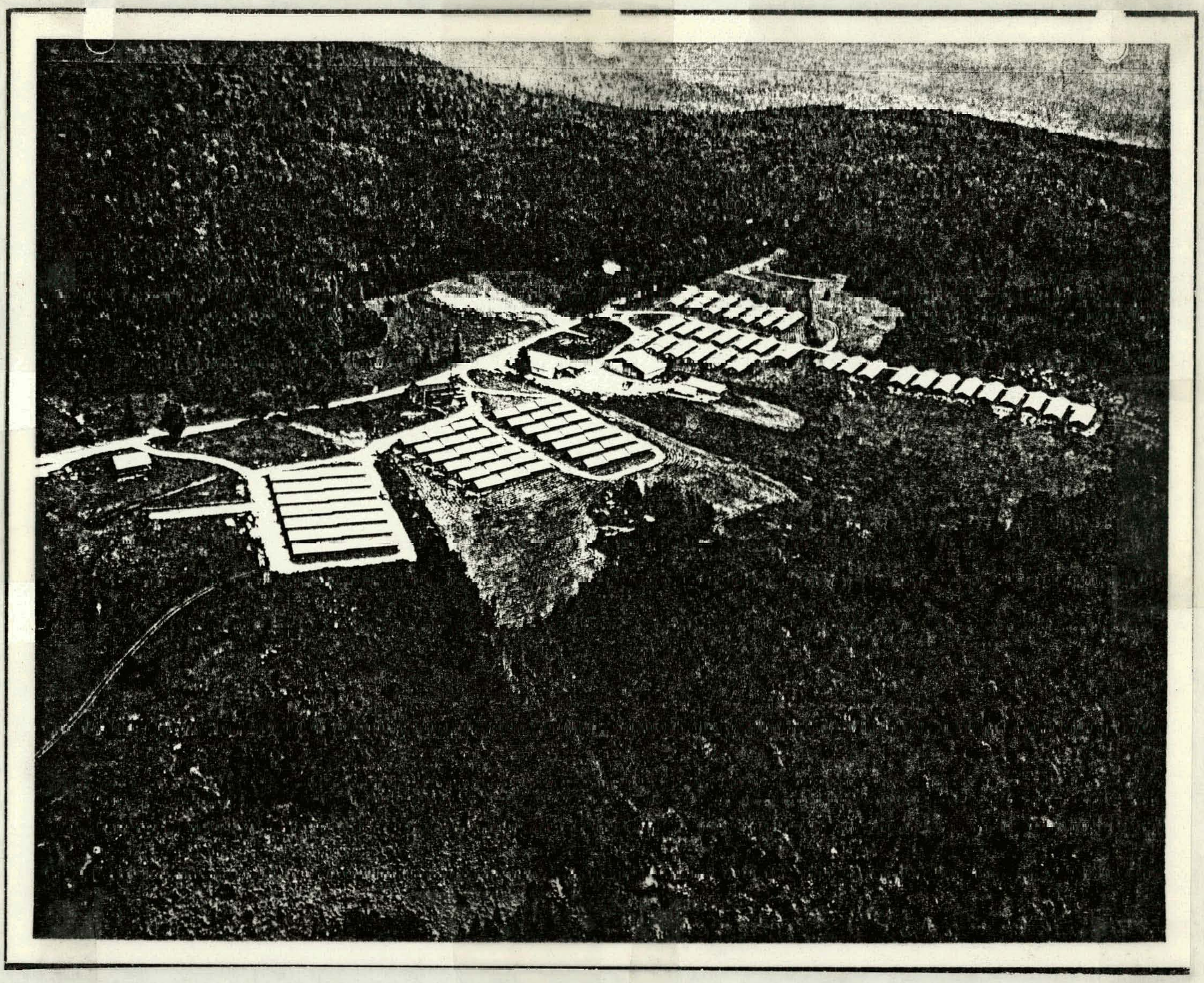
—Designed, built and maintained a physical plant of 70 buildings, including mink sheds, calf barns, freezer plants, factories, and residences.

—Owned and operated commercial freezer plants in Rutland, Vermont and Littleton, New Hampshire.

—Operated a fleet of refrigerated tractor trailers.

—Employed a full-time work force of 25 people who were skilled machinists, mechanics, welders, carpenters, electricians, plumbers, truck drivers and herdsmen. Additional part-time workers were hired during peak seasons.

In 1971, BMF's herd was decimated by a PCB (polychlorinated byphenyls)—contaminated ingredient. Thirty



Bethlehem Mink Farm raised 18,000 mink a year; manufactured and sold feed to mik farms and trout hatcheries in the eastern U.S. (photo circa 1960)

years of work and 18,000 mink died in 5 days. Since quality mink pelts require refined breeding strains perfected over the years, the ten year period projected to rebuild the herd dissuaded Dr. Polonsky and his key men from starting anew. With a successful law suit against the manufacturers of the contaminated feed in process and the overhead continuing, Dr. Polonsky converted the farm to raising veal calves in 1973. The Bethlehem Mink Farm is now one of the largest veal raising operations in New England.

Despite all of its set-backs, the Bethlehem Mink Farm has survived with all of its resources intact. Today, BMF is a holding company with one million dollars of assets and one-half million dollars of annual sales. Its operations include farming, the raising of 1,300 calves a year; service operations, refrigerated warehousing and trucking, and heavy equipment maintenance; real estate, rental of commercial and industrial properties, and land development.

In light of its resources and experience and because the Farm is located at the end of the national oil and food chains, the primary thrust of BMF's business development plan is the extension and diversification of its agricultural production. It is in this vein that we looked for a way in which the power from the dam might be tied in with existing and expanded food production through controlled environment agriculture at the dam site.

Northern New Hampshire's climate is very harsh, with more than 9,000 Heating Degree Days and average solar radiation of 300 Langleys. The state has a short growing season and like the rest of New England, is 85% dependent on food produced in other parts of the country and then transported 1500 to 3000 miles. This dependence has escalated our regional vulnerability in recent years to:

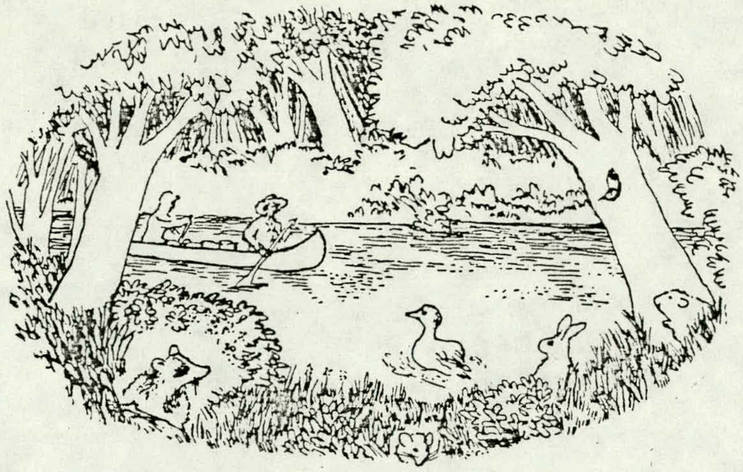
trucking strikes—which in 1973 severely reduced food supplies to the Boston market which funnels them to the rest of the region.

winter snows—which in 1978 stalled food trucks in Chicago and cut east-west rail service at Buffalo, threatening the supply of feed grain for dairy needs and poultry.

deep freezes in Florida or *drought* in California which threaten the supply of fruits and vegetables.

Should this cross-country link be broken, New Hampshire has only a seven day supply of food on the shelves of its supermarkets. The Commissioner of Agriculture in California has stated that due to increased population and the loss of farmland to commercial and residential development, there will be little food to export by the year 2000. While imminent food shortages have not yet affected New Englanders, rising food and energy costs have impacted the New England household far more severely than in any other region of the United States. Currently, it costs $3 billion a year to import 95% of our beef and 50% of our produce.

Bethlehem Mink Farm is addressing the problems of food and energy as valid social needs and a viable business strategy. Preliminary assessments of food production in controlled environments matched with the power capacities at the Bethlehem hydro site indicate we could raise 600,000 lbs. of lettuce and 300,000 lbs. of tomatoes. It is the overall goal of BMF to produce, process, and market 2 million pounds of food a year.



Engineering Feasibility Study

TECHNICAL SUMMARY - CIVIL WORKS

The Bethlehem dam is a hollow, reinforced concrete impoundment 150′ long x 21′ high. Large abutment and wing walls extend along the river banks at both ends of the struture. The dam itself has 9 interior caverns which are easily accessible for inspection. It is a gravity flow dam with Ogee spillway.

The dam is in sound condition and has recently been evaluated by an inspection team for the U.S. Army Corps of Engineers. It was rated as a "low-hazard" impoundment that presents no threat to life or property downstream. The gatehouse is structurally sound, but needs a new roof. Water control mechanisms must be replaced, including: trash racks, gate hoists, and assemblies.

The replacement of 1500′ of 6-foot steel penstock which connects the dam to the powerhouse represents the largest single expense in this restoration. It will cost $124 per running foot installed or $185,989 overall. The powerhouse is a brick structure which has been badly vandalized over the years. The building, however, is structurally sound and will require little money to enclose.

Early in the investigation it was decided that since BMF owned land adjacent to the original Public Service Co. parcel, the feasibility of running penstock further downstream to acquire additional head should be evaluated. Surveys determined that running penstock another 700′ would net 20 more feet of head, and cost $86,800 for additional penstock and $16,700 for a new powerhouse.

Restoration of the original facility, including repairs to the dam, gatehouse and powerhouse plus penstock replacement, will cost $216,463. Construction costs for the downstream site, including repairs to the dam, additional penstock and building a new powerhouse, total $319,963.

Throughout the investigation, strong emphasis was placed on a restoration program that would involve a minimum of outside contract work from specialty concerns. The cost of programming work can be tailored to use of equipment and personnel already on hand and working for the mink farm. Equipment and additional manpower will be drawn from local sources. In all cases the Bethlehem Mink Farm will act as general contractor. This approach is enhanced by the good condition of all civil structures and the ease of access to the area. The entire restoration program, through all phases, is designed to, and can be accomplished, with practically no change to the environment surrounding the project site.

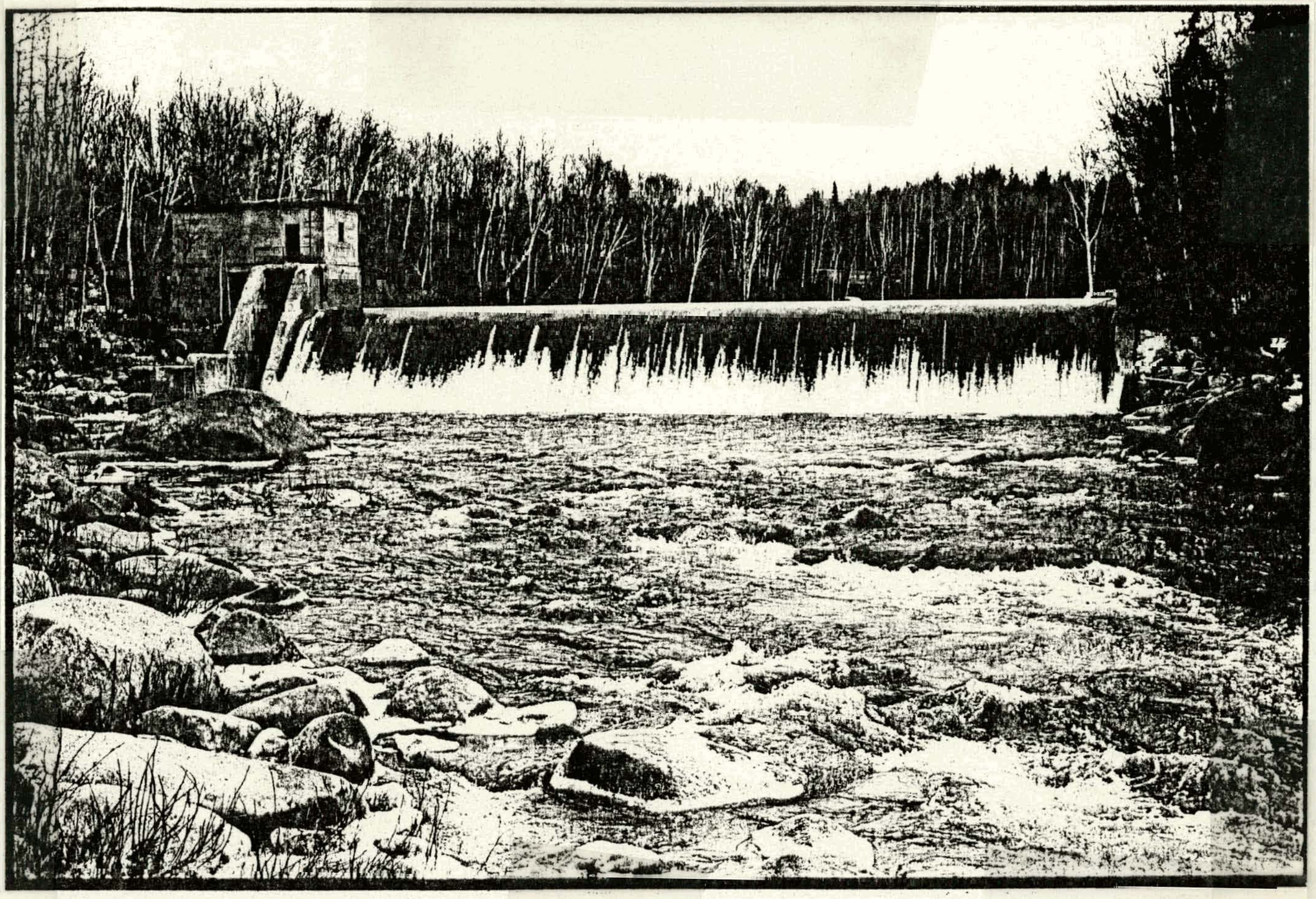
Many of the cost items are estimates; some are bid prices. A list of sources contacted and written information sent by these parties can be found in the Appendices.

CIVIL WORKS RESTORATION

Repair of Dam The east wing wall of the dam has several visible cracks and needs patching and improvement. Clearing of large trees with roots that tend to undermine the structure and weaken it, as well as the removal of some vegetative cover on the river banks, will be required. The east abutment of the dam needs to have minor form work and pointing up, particularly at the access to the caverns.

The top of the dam itself needs minor repair and pointing up. Sections of steel, bent and twisted from previous flashboard installations, should be removed and all holes pointed up. This work is relatively superficial and can be accomplished by lowering the water slightly. Expansion joints which are badly eroded need to be resealed with asphalt or equivalent type of sealant.

Silt has seeped into the dam through the vent ports and should eventually be removed. One of the steel cables used for the catwalk needs to be replaced; the other three can be repaired. The catwalk itself, consisting of 4 x 8 timbers and plank decking, will eventually have to be repaired. Electric lighting for inspection purposes can probably be replaced within the existing conduit with hanging type receptacles.



THE DAM, Looking East and upstream on a March morning

THE DAM, looking east and upstream on a March morning.

There are many leaks occurring within the caverns, some of which are caused by the holes left from the flash board supports. Structural repairs appear to be unnecessary within the caverns. However, some superficial repairs, including chipping, sandblasting, and surface restoration, will be necessary. There are many places where minor leaks occur, apparently where reinforcing rods and snap ties extended through the concrete. These can easily be sealed, both from within and outside of the dam.

The following repairs to the dam itself are required:

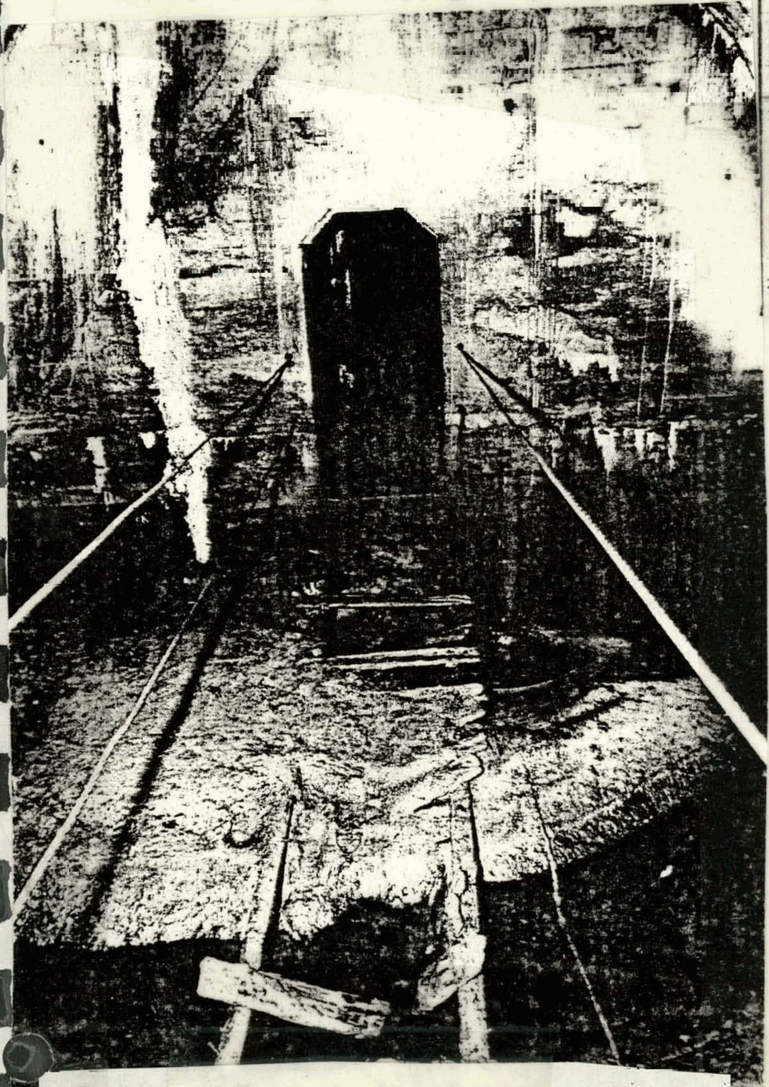
Repair of the east wing wall of the dam at points of cracking or other deterioration is to be done with epoxy mortar; in one place a small form will have to be constructed. Repair of surface deterioration on the dam itself and the caulking of expansion joints with asphalt, repair of loose flashboard holders and caulking of any holes; to be done while dam is de-watered. Removal of all silt and other rotted material by hydraulic means from within the dam; remains of old walks will have to be cut up and pushed out the base holes or up the main hatches. Replacement of hatch covers with steel plates using inside hold-down chain on the east end and securely latched on the west end. All of the above is designed to be accomplished entirely by BMF.

MATERIALS, LABOR AND COSTS (Dam Repairs)

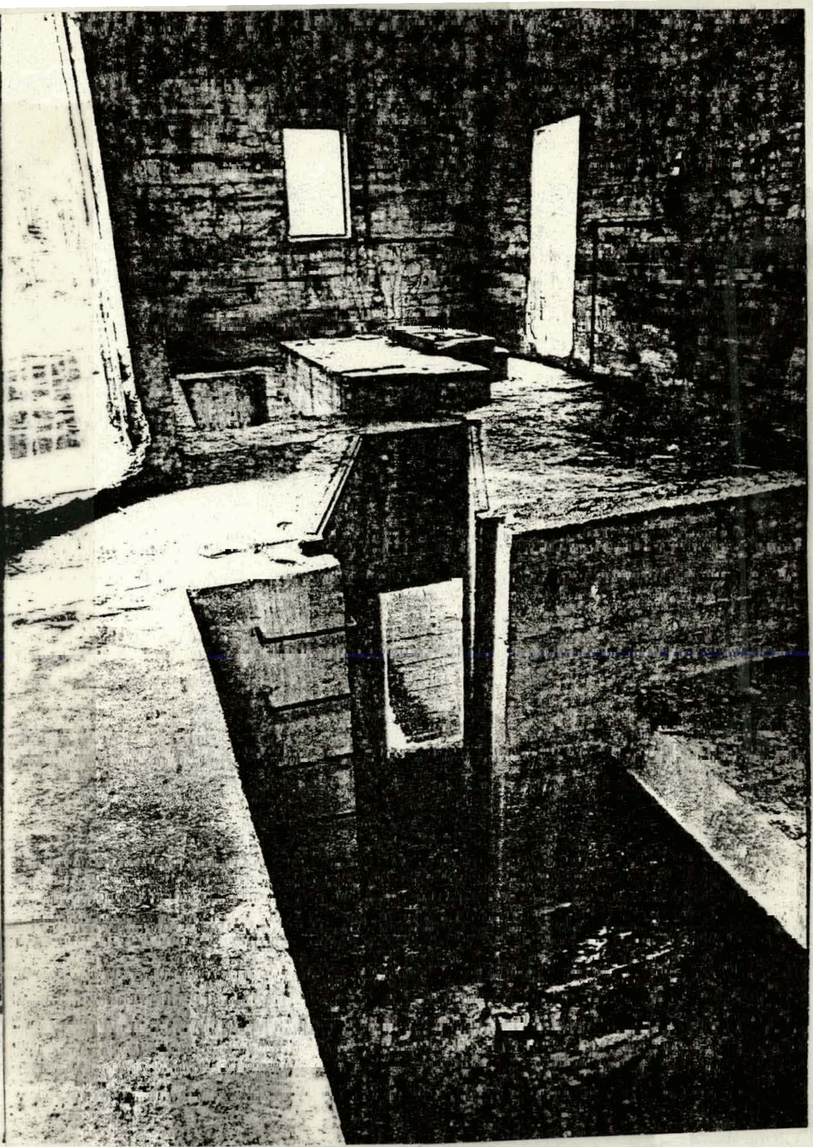
Cement and concrete	$ 300.00
Asphalt and caulking	110.00
Steel plate and related	80.00
Rental of hoses and pumps	280.00
Form lumber	80.00
Rental of compressor and small chipping hammer	130.00
Rental of cement mixer	60.00
Material transportation	135.00
Boat to transport material to east side	60.00
Labor at $96/day, 12 days	1,152.00
	$2,387.00

Repair of Gatehouse, Gatehouse Area, Floodgate, and Penstock Start The west end of the dam which contains most of the mechanisms for controlling water is in very poor condition. The main control gate (approximately 8 feet wide by 12 feet deep) is badly deteriorated, particularly the concrete on one side. It will be somewhat difficult to repair this gate, as the placement of stop logs ahead of the gate is hindered by erosion of concrete from a spring ice release. However, this can be accomplished during a low flow time of the year. The gate hoist and controlling mechanisms are completely gone and will have to be purchased before the gates can be repaired and put back into proper condition. Repair to the gates can most easily be done by bridging side-eroded sections with a temporary gate using flat, 1/4-inch steel and placing 6" timbers against the steel until the water is stopped, so that the area between the gate and the stop logs is allowed to drain.

The steel on both sides of the gate will have to be repointed and much cosmetic work will have to be done. Gate hoisting machinery, whether mechanical or electrical, will have to be installed. The gate lifting mechanism and timbers, which supported the rack assembly, extended well beyond the roof of the building itself. The control structure, which admits water to the trash rack and screen area, also is in extremely poor condition. It will have to be replaced at the same time that the main gate is installed because there is no way to stop the water in front of it. Once the main gate is raised and the pond level lowered, it may be possible to put stop logs completely across the



The dam is a hollow, reinforced concrete structure which has been rated by the U.S. Army Corps of Engineers as a low hazard impoundment. Compartments beneath the dam enable regular inspection. The catwalk must be repaired and silt which has seeped into the dam through vent ports must be removed.

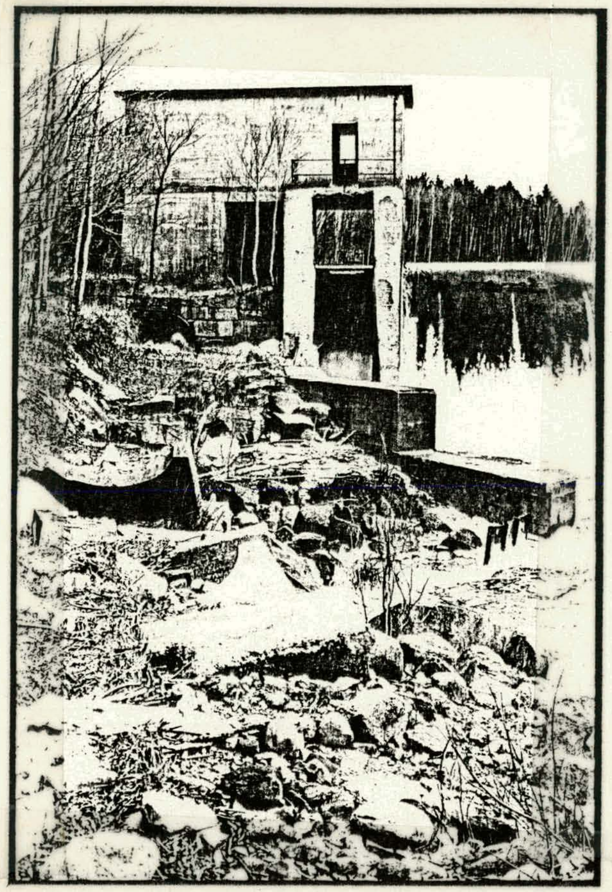


In order to control the flow of water and screen debris from passing into the penstock, the Gatehouse will require new gates and trash racks.

front in order to replace the gate.

All timbers connected with the control gate will have to be repaired or replaced. The lifting timbers and related rack gears are in place and it may be possible to find pinion gears and gate lifting mechanisms that will be compatible. The trash rack assembly will have to be completely replaced as will the hoist assembly that controls bypass water from this gate. This will allow the removal of trash by hydraulic means to the spillway. One large, one medium and one small sized gate assembly will have to be installed, as well as the required trash racks.

The area where the penstock starts will have to be pointed up and sealed. The drain valve in the bottom now leaks a considerable amount of water. The extension platform over the gate opening to the penstock, consisting of railroad iron, has been removed and this should be replaced to facilitate the removal of large floating debris which will be impossible to remove from inside the gatehouse. The gatehouse structure, with the exception of the roof, is in good repair.



Replacement of concrete saddles will be necessary at the start of the penstock run.

The continuous wing walls on the west side of the dam appear to be in relatively good repair except for the stop board adjacent to the gatehouse. These can easily be replaced. The structure will need to be re-roofed and the necessary controlling electrical gear installed. Sufficient power capacity to operate the gate hoists and related motors must also be made available. The extension of the main release gate at the rear of the gatehouse will need extensive renovation. There has been much erosion of the old bank-run concrete and a new surface will have to be applied, backed by the necessary reinforcing. In some areas it will have to be chipped with a jackhammer in order to get a good bearing surface. The rest of the wing wall down to where the pilings are driven appears to be in sound condition.

In order to install a new penstock, new saddles will have to be cast for approximately 200 feet from the gatehouse to where a firm footing for the former penstock starts. Provision will have to be made for a conduit to run along the penstock to support control cables and electric power cables between the gatehouse and the power plant.

Repair of the gatehouse includes the replacement of: doors, windows, bars over windows, outside catwalks, steel plate over bypass gate opening, steel door over the hatch behind the trash rack, chimney and stove, the roof, main gate, bypass gate, stop logs in flood gate with emergency lifting hoist, repair of concrete as required; installation of protective railings around all hazards, general electrical system (including lights under the dam, flood lights, building lighting) and all equipment necessary to bring the civil structure into useful service. All work will be done by the personnel of BMF. Outside contractors will furnish all the lifting hardware for one large and one small gate. The flood gate will be fabricated without hoist equipment, but will be dimensioned as in the drawing found in Appendix.

MATERIALS, LABOR, AND COSTS
(Gatehouse)

Materials for trashrack, 9′ x 17′ w/new "I" beams behind	$ 1,200.00
Material for gatehouse repair to roof, windows and doors	1,600.00
Material for walks, railings and support for same	810.00
Material for gate timbers and splines	460.00
Material for gate hardware for flood control gate (no lifter)	90.00
Gate hoist and hardware, main gate	3,804.00
Gate hoist and hardware, bypass gate	2,348.00
Chimney and stove	400.00
Material for electrical work	1,400.00
Material for bypass gate cover	45.00
Material for concrete repairs	120.00
Misc. tools for gatehouse operation and trash removal	600.00
Carpenter and rough mason onsite, 24 days at $96	2,304.00
Welding equipment and welder	1,100.00
Carpenter at principal's shop	192.00
	$16,473.00
Compressors, drills and sandblasting	300.00
	$16,773.00

The following repairs to the gatehouse area, floodgate, and penstock start will be necessary:

Repair of concrete work and lower portion of flood gate; construction of footings and replacement of concrete saddles for penstock. Construction of a timber crib above concrete retaining wall to stabilize erosion; fill added as required to provide access to gatehouse area; removal of trees near wing walls; repair of wing wall; removal of trash and dirt (particularly in the area above the gatehouse). Replace penstock 8" dump valve if required.

This work will be performed primarily by BMF personnel. Outside local contractors will be used for crane operation and trucking of fill. The crane will be used for the dredging and log removal operation as well as for replacement of saddles for the penstock, concrete pouring, repairs to gatehouse roof and installation of the first sections of the penstock.

MATERIALS, LABOR, AND COSTS
(Gatehouse area, Floodgate, Penstock Start)

Compressor, chipping and sandblasting equipment	$ 300.00
Concrete for footings for old saddles	400.00
Timber for crib work	300.00
Lumber for footings and saddles	240.00
Misc. fill taken near site. Figure includes loading and transportation and spreading to provide gatehouse access for the crane	850.00
Cleaning of the inlet structure and area in front by crane, above, 10 hours	650.00
Material handling of concrete and placement of first 120 feet of pipe	650.00
Transportation of crane and use of accessory crane equipment	520.00
Rough carpentry, masons and common labor	960.00
	$4,870.00

Penstock Replacement If a penstock of other than steel construction is contemplated for the project, the wing wall extending downstream from the dam should be enlarged and extended by another 50 feet, as indications by abrasions on rocks show that ice has traveled at least this far. The area directly in front of the dam will require removal of boulders and a concrete slab that appears to have broken off from the previous structure. Approximately 200 feet downstream from the dam it appears that the penstock can be bedded into native terrain with no problem from ice damage beyond that point.

Depending on the type of penstock selected, some fill will be needed to grade the penstock run. There are several points where the bank has eroded and rocks have tumbled down. Most of the penstock area is well graded and can be easily worked with small machines. If light material penstock is chosen, there are at least two spots along the penstock run where clay seems to be predominant in the soil. If light material is chosen, good drainage under the penstock will be necessary to prevent excessive weight build-up on the upslope side which could displace the structure, especially if emptied of water.

The following penstock repairs are required:

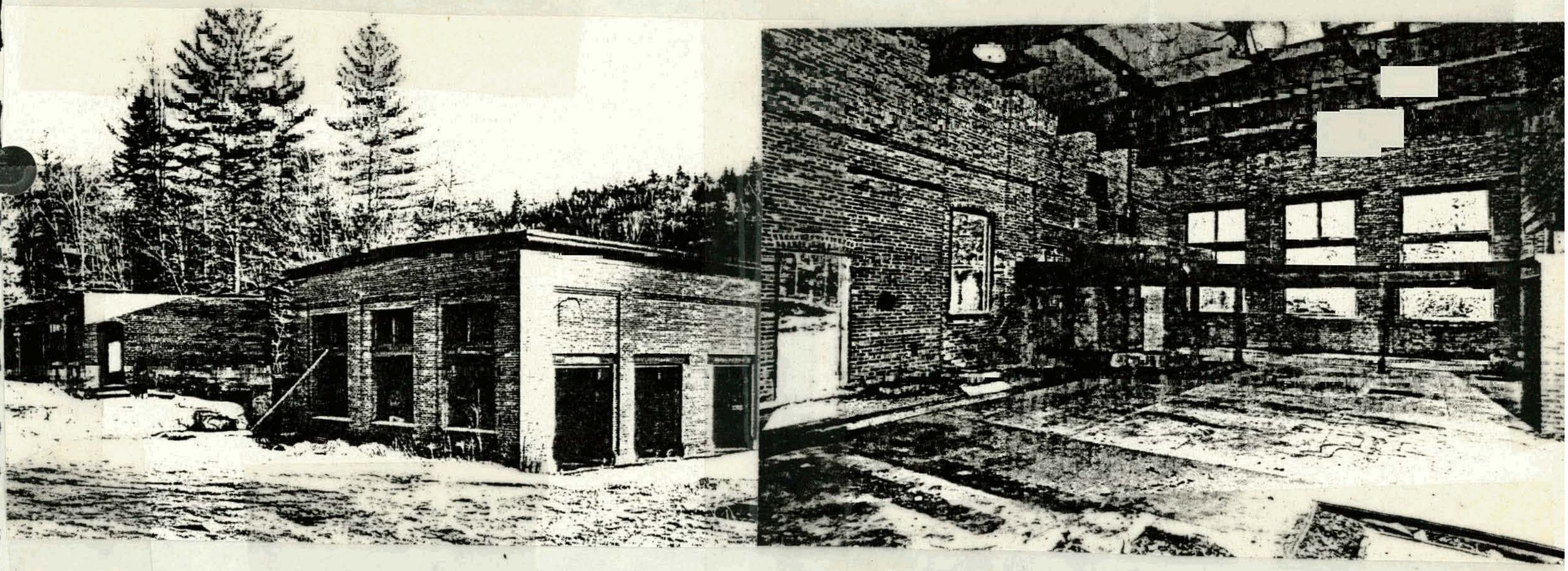
Replacement of penstock, expansion joints, welding; removing silt from the bed; placement of new sand bedding and timber culverts where required; asphalt coating of penstock; installation of 13 hangers and support pipes for power and control cables; ventilation of penstock during welding. The lowest price obtained for penstock was for steel delivered by truck to the site. (See Appendix C for full discussion of penstock options). It is proposed that the first sections be installed by the crane already on site and welded in place. The steel that is already cast into the gatehouse appears to be in good enough shape to be welded directly to the new pipe inside and outside, with a "bump" or equal joint. Flat bars can be used to bridge the weld as required. One expansion joint on the straight section is to be used.

The next sections to be installed can be set on a trailer which acts as a dolly and is then moved into place by a bulldozer. This will save the expense of using a crane. The forward end of the pipe will be attached to the blade of the bulldozer and steered up the right of way until it is in position. The trailer will be unloaded by using the hydraulic system of the bulldozer to lower the forward end, allowing blocks to be placed on the raised upper end. By raising the bulldozer blade the dolly can be pushed down to the forward end of the pipe. Then some blocks will be placed just behind the dolly, the pipe lowered onto the blocks, and the dolly will be pulled out and will return for another length of pipe. The pipe will be loaded back onto the dolly in the pipe staging area in exactly the same manner.

At the lower end of the penstock a slight tapered section will be used to enter the powerhouse and will be anchored to the existing pipe at two locations. If, at a later date, it is decided to use a surge tank, this same configuration can be used for this purpose. The penstock will end at the butterfly valve inlet flange.

MATERIALS, LABOR, AND COSTS
(Penstock)

250 yards of bedding includes trucking	$ 375.00
Loader to carry material up the line	320.00
Welding top section of old pipe and reinforcement of old section	360.00
Dresser coupling for expansion	1,100.00
38 sections of 6' pipe in 40' lengths	159,752.00
Welding 39 joints, 10 hrs. per joint, welder/helper (5 passes) will allow for field work while welder is working, 390 hours at $18 welding, $12 labor	11,700.00
Asphalt coating to be applied by labor above	700.00



Although the powerhouse has been vandalized over the years, it is a brick building that is structurally sound.

Wood blocks to elevate pipe for handling and coating, 80 pieces, 6 x 8 rough timber	320.00
Crane for upper end work	520.00
Handling of pipe at site and use of equipment to position lower sections as required	8,000.00
Allowance for special cuts to make lower bend	1,000.00
Lower end welding	360.00
Placement of 13 12′ x 4″ posts f/control and power cables welded to penstock	780.00
Material for posts and hardware	702.00
Per foot price—$124.00 installed	
	$185,989.00

POWERHOUSE REPAIRS

The powerhouse has been badly vandalized over the years that the site has been idle. It is a brick building which is still structurally sound, but will require complete installation of doors and windows. Only 500 sq. feet of the present building will be needed to house the turbine, service area and equipment (including: electric lighting, power outlets and control cables).

Almost all conduit within the building is intact and could be utilized again, as well as the overhead structural girders which were originally used for the lifting device for the service of the turbine and related diesel equipment.

Two approaches might be followed in building renovation. One would be to replace the windows on the river side of the structure with standard type glass windows and brick in all the rest of the openings, except for the entry doors. Alternatively, since it appears that the original building was built in two sections, it might be more economical to construct an internal wall within the building. This would consist of approximately 20 feet of cement block built to the ceiling and isolating the turbine section. The balance of the building could be left open with the windows barred so that the remaining internal space would provide ample cooling for the transformers. This would greatly shorten the distance that heavy electrical cables would have to be run. It would also allow for less expensive internal switch gear. Transmission of the energy to a transmission line, about 50 yards away, would be an easy step.

Retrofitting of the powerhouse will include:

Installation of the butterfly valve, cutting out the floor to lower the turbine six feet, pouring a new concrete floor, casting all settings for the turbine, speed increaser and generator. Area to be lowered is 12′ x 20′ minimum and will be engineered to take the load of the turbine.

500 square feet within the present structure will house the equipment required for electrical controls and mechanical operation including electric lighting and power outlets, power for the gatehouse and control cables. A cement block wall will enclose this area to the upper deck with a removable cover placed over the old generator opening. Heating of the structure under normal conditions would be through heat dissipation from the generator. Propane gas would be used for emergency heating. Security bars would be placed over the east windows and main doors. Summer ventilation would be by means of gravity units.

MATERIALS, LABOR, AND COSTS
(Powerhouse Repair)

Welding flanges on end of penstock including flange	$ 450.00
Compressor for chopping out old concrete	600.00
Helper to remove old material	360.00
Loader to haul out old material	134.00
Form work for new floor	400.00
Steel reinforcing and 8″ slab floor	440.00

Cement blocks and misc. masonry materials	600.00
Convenience electrical service f/generator room and related space w/provision for service to gatehouse	1,100.00
Cables for service to gatehouse	450.00
Control cable for water regulator or other controls	240.00
Hardware and insulators	260.00
Doors, windows to be repaired and required security	800.00
Cover f/generator opening, 1/4" plate, braces, lifting eye	260.00
Emergency heating, propane	150.00
Summer ventilation units	200.00
	$6,444.00

Downstream Powerhouse The above focuses on reactivating the original dam and replacing the original components. However, power output would be increased 50 percent by building a new powerhouse further downstream.

The structure would be concrete to a 4 foot level on the main floor and then framed above to reduce cost. The penstock would be ground level for an Ossberger turbine and halfway below grade for a tube turbine.

Additional costs include preparation for a road extension, bed clearing and grading for the penstock, extension of the transmission lines and extension of power control cables to the gatehouse.

MATERIALS, LABOR, AND COSTS
(Downstream Option)

Penstock, ±700' at $124/ft	$ 86,800.00
Access road, 500 feet	2,000.00
Clearing and ground preparation for penstock	1,500.00
Control and power cables for additional penstock	375.00
Civil structure	12,825.00
Total	$103,500.00

MISCELLANEOUS COSTS
The following contingency equipment and associated costs would be involved in any option:

Cable for construction lighting during welding operation and portable grinding tools	$ 600.00
Blower for ventilation of penstock during welding (attic fan mounted in plywood)	150.00
Temporary power service or construction generator	650.00
Chain hoist for powerhouse with mounting to fit existing beams	600.00
	$2,000.00

TECHNICAL SUMMARY - STREAMFLOW AND TURBINE SETS

In our analysis of the power potential for on-site agricultural use, we were particularly concerned with the power available during winter months when the need for supplemental lighting in vegetable production is greatest. For this site, excellent stream flow data were obtained from the nearby U.S. Geological Survey gauging station which covers 91.6% of the total drainage area of 95.6 square miles.

To gain a feel for the stream flow, histograms of 5 cubic feet per second (cfs) intervals were drawn for each month.

The manufacturer's data for each of the candidate turbine sets (turbine, generator, exciter, speed increaser, and controls) were reviewed and recomputed to provide the expected power output for each 5 cfs stream flow interval. A comparison among the several turbine candidates under expected conditions for each month of the year was made at two possible sites.

By combining the frequency data used for the stream flow histograms with the expected power output at each interval, the cumulative power potential for each month was derived.

Four candidate turbine sets were evaluated for the old powerhouse site (42 feet of head, 1500 foot penstock run) and three sets for the lower site (62 feet of head, 2200 foot penstock run).

Our analysis showed that the multi-compartment, cross-flow Ossberger turbine operates efficiently over the entire range of stream flows. The Brown Boveri Francis type units provide highest peak efficiency, but are ineffective below 45 cfs. The Allis Chalmers tube-type units offer high peak efficiency but cannot operate continuously below 70 cfs. Replacement of the original Allis Chalmers 47-inch vertical turbine is too expensive.

The costs of the site restoration, new penstock, turbine set, interconnection equipment, powerhouse and installation were estimated for each combination.

The Ossberger turbine set at the downstream site has the lowest cost per installed kilowatt, the greatest output during low streamflow months, and the greatest annual power production.

After adjusting for assumed down time of 5% and increased drainage area, the monthly average generating rate is given below.

MONTH	KWH	MONTH	KWH
Oct	403	Apr	661
Nov	505	May	706
Dec	484	Jun	607
Jan	340	Jul	402
Feb	340	Aug	297
Mar	441	Sep	309

The nameplate capacity is 750 KW and requires an investment of $825,076. This provides an annual production of 4,014,000 KWH with a plant factor of 61%.

In the technical analysis, some of the data are provided in the exhibits and are not repeated in the text. Our effort was directed toward keeping investment and operating costs to a minimum without sacrificing safety or performance features.

This feasibility study is based on the need for an accurate prediction of daily power potential each month of the year for an agricultural end use of this run-of-the-river hydro site. While the concerns of the farm are often the same as those of a utility, our priorities are different. Our primary goal is to produce some power at all times, with particular emphasis on the winter months. Our second priority is to produce the maximum number of kilowatts annually. Demand is of less concern since short term limitations of power availability can be accommodated. However, we have every incentive to use the power efficiently to provide the maximum production of food at the lowest possible cost.

STREAM FLOW ANALYSIS

The Bethlehem Dam is served by a drainage area of 95.6 square miles and has an average stream flow of 216 cfs. The major portion of the drainage area takes in the slopes of the White Mountains, including the western slopes of Mt. Washington (elevation 6288 feet). The weather on Mt. Washington is severe; runoff is usually greater and occurs later than at other sites in New England. The stream flow is monitored by a U.S. Geologic Service gauging station with digital recording equipment. This gauging station covers 87.6 square miles or 91.6% of the drainage area of the dam.

Exhibit A shows a map of the drainage area delineating that section which is served by the gauging station (A) as well as the dam site (A + B). The comparative analysis that follows is based on gauging station data only.

Exhibit B provides the Duration Table of Daily Discharge for the years 1941-1973. It also provides the Flow Magnitude Intervals including the 100 and 200 year magnitudes.

It should be noted that the river flows at 21 cfs or more 100% of the time. The average flow of 200 cfs or more occurs 26% of the time.

Exhibit C provides a plot of the above stream flow data for intervals up to 200 cfs.

As discussed earlier, we are concerned not only with the duration of reduced flows, but also with when they occur. The monthly average daily flow is plotted in Exhibit D for the period 1967 through 1977. This seasonal pattern shows the expected monthly power production. More detail was necessary in order to analyze the daily power potentials for agricultural production.

Accordingly, the streamflow data (1967 through 1977) were tabulated by streamflow intervals for each month of the year. These data, taken from 11 years of USGS daily readings from the Bethlehem Junction station, were converted to the number of hours at each 5 cfs interval and are represented in Exhibit E. The above model was developed by hand on graph paper (over 4,000 data points). For example, 3 days in June were found to flow between 97.5 and 102.5 cfs during the 11 years. The overall error rate is less than 4/10 of 1%. The actual site has 9.1% more drainage area than the above model. This model provides data points for turbine and generator output comparisons on a monthly/seasonal basis.

With some embarrassment, we report that the USGS is able to provide the streamflow curves we plotted by hand. This is not a usual request, but the Service believes it can provide the data from its computer banks. There was, nonetheless, a good reason for doing Exhibit E by hand. We were not familiar with streamflow patterns and our efforts allowed us the opportunity to see the actual effect of summer storms and winter thaws and other variations.

The information in Exhibit E is essential for projecting agricultural production and growing cycles in controlled environments at the site. The reason that this type of data is not generally available is that there has not been demand for it. The implications of our methodology will become clear in the consideration of the various turbine options.

Histograms for each month were drawn based upon the data supplied by USGS. A histogram is a plot of the frequency magnitude at each interval. It provides a visual picture of the distribution by month, useful in forming concepts and public presentations. Exhibit F provides these histograms.

For operation of the plant these histograms and our new USGS data, combined with observatory data of temperature and precipitation, will enable us to develop models to anticipate stream flow for better planning of the day to day operation.

Observations of bi-hourly readings of stream flow data noted that there was no significant variation of flow during a 24-hour period.

The amount of stored water behind the dam is too small to provide any useful peaking capability. Our agricultural uses do not require peaking capability. Additional analysis found in this report does indicate that the site can replace oil-based capacity on a year-round basis.

TURBINE SET INFORMATION

A turbine set for this discussion includes the turbine, butterfly valve, alternator, exciter, governor, controls, and speed increaser.

Three site locations were considered for location of the turbine:

EXHIBIT A

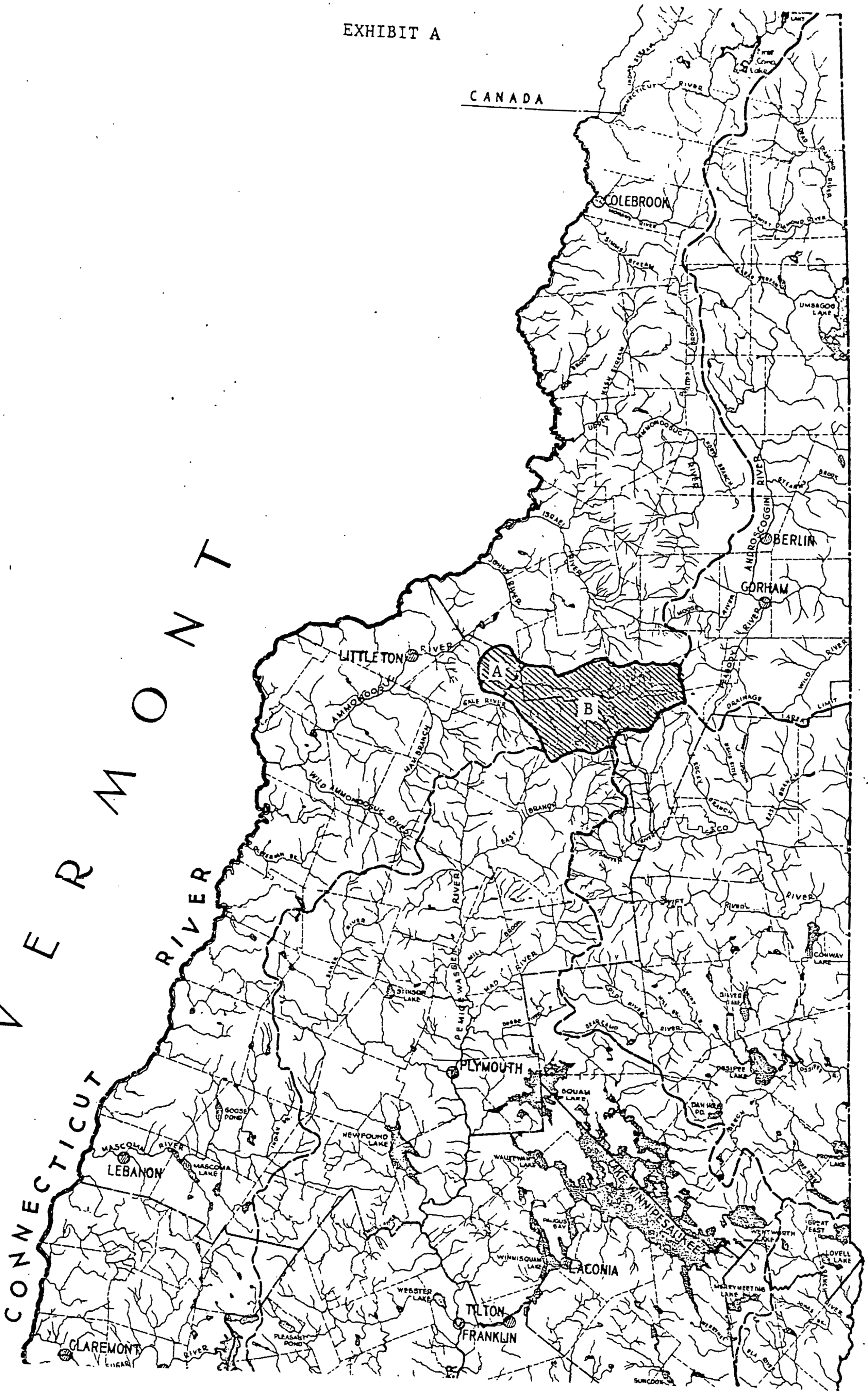

CANADA
MAINE
VERMONT
CONNECTICUT RIVER
COLEBROOK
BERLIN
GORHAM
LITTLETON
ANDROSCOGGIN RIVER
UMBAGOG LAKE
A
B
PLYMOUTH
LEBANON
CLAREMONT
LACONIA
TILTON
FRANKLIN
NEWFOUND LAKE
SQUAM LAKE
WINNISQUAM LAKE
OSSIPEE LAKE
CONWAY LAKE
WENTWORTH LAKE
WEBSTER LAKE
STINSON LAKE
GOOSE POND
PLEASANT POND
MASCOMA RIVER
MASCOMA LAKE
WILD AMMONOOSUC RIVER
PEMIGEWASSET RIVER
SWIFT RIVER
BEARCAMP RIVER
LAKE WINNIPESAUKEE

EXHIBIT B

DURATION TABLE OF DAILY DISCHARGE 1941 - 1973

AMMONOOSUC RIVER AT BETHLEHEM JUNCTION

STATION 01137500

CLASS	CFS	TOTAL	ACCUM	PERCT	CLASS	CFS	TOTAL	ACCUM	PERCT
0	0.0	0	12053	100.0	18	360.0	351	1728	14.3
1	21.0	13	12053	100.0	19	430.0	322	1377	11.4
2	25.0	74	12040	99.9	20	510.0	224	1055	8.8
3	29.0	382	11966	99.3	21	600.0	215	831	6.9
4	35.0	537	11584	96.1	22	710.0	162	616	5.1
5	41.0	745	11047	91.7	23	840.0	111	454	3.8
6	49.0	879	10302	85.5	24	990.0	116	343	2.8
7	57.0	1054	9423	78.2	25	1200.0	73	227	1.9
8	68.0	986	8369	69.4	26	1400.0	40	154	1.3
9	80.0	970	7383	61.3	27	1600.0	38	114	.9
10	95.0	796	6413	53.2	28	1900.0	42	76	.6
11	110.0	786	5617	46.6	29	2300.0	18	34	.2
12	130.0	894	4831	40.1	30	2700.0	4	16	.1
13	160.0	581	3937	32.7	31	3200.0	8	12	.0
14	190.0	421	3356	27.8	32	3800.0	1	4	.0
15	220.0	450	2935	24.4	33	4500.0	2	3	.0
16	260.0	412	2485	20.6	34	5300.0	1	1	
17	310.0	345	2073	17.2					

FLOW MAGNITUDE INTERVALS

AMMONOOSUC RIVER AT BETHLEHEM JUNCTION

STATION 01137500

EXCEEDANCE PROB	RECURRENCE INTERVAL	MAGNITUDES
0.9900	1.01	1598.524
0.9500	1.05	2055.104
0.9000	1.11	2372.004
0.8000	1.25	2847.570
0.5000	2.00	4155.762
0.2000	5.00	6303.801
0.1000	10.00	7962.816
0.0400	25.00	10341.707
0.0200	50.00	12328.059
0.0100	100.00	14505.684
0.0050	200.00	16899.535

EXHIBIT C

Yearly Stream Duration
Bethlehem Junction Sta.

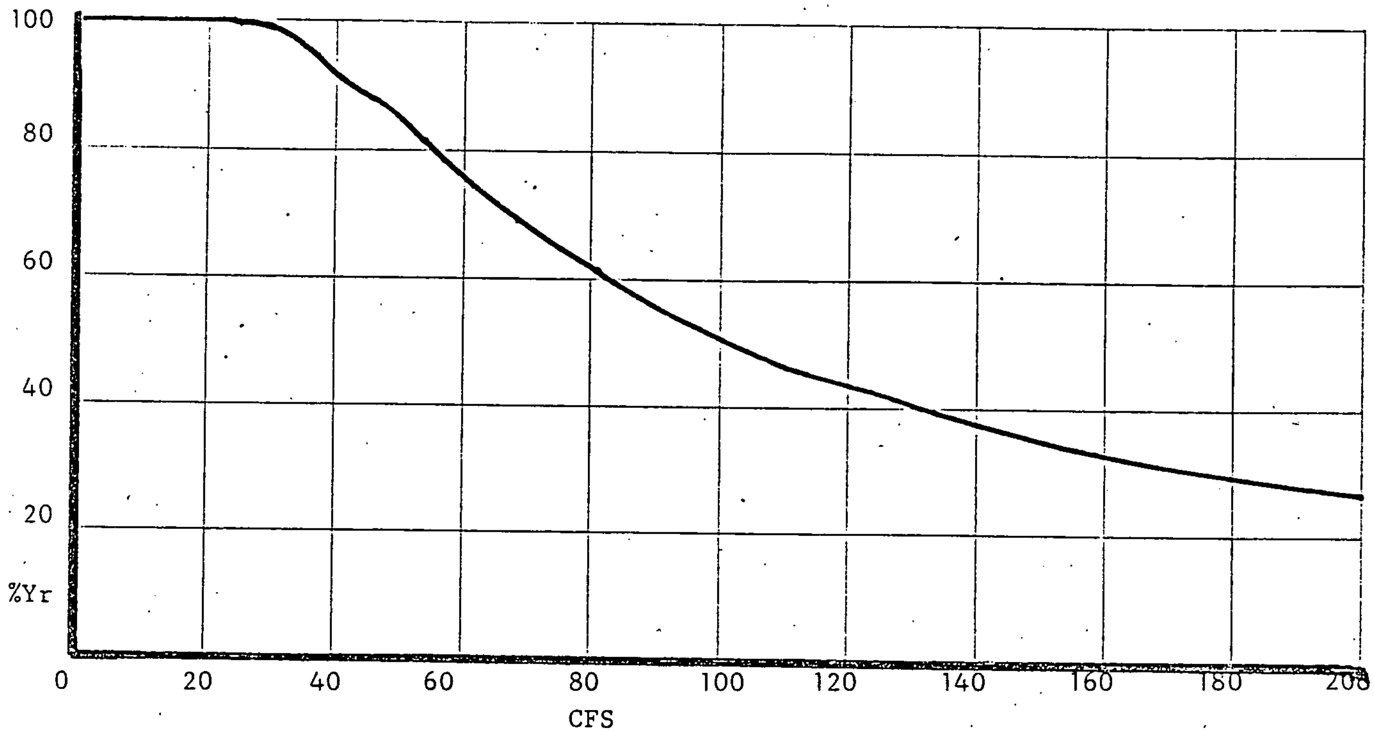


EXHIBIT D

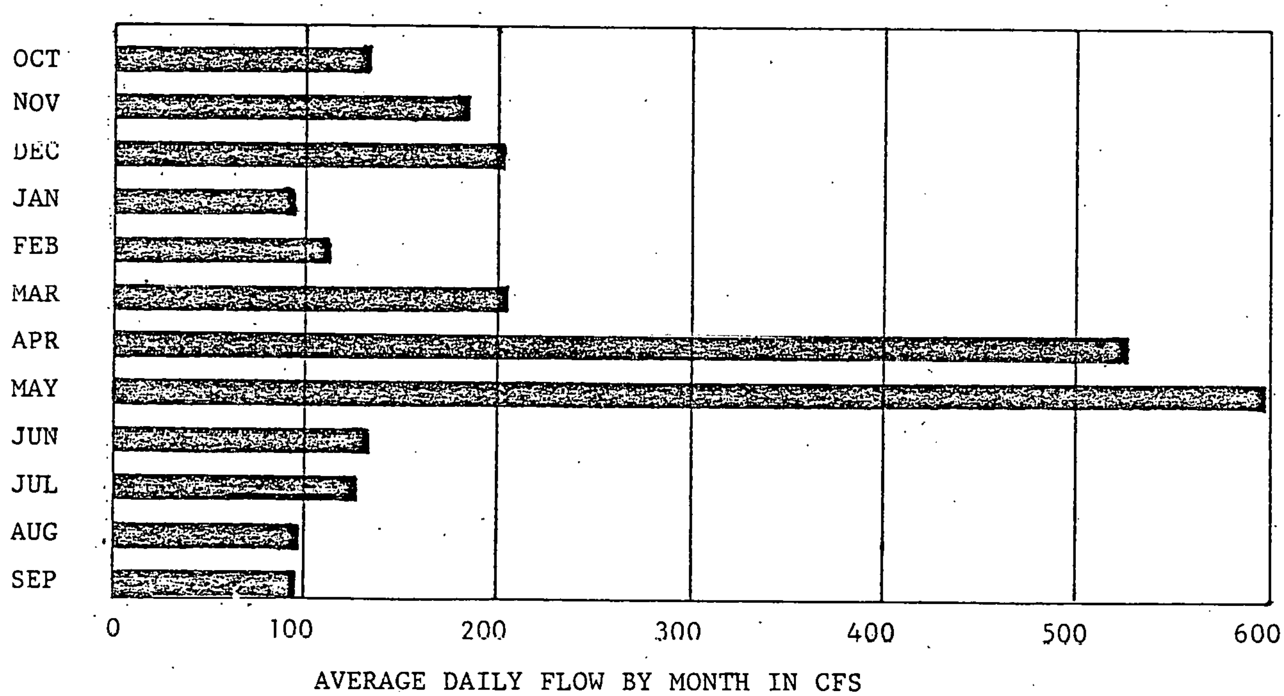


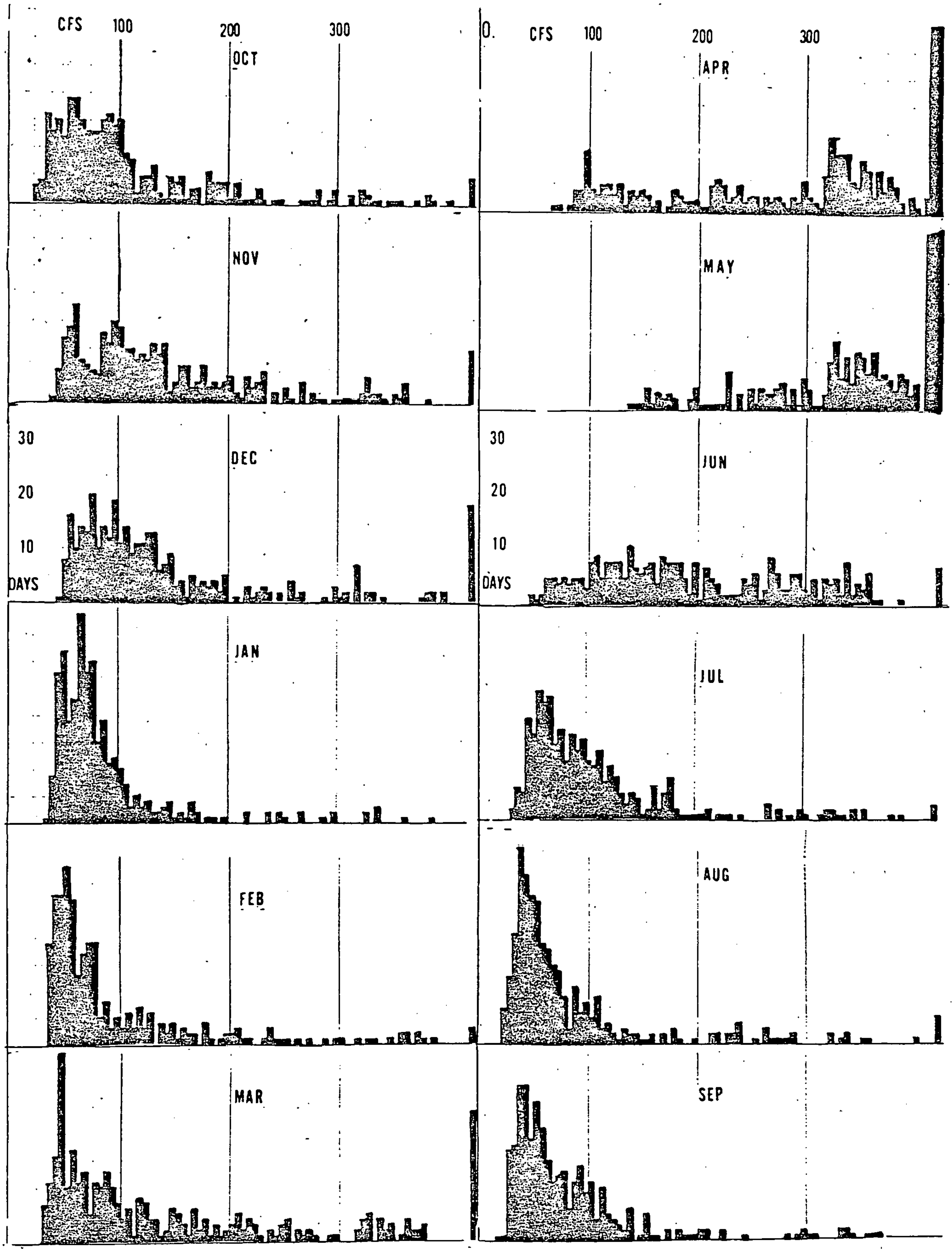
EXHIBIT E

HOURLY STREAM FLOW DURATIONS BY MONTH

For Period 1967 - 1977

CFS	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
20												
25												
30	6.6										28.4	41.9
35	8.8					15.4				4.4	45.8	39.7
40	35.3			2.2	41.4	24.1				13.1	80.7	64.0
45	28.7	2.2		19.6	61.0	32.9				10.9	69.8	64.0
50	33.1	13.3	2.2	61.1	61.0	76.8			4.4	41.6	61.1	41.4
55	26.5	26.6	17.4	69.8	72.0	21.9			2.2	35.0	58.9	57.4
60	41.9	31.0	34.9	41.5	58.9	37.3			4.4	50.3	41.4	46.3
65	41.9	39.9	21.8	50.2	28.4	21.9			11.1	48.1	39.3	33.0
70	33.1	17.7	30.5	85.1	37.1	28.5	2.2		11.1	50.3	32.7	24.0
75	38.7	15.5	30.5	61.5	41.4	11.0	2.2		8.9	30.6	30.5	26.5
80	28.7	13.3	43.6	65.5	41.4	24.1	–		11.1	37.2	19.6	28.7
85	28.7	11.1	21.8	32.7	10.9	21.9	2.2		8.9	24.1	6.5	13.2
90	33.1	28.8	30.5	41.5	17.4	28.5	8.8		11.1	24.1	24.0	24.3
95	35.3	24.5	26.2	24.0	6.5	21.9	6.6		11.1	35.0	13.1	30.9
100	30.9	33.2	41.4	26.2	10.9	15.4	24.0		6.7	32.8	17.4	19.9
105	33.1	31.0	24.0	21.8	6.5	8.8	8.8		17.8	24.1	10.9	24.2
110	19.9	22.2	30.5	15.3	13.1	13.2	6.6		20.0	21.9	19.6	8.7
115	17.7	22.2	19.6	6.5	6.5	2.2	10.9		11.1	28.4	6.5	21.8
120	4.4	17.7	24.0	10.9	15.3	17.6	10.9		17.8	13.1	8.7	10.9
125	11.0	19.9	24.0	7.5	6.5	15.4	6.6		17.8	21.8	4.4	8.8
130	11.0	17.7	28.4	8.7	13.1	8.8	10.9		17.8	17.5	4.4	6.6
135	15.4	24.4	28.4	4.4	–	8.8	2.2		11.1	10.9	2.2	4.4
140	4.4	17.7	13.1	4.4	8.7	2.2	8.8	2.4	24.5	6.6	6.5	13.2
145	2.2	24.4	15.3	6.5	4.4	4.4	6.6	2.4	15.6	10.9	4.4	–
150	11.0	4.4	19.6	8.7	8.7	13.2	8.8	2.4	13.4	8.8	4.4	2.2
155	8.8	8.9	6.5	2.2	2.2	11.0	6.6	9.4	15.6	2.2	2.2	11.0
160	11.0	15.5	8.7	4.4	6.5	6.6	2.2	2.4	17.8	4.4	4.4	2.2
165	2.2	15.5	2.2	2.2	4.4	2.2	4.4	7.1	8.9	13.1	–	2.2
170	6.6	6.6	10.9	8.7	4.4	13.2	–	4.7	20.0	4.4	4.4	–
175	6.6	8.9	6.5	4.4	–	4.4	2.2	7.1	17.8	10.9	–	4.4
180	–	15.5	8.7	–	8.7	8.8	8.8	4.7	17.8	17.5	6.5	–
185	13.2	6.6	6.5	2.2	2.2	2.2	6.6	–	17.8	4.4	2.2	4.4
190	8.8	8.9	8.7	2.2	–	6.6	4.4	–	11.1	2.2	–	2.2
195	8.8	6.6	4.4	–	2.2	2.2	4.4	4.7	4.4	2.2	–	2.2
200	8.8	8.9	10.9	2.2	4.4	4.4	4.4	9.4	17.8	2.2	2.2	2.2
200+	101.6	116.2	141.8	41.5	74.0	201.9	548.1	687.3	316.5	70.0	74.2	48.5
Total	747.2	726.8	743.5	745.2	680.1	738.8	720.0	744.0	723.4	735.0	752.6	735.8

EXHIBIT F



CFS DAILY AVERAGES BY MONTH FOR 11 YEARS

1. At the dam, providing a head of 21 feet,
2. At the old powerhouse site, providing a head of 42 feet and requiring a penstock run of 1,500 feet (Option 1),
3. At a downstream site, providing a head of 62 feet and requiring a penstock run of 2,200 feet (Option 2).

The location at the dam itself could not provide enough power potential for the scale of on-site operation projected and therefore was not considered further.

Inquiries were made to many potential suppliers of turbine sets. However, three corporations were selected as the best qualified. Their quotations and specifications were received as noted below:

A. F.W.E. Stapenhorst of Pointe Claire, Quebec: representing the Ossberger Cross-Flow Turbine which is manufactured in Germany. (Appendix D-1)
B. Brown Boveri Corp. of No. Brunswick, N.J.: which quoted a horizontal Francis turbine for Option 1 and a vertical Francis turbine for Option 2. These turbines are manufactured in Norway. (Appendix D-2)
C. Allis-Chalmers of York, Pa.: Allis-Chalmers is the successor of S. Morgan Smith which made the original 47 inch vertical Francis turbine. They quoted a replacement turbine for the original site (Appendix D-3) as well as a modern tube turbine for both sites (Appendix D-4)

All three quotations were fully responsive to the reactivation of the Bethlehem Dam, and included quotations for turbine, butterfly valve, governor, alternator, exciter, speed increaser, and controls. All three suppliers are very well qualified and are recognized world wide for excellence in the hydroelectric field.

The Farm sent a team to Allis-Chalmers to inspect their tube turbines and to exchange information. Another team visited FWE Stapenhorst at Pointe Claire, Quebec and also visited the Gouin Reservoir of Quebec Hydro that had an installation of two Ossberger Turbines of approximately the same size of our proposed installation.

Appendix E indicates our specifications for alternator, controls, and for the utility intertie. Cost estimates for the intertie at the old site are $18,090; and $24,090 for the intertie at the proposed new site.

The following relationship was used in developing power calculations:

$$P = \frac{62.4 \times .746}{550} \times H \times Q \times E_T \times E_A$$

P is the Power Output in KW
H is the dynamic head in feet
Q is the streamflow in cubic feet per second (CFS)
E_T is the turbine efficiency
E_A is the alternator efficiency

Note that H, E_T and E_A are affected by the streamflow as follows:

H (head) is decreased due to friction in the penstock and hydraulic components.
E_T is characteristic of the particular turbine.
E_A is a function of the design of the alternator, and the load on the alternator.

OLD POWERHOUSE SITE - Option 1

Exhibit G provides the chart comparing turbine efficiencies and power output for the three candidate sets at the old powerhouse site (42 ft. static head) by streamflow interval. For convenience the best values are underlined. The first column in Exhibit G gives the streamflow intervals in cfs. The second column provides the effective head as derived for each interval. The effective head was determined by taking the static head and subtracting the loss of head due to flow in the six (6) foot diameter penstock. Friction values were taken from published charts.

The third column provides the manufacturer's data for efficiency of the Ossberger turbine. This turbine is operable over the entire range and is more efficient than the Brown Boveri unit below 100cfs, or the Allis-Chalmers unit below 85 cfs. The Ossberger unit has the lowest peak efficiency (84.5%).

The fourth column represents the efficiency of the Brown Boveri turbine, which has the highest peak efficiency of 96%. However, the efficiency of this unit falls off rapidly below 100 cfs to an almost negligible output below 45 cfs.

The next column provides the efficiency for the Allis-Chalmers tube-type turbine with adjustable pitch. This unit cannot safely be operated below 70 cfs and requires mounting such that the draft tube is no more than one meter above tail water.

The power output for each of the candidates is provided by the last three columns. Exhibit H provides a graph of the above power output data.

The original S. Morgan Smith 47" vertical unit is too expensive to replace and was not evaluated in detail.

By integrating power output at each streamflow interval with the average duration of each interval (Exhibit E) for each month of the year, we obtain monthly output in KWH.

Table 1 derives average monthly output and potential annual output in MWH, and presents this output as a percent of capacity.

EXHIBIT G

OPTION 1 - CANDIDATE TURBINE SETS FOR OLD POWERHOUSE SITE

STREAM FLOW CFS	EFF. HEAD FEET	TURBINE EFFICIENCIES Ossberger	Brown-Boveri	Allis-Chalmers	POWER OUTPUT Ossberger	Brown-Boveri	Allis-Chalmers
20	41.8	.706			38		
25	41.8	.726			51		
30	41.8	.745			65		
35	41.7	.763			80		
40	41.7	.778			95		
45	41.7	.789	.27		109	32	
50	41.7	.798	.35		125	49	
55	41.7	.806	.42		141	68	
60	41.7	.812	.47		156	87	
65	41.6	.816	.52		171	106	
70	41.6	.820	.55	.80	186	123	181
75	41.5	.823	.63	.81	201	151	197
80	41.6	.826	.70	.825	216	180	215
85	41.5	.829	.73	.835	230	203	231
90	41.5	.832	.78	.845	245	231	248
95	41.4	.835	.824	.857	260	256	266
100	41.3	.838	.865	.867	275	283	283
105	41.2	.840	.875	.875	289	300	300
110	41.1	.842	.895	.880	303	321	316
115	41.0	.843	.916	.886	317	343	332
120	40.8	.844	.925	.890	330	360	346
125	40.7	.845	.936	.896	344	379	362
130	40.6	.845	.946	.898	357	398	377
135	40.5	.845	.957	.900	370	416	391
140	40.4	.845	.958	.903	383	431	406
145	40.3	.844	.960	.904	395	447	420
150	40.2	.844	.961	.903	408	461	433
155	40.0	.843	.962	.901	419	475	444
160	39.9	.842	.961	.899	432	488	456
165	39.8	.841	.948	.895	444	495	467
170	39.7	.840	.932	.890	455	500	477
175	39.6	.838	.916	.886	466	500	487
180	39.5	.836	.907	.882	478	500	497
185	39.4	.834	.896	.875	489	500	500
190	39.2	.831	.885	.870	498	500	500
195	39.1	.828	.869	.865	500	500	500
200	39.0	.825	.853	.850	500	500	500

Best values are underlined

EXHIBIT H

POWER CURVES AT CFS

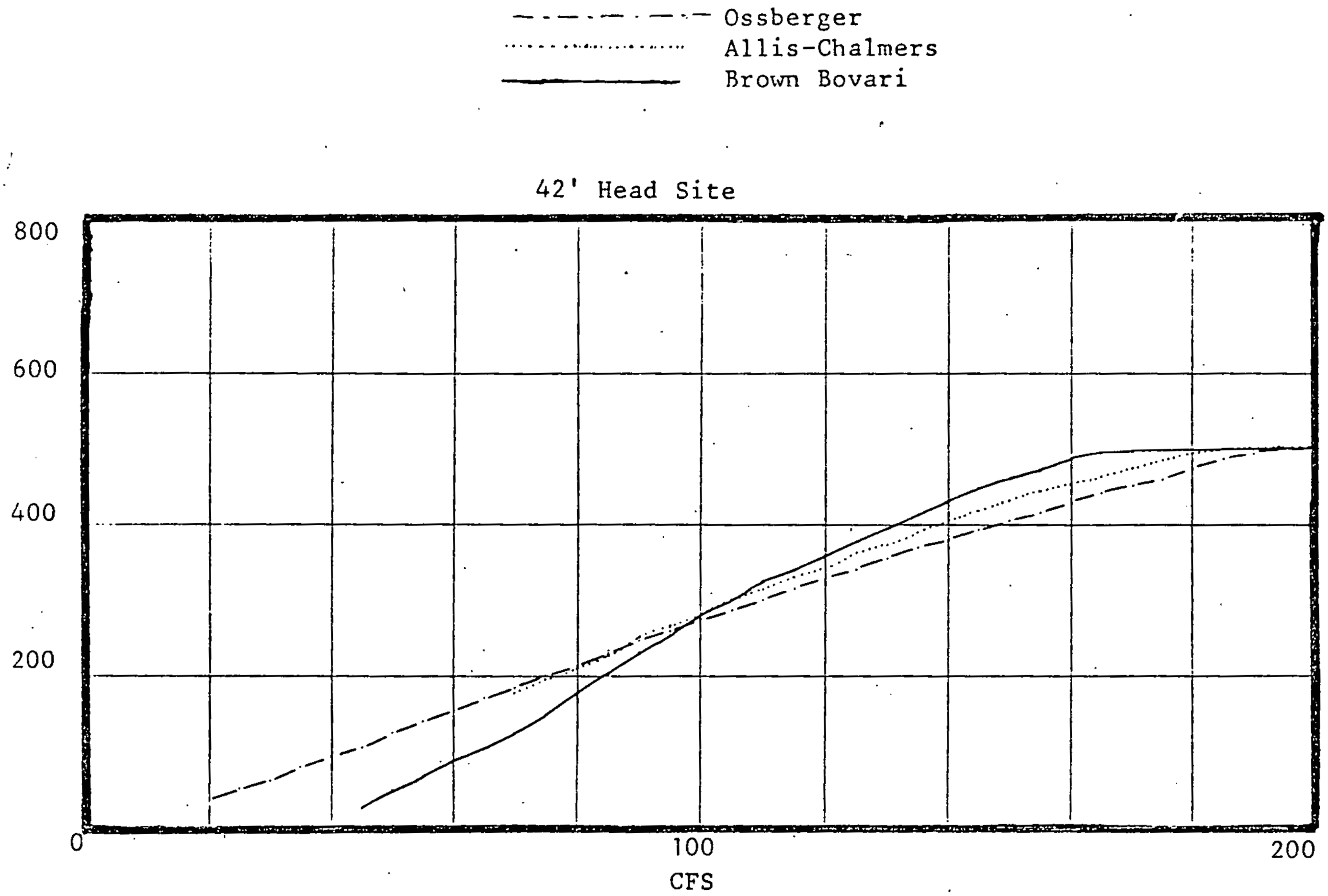


EXHIBIT J

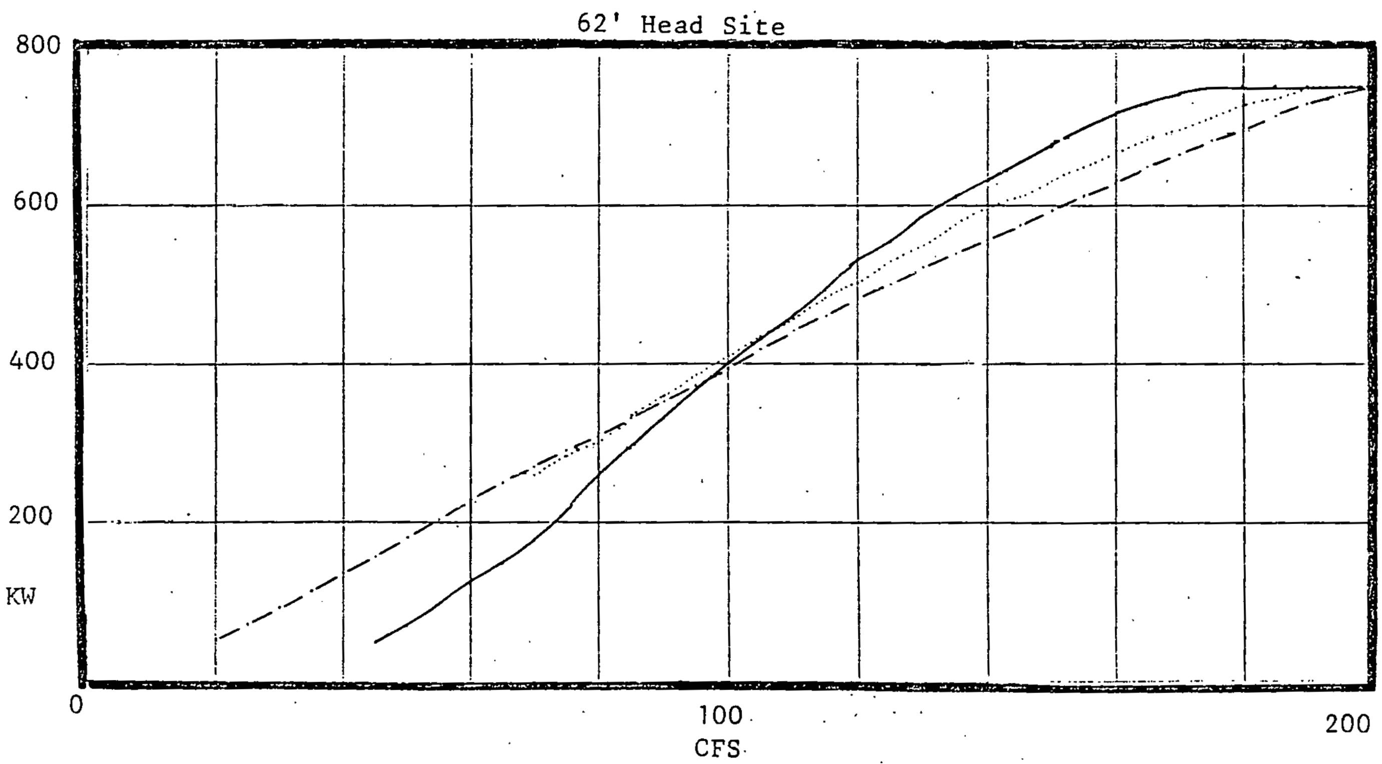


TABLE 1*
AVERAGE MONTHLY POWER POTENTIALS
(old powerhouse)

MONTH	Ossberger	Brown-B	Allis-C
OCT	**285**	256	245
NOV	339	**343**	322
DEC	**320**	311	304
JAN	**245**	197	189
FEB	**259**	217	194
MAR	**292**	288	270
APR	465	**470**	447
MAY	496	**499**	497
JUN	421	**428**	424
JUL	**276**	253	240
AUG	**203**	158	139
SEP	**210**	168	152
Monthly Average	**317**	299	286
Yearly Megawatts	**2785**	2629	2515
Operating %/year	**100**	94	70
% capacity	**63**	59	57

*Best values are in boldface.

The Ossberger unit provided the maximum output for every month except April, May and June. It also provided the maximum annual output despite its lower peak efficiency. For on-site use the ability to operate continuously is very important; the Ossberger unit is therefore the most desirable technical choice.

DOWNSTREAM POWERHOUSE SITE - Option 2

The Bethlehem Mink Farm acquired additional land continuing downstream from the old powerhouse site. This lower site provides a 62 ft. head and requires only 700 feet of additional penstock.

Exhibit I compares power outputs using the same methodology for the old site. The same performance characteristics apply, but the output is approximately 50% greater.

Exhibit J is a graphic presentation of the electrical output for each streamflow interval.

Table 2 provides average monthly outputs, annual output and output as a percentage of capacity.

As previously mentioned, the streamflow was taken as measured at the gauging station. The entire drainage area for the site is 9.1% greater (Exhibit A). The streamflow is also greater by that amount. Table 3 presents a revised calculation of power output. This adjustment is significant, but it does not alter the previous conclusion that the Ossberger unit is the optimal choice. Finally, the last column allows for 5% down time and is the projected performance.

TABLE 2*
AVERAGE MONTHLY POWER POTENTIALS AT DOWNSTREAM SITE

MONTH	Ossberger	Brown-B	Allis-C
OCT	**406**	378	360
NOV	**509**	466	508
DEC	**490**	488	478
JAN	**339**	290	276
FEB	**342**	321	288
MAR	**451**	420	400
APR	694	**702**	699
MAY	743	**748**	745
JUN	625	**641**	630
JUL	**402**	374	353
AUG	**299**	230	205
SEP	**308**	248	216
Monthly Average	**467**	442	426
Yearly Megawatts	**4097**	3889	3738
Operating %/year	**100**	94	70
% capacity	**62**	59	57

*Best values are in boldface.

Again, the Ossberger unit provides the maximum output for 9 months of the year as well as the greatest annual output, operating time, and plant factor.

TABLE 3
ADJUSTMENT FOR TOTAL DRAINAGE AREA AND DOWN TIME

	Original	Adjusted	x .95
OCT	406	424	403
NOV	509	532	505
DEC	490	510	484
JAN	339	358	340
FEB	342	358	340
MAR	451	464	441
APR	694	696	661
MAY	743	743	706
JUN	625	639	607
JUL	402	423	402
AUG	299	313	297
SEP	308	325	307
Average	467	482	458
MWH	4097	4226	4014
%	62	64	61

EXHIBIT I

CANDIDATE TURBINES FOR OPTION 2 - DOWNSTREAM SITE 62' HEAD

STREAM FLOW CFS	EFFECTIVE HEAD FEET	POWER OUTPUT (KW)		
		Ossberger	Brown-Boveri	Allis-Chalmers
20	60.7	54		
25	60.7	74		
30	60.71	95		
35	60.6	117		
40	60.6	138		
45	60.6	159	46	
50	60.5	181	72	
55	60.5	205	99	
60	60.4	227	126	
65	60.4	248	153	
70	60.3	270	179	263
75	60.3	291	218	286
80	60.2	312	260	311
85	60.2	334	295	336
90	60.1	355	334	360
95	60.0	377	372	386
100	60.0	399	406	412
105	59.9	420	431	436
110	59.8	441	462	459
115	59.6	461	494	482
120	59.5	481	528	505
125	59.4	501	556	529
130	59.3	521	587	551
135	59.2	540	611	572
140	59.0	559	633	593
145	58.9	578	656	614
150	58.7	596	677	633
155	58.6	614	700	650
160	58.5	632	719	669
165	58.3	650	732	684
170	58.1	666	744	698
175	58.0	683	750	714
180	57.8	699	750	728
185	57.6	715	750	739
190	57.4	729	750	750
195	57.2	743	750	750
200	57.0	750	750	750

CONCLUSION

The total investment costs of reactivation, including turbine and site options, are outlined in Exhibit K. This exhibit compares reactivation costs, costs per KW, and plant utilization factor. It is clear that the most economic choice ($1000 per KW) with the most output (4014 MWH) is the Ossberger Turbine Set at the downstream site (62 ft. head).

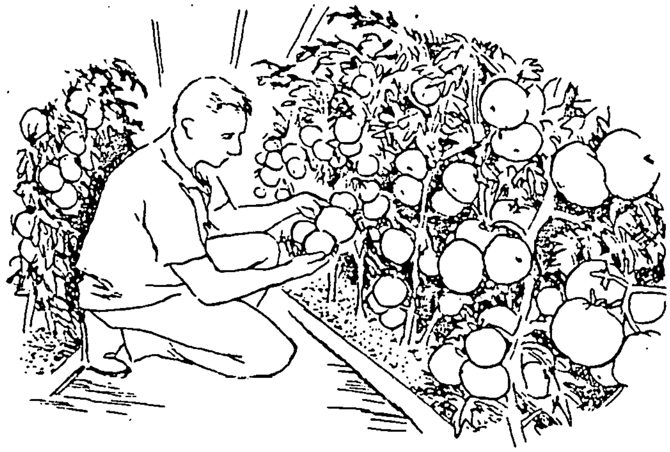
Reviewing the earlier discussion, the Ossberger Turbine Set had the greatest output for 9 months (which included the low flow months when on-site use is critical to an agricultural application) and was the only option which provided continuous output during the winter months. Therefore, from the standpoint of both economic and operations considerations, we conclude that the Ossberger Cross Flow Turbine at the downstream site is the best choice for reactivation of the Bethlehem Dam.

EXHIBIT K

COST ANALYSIS OF DEVELOPMENT OPTIONS & EQUIPMENT

Item							
Manufacturer	Ossberger	Brown Boveri	Allis-Chalmers	Allis-Chalmers	Ossberger	Brown Boveri Boveri	Allis-Chalmers
Turbine Type	Cross Flo	Horiz. Francis	Tube	Vert. Francis	Cross Flo	Vert. Francis	Tube
KW	500	500	500	350	750	750	750
Head (feet)	42	42	42	42	62	62	62
Restore Dam Area	24,030	24,030	24,030	24,030	24,030	24,030	24,030
Powerhouse Activity	2,384	2,384	15,209	450	14,825	14,825	14,825
Cables, etc.	4,060	4,060	3,060	4,060	4,435	4,435	4,435
Sub Total	30,474	30,474	42,229	28,540	43,290	43.290	43.290
Penstock	185,989	185,989	182,889	185,989	274,289	274,289	271.179
Turbine Set	246,000	364,000	304,000	626,000	345,000	378,000	420,000
Utility Intertie	18,090	18,090	18,090	18,090	24,090	24,090	24,090
Installation/Adm	63,000	63,000	63,000	63,000	63,000	63,000	63,000
Cost	543,553	661,553	610,278	911,619	752,669	785,669	824,569
$/KW	1,087	1,323	1,221	2,604	1,003	1,048	1,099
MWH/yr	2,785	2,629	2,515	1,932	4,097	3,889	3,738
% Capacity	63	59	57	63	62	59	57

Please note that adjustments have been made in the above figures to account for variations in installation requirements for various turbines.



Economic and Financial Review

CAPITAL COSTS FOR REACTIVATION AND RETURN ON INVESTMENT

Total capital costs for reactivation of the Bethlehem Dam are estimated at $827,935 or $1,106 per KW of installed capacity. This 750 KW installation will produce 4,014,000 KWH at a plant factor of 61% and a cost per KWH of 4.015¢. Financing is calculated on 110% of capital costs in order to allow for contingencies of cost overruns and/or inflation. A cost summary appears below in Table 4.

**TABLE 4
CAPITAL COSTS AND
RETURN ON INVESTMENT**

Cost Estimate	$ 750,069
10% Contingency	75,007
Investment	825,076
15% Return on Investment	123,761
Annual Expenses	37,000
Annual Cost	160,761
Annual Production	4,014,000 KWH
Cost/KWH	4.015¢

OPERATING COSTS

Annual operating costs include: administration, consultant fees, regular maintenance repairs, supplies, unscheduled maintenance, taxes, insurance and/or an equipment reserve allowance. It is important to note that the Farm will be able to integrate dam operations with ongoing projects and personnel.

Three to five days of special engineering consultant time will be provided for during the year. While we do not anticipate this to be an ongoing expenditure for the life of the project, we believe such an expense is initially justified. Monthly maintenance costs for brush clearing, painting, penstock repair etc., are estimated to be about $2,000 per year. "Operator costs" will include an average of two hours per day to maintain equipment, clean racks, answer shutdown calls, and keep an eye on things over the year. If a full time station attendant was necessary, these costs would increase drastically. Eight to twelve hours a month are allocated for administration, site tours and necessary paperwork.

We could only estimate the operating expenses for taxes, insurance and equipment reserves.

The Town of Bethlehem, because of its lack of familiarity with hydroelectric installations, was not willing to estimate a valuation for tax estimating purposes. The selectmen referred us to the Office of the State Tax Assessor. Since we are not a utility, the State assessor disclaimed responsibility for assessing a potential installation at our site. Both State and Town officials conceded that they had no experience in evaluating hydroelectric installations owned by non-utilities. To arrive at a tax rate we used the current formula for the Town of Bethlehem of $5.06 per hundred on 53% of a "fair market" value of $690,000.

Since the dam and powerhouse are located in a flood plain there is no private or public insurance coverage available. A bill now pending before the New Hampshire Legislature would limit liability for small dams to $50,000. As indicated earlier in the technical summary of the civil works, the Army Corps of Engineers has classified the dam as a "low hazard" impoundment presenting little or no danger to life or property downstream. To protect itself, BMF will establish an equipment reserve of $8,900. General liability insurance is currently being paid on the hydro property as part of the Farm's overall coverage.

TABLE 5

OPERATING COST ESTIMATES

Consultants @ $200/day x 5	$ 1,000
Repair and Supplies	2,000
Operator maintenance @ $5.75/730 hrs.	4,200
Administration $200/month	2,400
Taxes	18,500
Equipment Reserve/Insurance	8,900
TOTAL	37,000

The above total appears to be reasonable based upon research of R. Taylor of the Applied Physics Laboratory at Johns Hopkins University. At small scale hydroelectric sites in Pennsylvania operated by Potomac Edison Co. and Rural Electrical Co-op the following formula seems to apply: RATE = $.2015 \times \text{Capacity}^{-.472}$. Thus a 750 KW site should have .886¢/KWH in operating costs. The above total is .911¢/KWH for our site.

At the onset of this project it was difficult to calculate the value of the power we would generate. In February of 1978, we discussed sale of power to the local franchiser, Public Service Company of New Hampshire. Representatives from the Company informed us that if Public Service agreed to buy power from us, they could pay only 1¢/KWH for dump power and 2.2¢/KWH for all the power we could produce. While it was never our intent to sell power, our assumption was that we must be able to reactivate the dam at a cost per KWH that we could be paid for the power in the open market. Evidence of this would be essential to any negotiations with a bank or other financial institution relative to our proposal for raising vegetables in a controlled environment.

Developing a financing plan for a small scale hydroelectric installation has been like trying to figure out whether the chicken or the egg comes first. It is impossible to project revenues to a bank without a power contract. A power contract cannot be negotiated without a feasibility study and/or a license to produce power at a specific site. In New Hampshire, power contracts were heretofore negotiated between the utility and small producer, and then approved by the Public Utilities Commission.

In the spring of 1978, the New Hampshire Legislature passed the "Limited Energy Producers Act." This requires that utilities purchase power from small (under 5 MW) producers and authorizes the PUC to set the rate structure. As this report was being compiled the PUC announced that the public utilities must pay small producers of power 4¢ (non-firm) to 4.5¢ (firm capacity) per KWH.

FINANCING

Our financial plan envisions two stages of development: (1) reactivation of the dam and sale of power to a utility; (2) conversion to on-site use in an agricultural operation.

The Limited Energy Producers Act of 1978 stipulates that *all* of a small producer's power must be sold to a utility in order to qualify for the rate established by the PUC. Since each year that the project is delayed adds 10% to the cost of reactivation, BMF is committed to bring the dam on line as soon as possible. The scope of this study did not permit an in-depth analysis of a controlled environment with a run of the river power source.

Our initial discussions with local commercial banks were informative but not very enthusiastic. Loan officers indicated that money was tight, loan guarantees would be necessary and that interest rates would be high. They suggested that the larger banks "downstate" or in Boston had more money available. In late March 1979, interest rates were running around 13% for a 20 year payback period.

The Farm approached its principle lender, Farmer's Production Credit Association. The FPCA local loan officers had never considered giving a farm loan to a hydroelectric project. However, they conceded that if the project was part of the Farm's overall development plan and as long as non-farm related revenues did not exceed one-half of its total income in a given year, then perhaps the Board of Directors might consider giving a loan for the project. Such a loan would have a payback of 7 years, a variable interest rate of 1% above prime, and would require the purchase of stock equal to 10% of the balance outstanding on the principle.

Each bank required a power contract and preferred to have a loan guarantee. We conferred with the Small Business Administration, which indicated that in the case of energy related projects that created jobs, the agency could guarantee up to $500,000. The exposure of the participating bank would be 10%. SBA suggested that larger amounts could be guaranteed by Farmer's Home Administration (FmHA). FmHA in Montpelier, VT, stated that it was interested (by legislation) in developing or financing business or industry that increased employment or controlled and abated pollution in rural areas. FmHA in Montpelier was initially skeptical about the creation of jobs at a hydroelectric site. If that site were tied to an industry that employed more people, FmHA would be more enthusiastic. However it has been pointed out that loan guarantees go into effect only upon completion of construction.

CASH FLOW PROJECTIONS

We used a relatively straightforward methodology for our financial analysis, attempting to estimate the flow of income, annual costs and debt service, and the profit before taxes. The cash flow projections in the table below are based upon a 10% increase in revenues and operating expenses for 10 years. The principal of $825,000 is amortized over 20 years at 13% interest. The following table assumes production of 4 million KWH a year starting with a power value of 4.5¢.

TABLE 6

CASH FLOW PROJECTIONS
4,000,000 KWH

Year	¢/KWH	Year Revenues	Debt Service	Operating Expenses	Profit Before Taxes
1	4.5	180,000	117,442	37,000	25,558
2	4.95	198,000	117,442	40,700	39,858
3	5.44	217,800	117,442	44,770	55,608
4	5.99	239,580	117,442	49,277	72,891
5	6.59	263,538	117,442	54,171	91,925
6	7.25	289,891	117,442	59,588	112,861
7	7.97	318,880	117,442	65,546	135,892
8	8.77	350,769	117,442	72,101	161,226
9	9.65	385,845	117,442	79,311	189,092
10	10.61	424,430	117,442	87,242	219,746
Totals/10 Years		2,868,733	1,174,420	589,676	1,104,647

We are encouraged by a projected rate of return on investment of 22% in the first year of operation. This projection does not, however, anticipate the effects of reduced stream flow in a low water year or the as yet unresolved environmental issues of minimum stream flow and fish passage. We believe that the current rate of energy costs will continue to rise and that an on-site agricultural application will make efficient use of the dam's capacity.

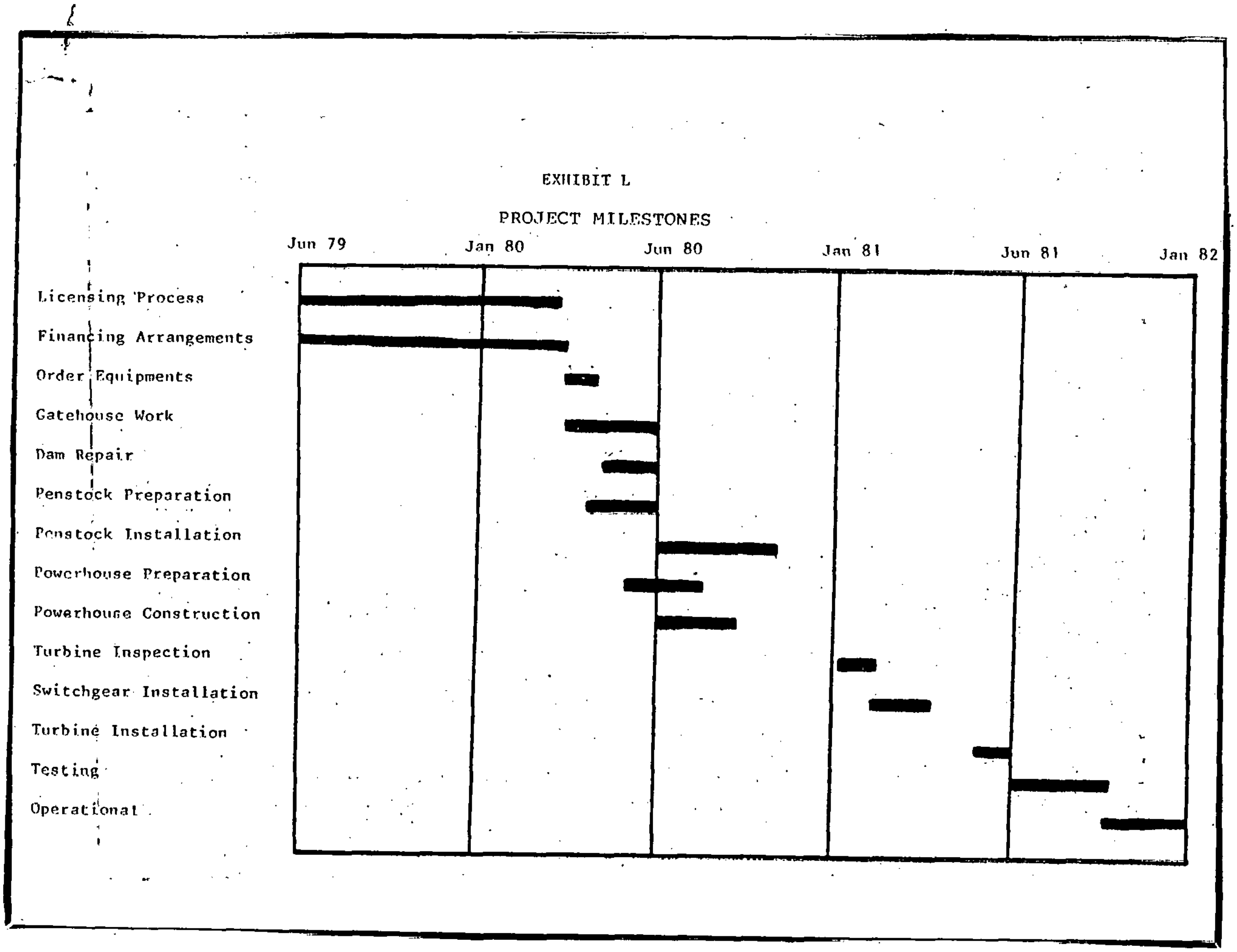
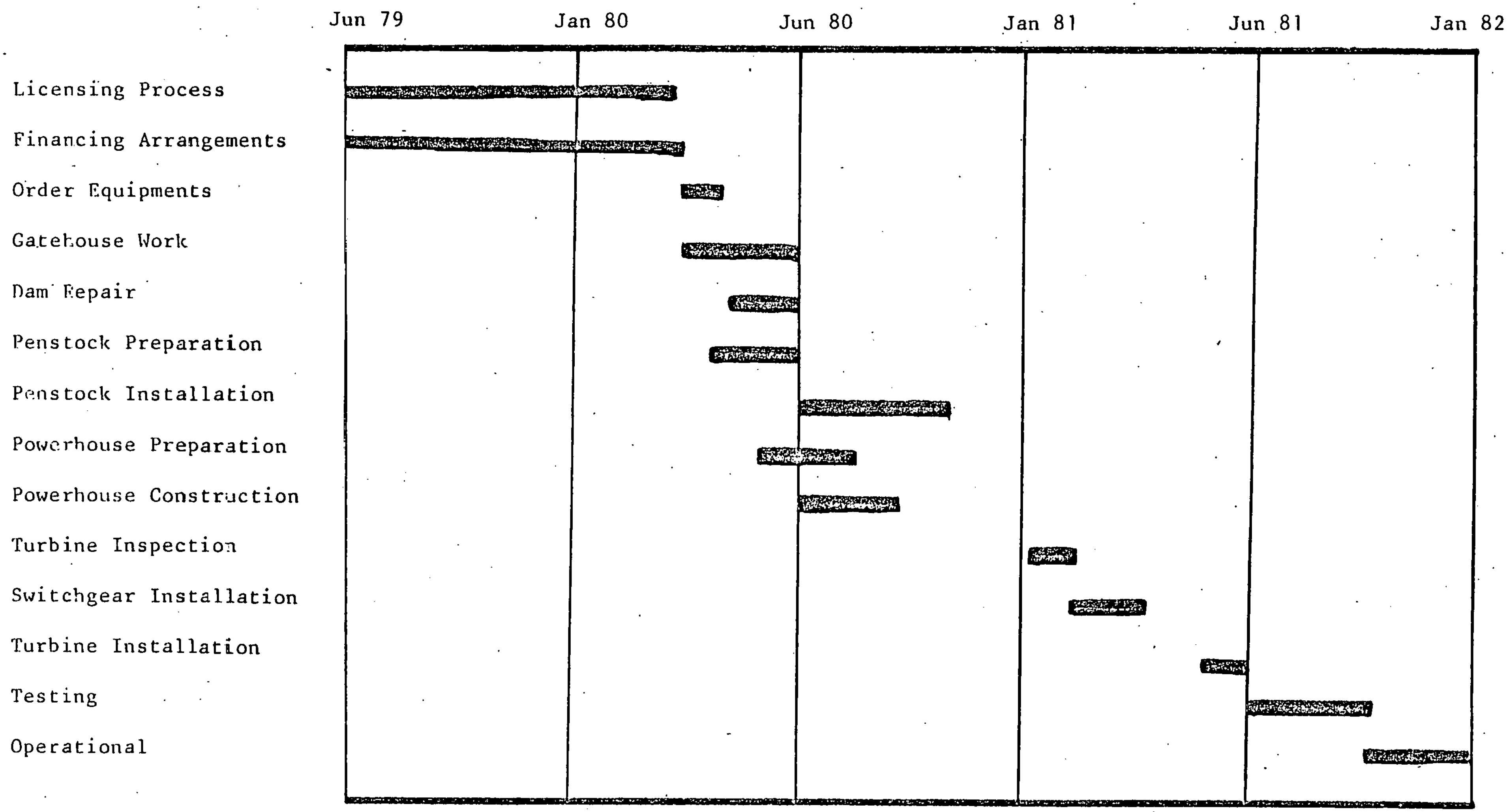
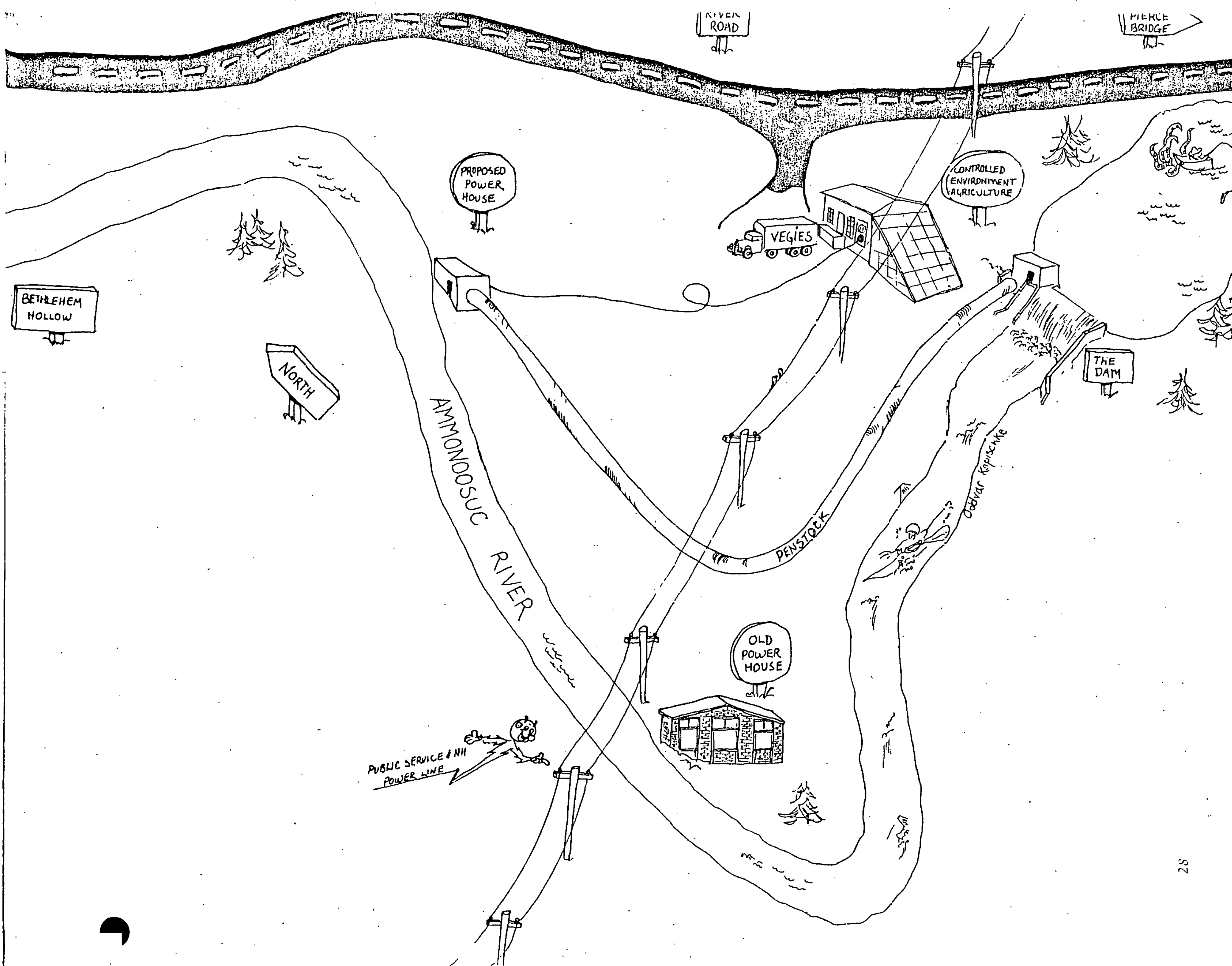
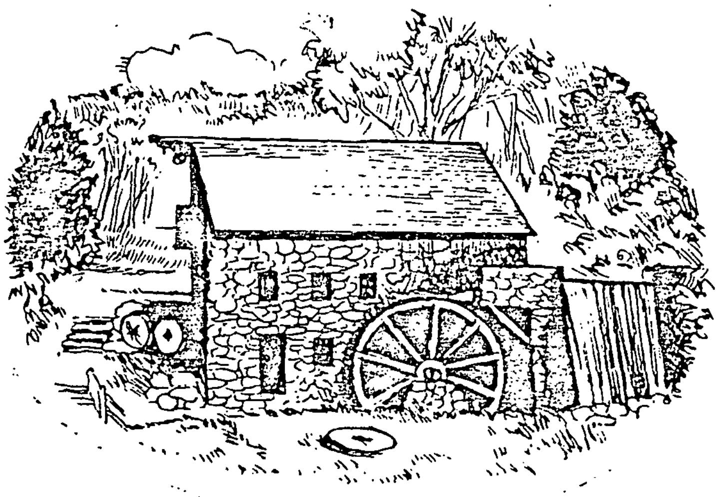


EXHIBIT L

PROJECT MILESTONES




RIVER ROAD
PIERCE BRIDGE
PROPOSED POWER HOUSE
CONTROLLED ENVIRONMENT AGRICULTURE
VEGIES
BETHLEHEM HOLLOW
NORTH
AMMONOOSUC RIVER
PENSTOCK
THE DAM
Oddvar Kopischke
OLD POWER HOUSE
PUBLIC SERVICE of NH POWER LINE



Use of Power

PRESENT BMF POWER DEMAND

Although much small hydro interest nationwide has focused on sale of power to utilities, BMF decided to focus on end-use of the power at the site. Such an approach is appealing for often-discussed reasons such as: minimization of transmission line losses, optimal management of load to meet power capacity and use of interruptible power, and maintenance of incentive to be as efficient as possible in all energy-related operations. Given the Farm's experience in the agricultural field and market trends toward ever-increasing food costs in Northern New England, we explored the manner in which power utilization could be optimized in the production of food.

BMF already has two operations which can use electricity from the dam: its wholly-owned Saranac Refrigerated Warehouse in Littleton, New Hampshire and veal barns at the Farm itself. Internal use at Saranac would involve wheeling the power to the warehouse over 22 miles of transmission lines (although the site is only 7 miles away). The Warehouse is New Hampshire's only public, refrigerated warehouse of significance and can store 3 million pounds of product. Monthly power consumption is generally a function of the mass stored inside the freezer; the less product, the higher the use. The highest recorded demand was about 72 KW; the freezer operation uses an average of about 438 MWHe per year.

The greatest demand for electricity at the Farm itself presently comes from the veal operation. BMF is one of the largest producers of veal in New England, raising about 1300 head per year. Electricity is used to mix feed, pump water, and move air in the barns. Records indicate that the highest demand, 28 KW, occurs during the summer, when the fans, feed mixers, and pumps are all operating simultaneously. Average annual power use for raising veal is 67 MWHe.

Since neither of the existing operations above can use a significant amount of the power from the site, much of our attention has been directed toward controlled environment agriculture sized to match the power output from the dam. Our preliminary thinking about such a facility is presented below:

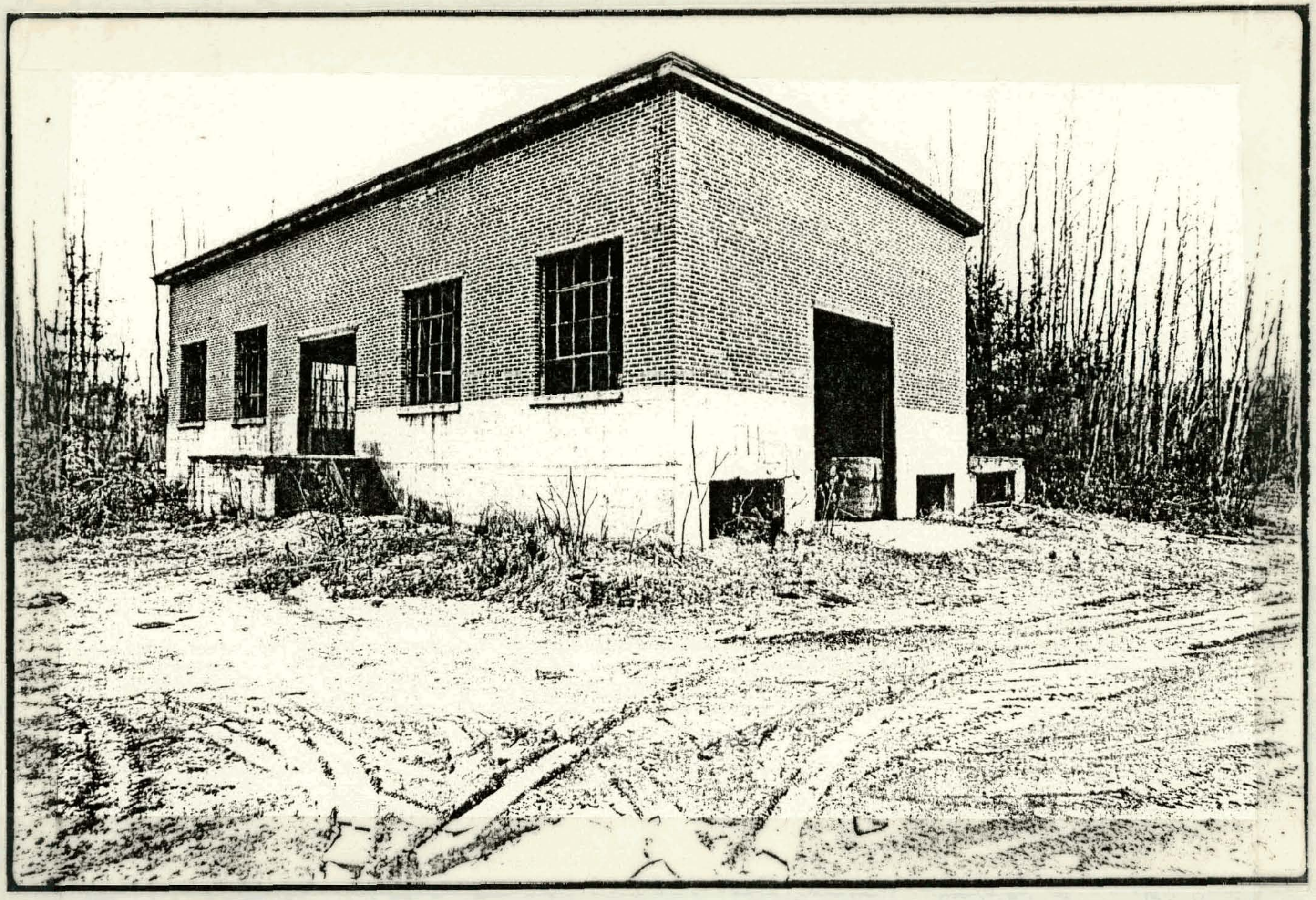
CONTROLLED ENVIRONMENT AGRICULTURE (CEA)

There are three existing masonry structures currently at the site which are not in use. Of these, the former Public Service Co. Transformer Service building located about 30 feet from the dam is favorably suited to re-use as a Prototype Aquaculture/Agriculture Production Facility. This could serve as an experimental model for a larger facility to be constructed at the site for maximum utilization of the power produced at a later date.

Electricity generated would be used to produce both light and space heating through lighting of the structure to extend the growing season and to supplement natural daylight. An integrated biological system of aquatic and vegetable production (probably talapia or other warm water fish and lettuce and tomatoes, along with final stage maple syrup production and some food drying and/or canning operations combined) would provide for balanced load management on a seasonal and daily basis which would be compatible with the electricity generating pattern of the plant.

Schematic diagrams of what such a facility might look like are found in Exhibits M1&2.

Any sort of reasonable determination about the quantity and quality of crops and fish species which could be grown under such CEA arrangements would require a full feasibility study unto itself. Relevant research which is being conducted at a variety of test facilities around the country is currently being surveyed by the BMF, as are local market conditions for the produce. However, some



The former transformer storage building could be refurbished and used as a facility for controlled environment agriculture.

very preliminary data on vegetables have been developed to further illustrate the CEA concept.

Lettuce and tomatoes appear to be two viable crops which would complement one another in a CEA facility. Lettuce can tolerate varying amounts of light in a controlled environment. Lights give off low grade waste heat which could be used to supplement tomato production. In our calculations we have assumed that 400 KW of the dam's power would be used initially, to insure sufficient surplus for other operations and a significant margin of error.

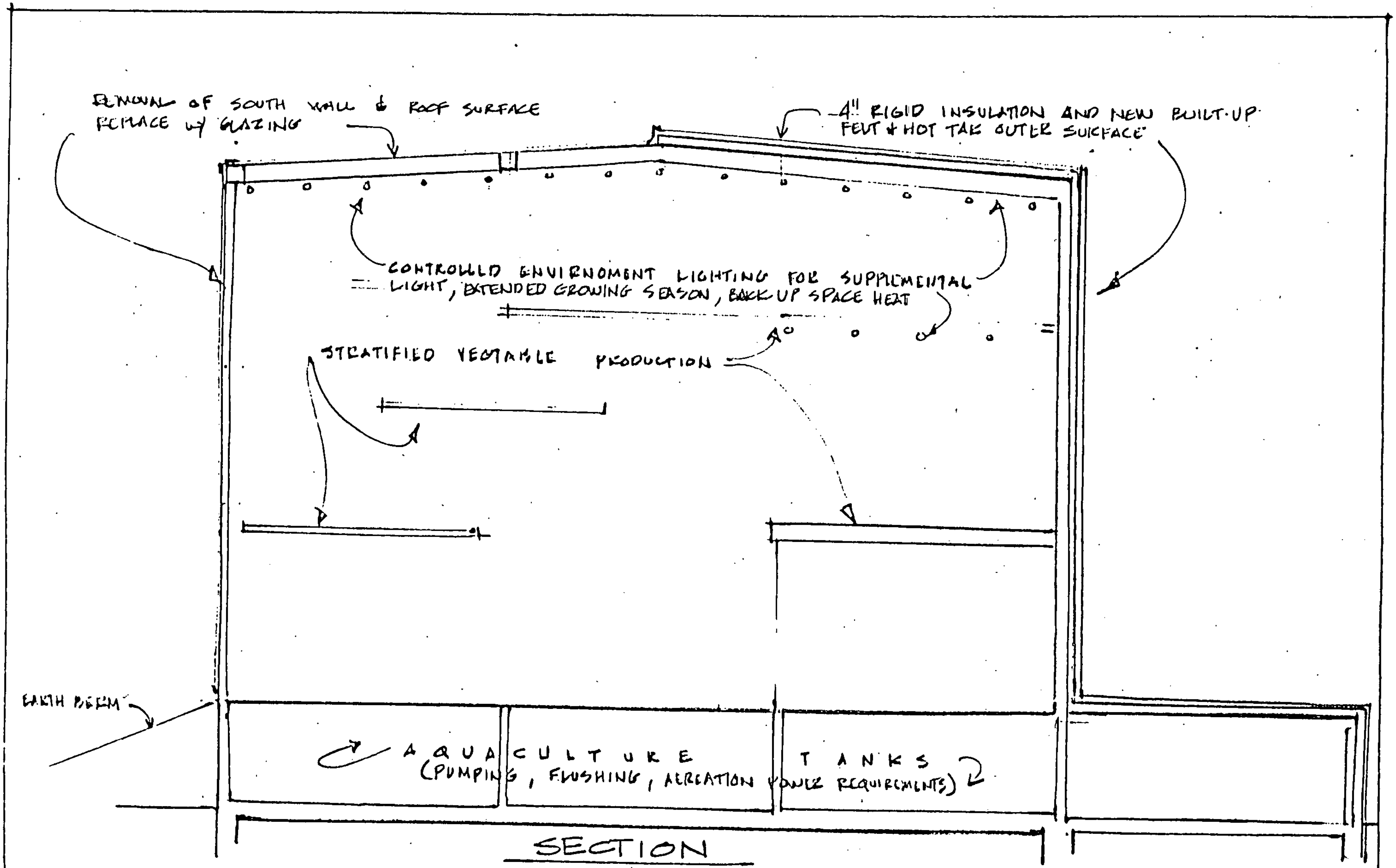
The University of Connecticut has worked with Grand Rapids leaf lettuce for several years in various CEA's. Lee Frankl (South Dennis, Mass.), General Electric (Syracuse, N.Y.), General Mills, and others in the Southwest are starting up production models. Lettuce is particularly applicable to a run-of-the-river power site because it can go without light for days and can be "held" with just a few hours of light.

There are several ways to grow lettuce. Our model uses a 4 by 32 foot shallow tank and special electric lighting facilities. (1) Young lettuce is started at one end of the tank and moved down every day so that production could occur continuously. The bed area needed for a 400 KW unit would be about 26,000 square feet. (2) Harvesting takes place at the end of thirty days. State-of-the-Art technology indicates that 80 pounds of lettuce per square foot can be obtained utilizing a hydroponic, nutrient solution which is constantly pumped across the tank. Beds can be stacked 3 or 4 high to optimally use the space available. However, production would be scheduled so as not to compete with local summer lettuce and to adjust to various load demands placed upon our run-of-the-river system.

Lighting requirements for lettuce production are about 46 watts for 16 hours per day per square foot during the thirty day growing period. Such production amounts to 3.38 KWH per pound.

As mentioned, tomatoes are a good complement to lettuce because they can use the waste heat resulting from lettuce production. Some 80% of the energy input into the lettuce CEA is converted into low grade waste heat and such energy would be most important during the colder, low-flow months. The air flow needed to move heat to the tomatoes will also help with normal circulation of air which is necessary for such a crop. In our thinking at the

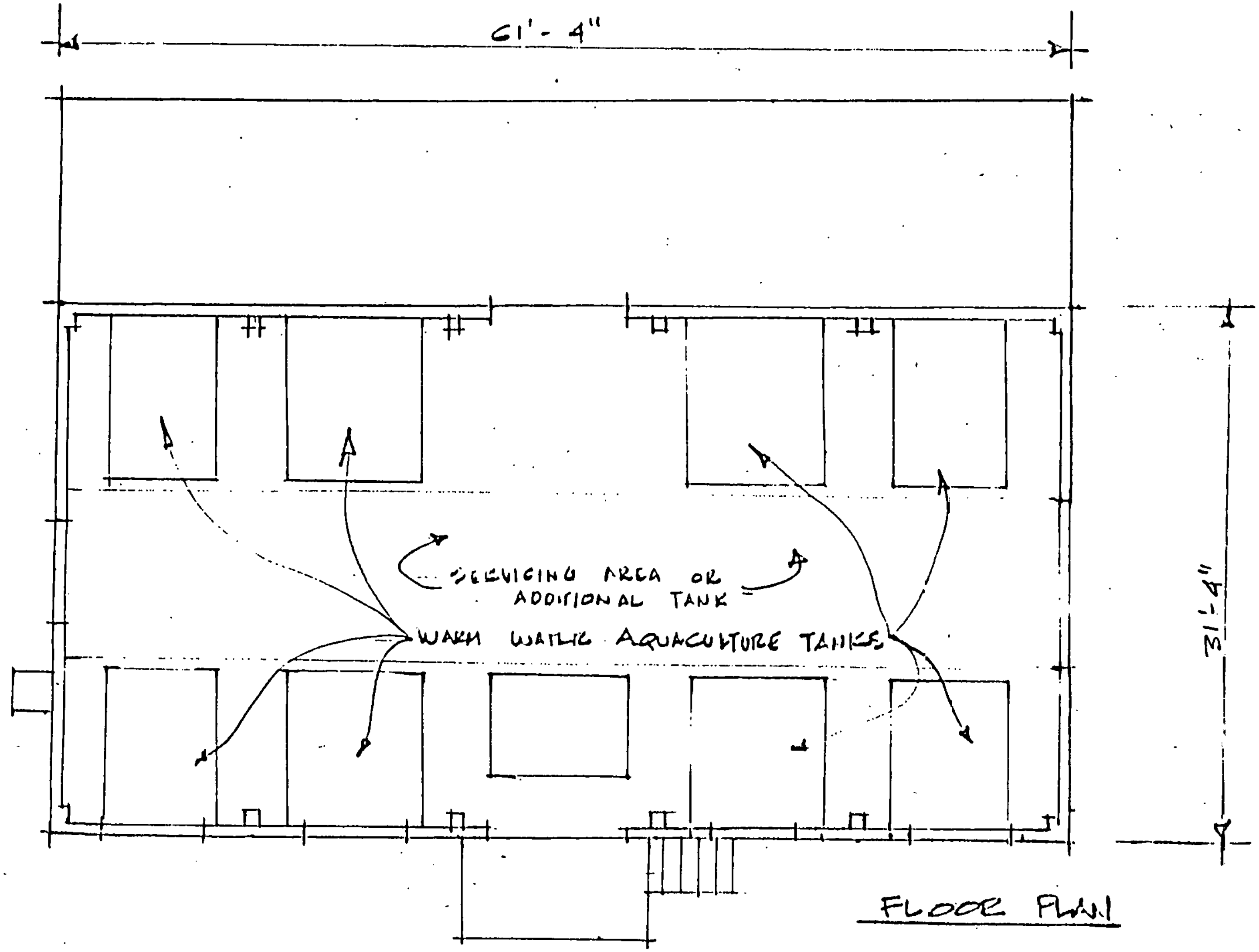
EXHIBIT M



PROTOTYPE AQUACULTURE / AGRICULTURE PRODUCTION FACILITY

SCHEMATIC DESIGN - REUSE OF TRANSFORMER SERVICE BUILDING
BETHLEHEM MINK FARM HYDROELECTRIC PROJECT / BETHLEHEM NH

SCALE: 1" = 5'-0"
DATE: 3/27/79
DESIGN: ERIC GRIFFIN



FLOOR PLAN

PROTOTYPE AQUACULTURE/AGRICULTURE PRODUCTION FACILITY

SCHEMATIC DESIGN - REUSE OF EXISTING TRANSFORMER SERVICE BUILDING

BETHLEHEM MINK FARM HYDROELECTRIC PROJECT
BETHLEHEM · NEW HAMPSHIRE
(Note: Building is located 30' from Dam)

SCALE: 1"=10'
DATE: 3/27/79
DESIGN: FRITZGRIFFIN

N

present time, tomato production would not take place during the months of December, January, and February when little natural light is available and large energy inputs would be necessary.

In our calculations, we have sized the amount of tomato production according to the degree days and waste heat supplied during December. Production was figured for two crops of 15 and 8 pounds per plant, with 1.5 square feet per plant in the bed and 4 square feet per plant overall. Tomatoes grown under these conditions would use a maximum of 18,500 square feet of bed area. There is nothing to prevent hydroponically grown tomatoes from being "stacked" on top of our lettuce production units, creating a stratified growing situation.

On the following page are pictures of an actual CEA: The New Alchemy Institute in Woods Hole, Massachusetts. The Institute has been a pioneer in the development and maintenance of self-contained biosystems.

Preliminary assessments of food production in controlled environments matched to the power capacities of the dam, in addition to use at the warehouse and veal barns, indicate that we could raise approximately 590,000 lbs. of lettuce and 282,000 lbs. of tomatoes a year.

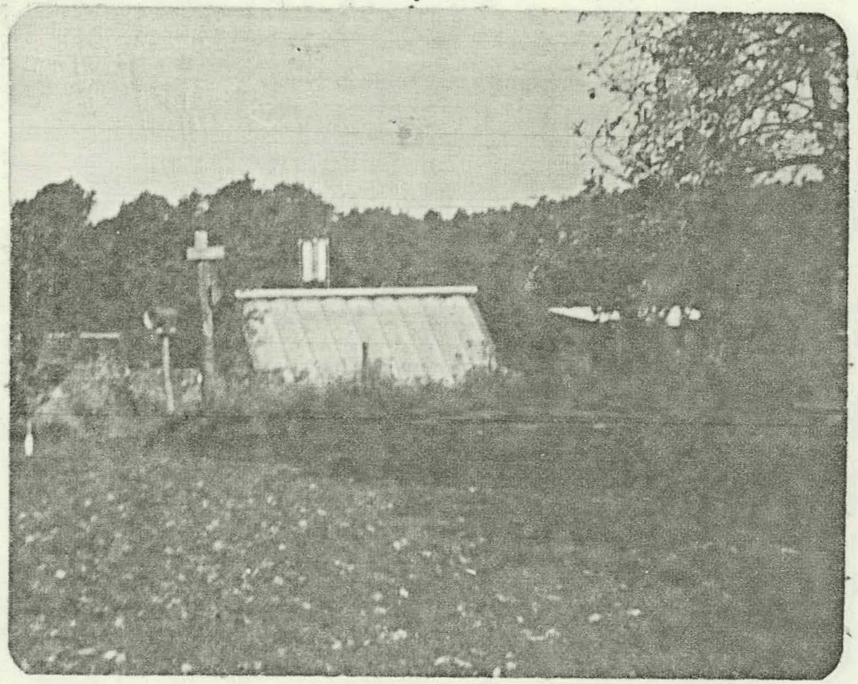
LOAD MANAGEMENT FORECAST

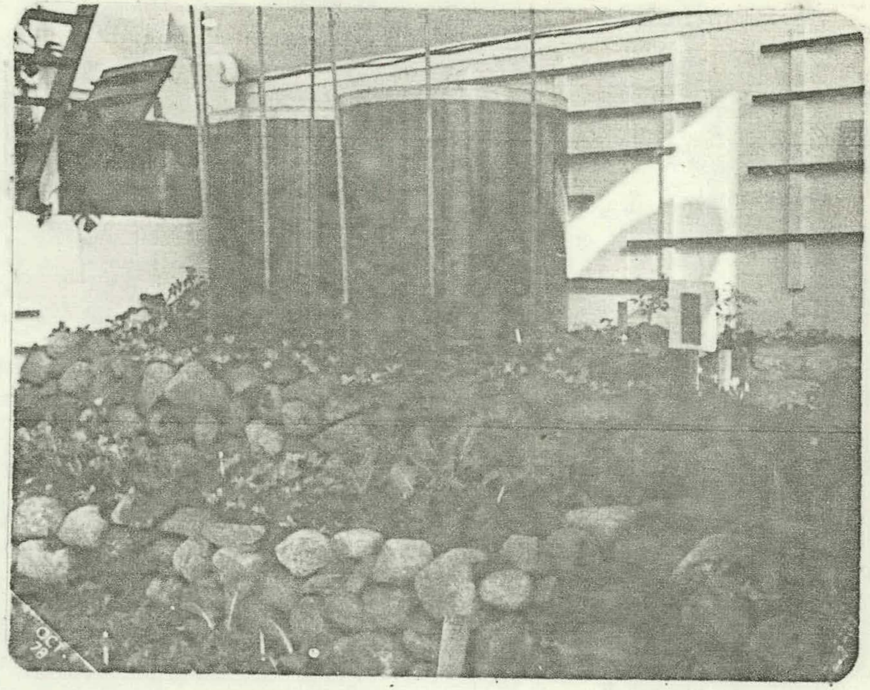
The following load management chart projects monthly and annual power output, food production, and the number of labor hours necessary to sustain each operation. Vegetable production in a controlled environment at the dam will create 11 new jobs, with another 3 to 4 positions anticipated for the processing and distribution of 872,000 pounds of lettuce and tomatoes. Time did not permit us to gather enough data pertinent to aquaculture.

The chart indicates external sale of power and wheeling to other operations. Currently, there is no provision or precedent for retail sale or wheeling of power in New Hampshire. The political climate in the state is changing quickly, however, and proposals for retail sale and wheeling of power are being reviewed by the state legislature and Public Utilities Commission.

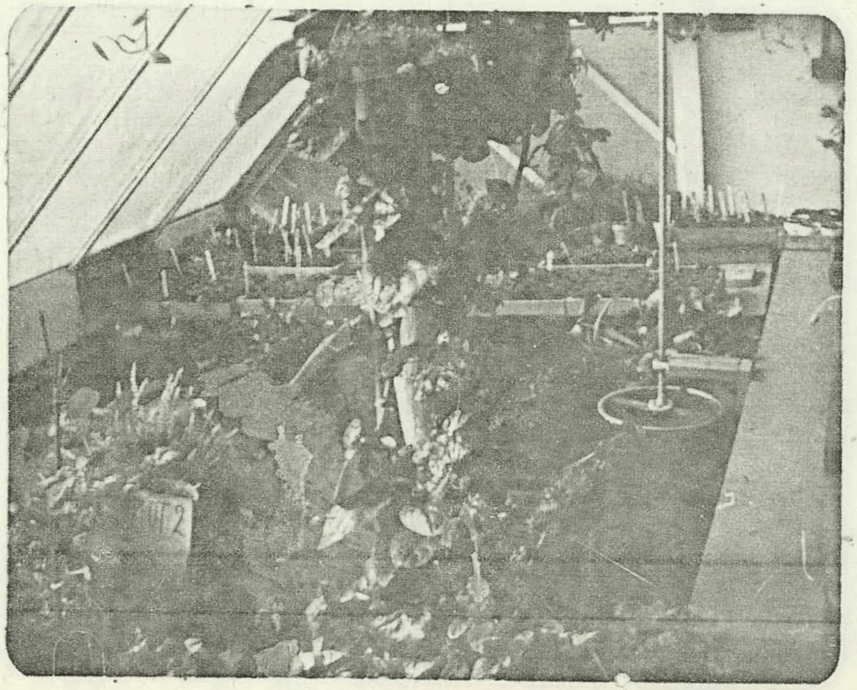
Only three years ago, the Governor's Commission on Hydroelectric Power concluded that generation from small dams would not be commercially viable before 1983. In 1978 the state legislature enacted the "Limited Electrical Energy Producers Act," mandating public utilities to buy power from small, independent producers. In recent weeks, the Public Utilities Commission set the rate public utilities must pay at 4 to 4½¢ per KWH. There is now before the legislature a bill which would authorize retail sale of power by small producers.

It is expected that by the time BMF is ready to implement on-site use of the power our load management plan will be applicable.





CEA-Family Model, New Alchemy Institute, Woods Hole, Mass.



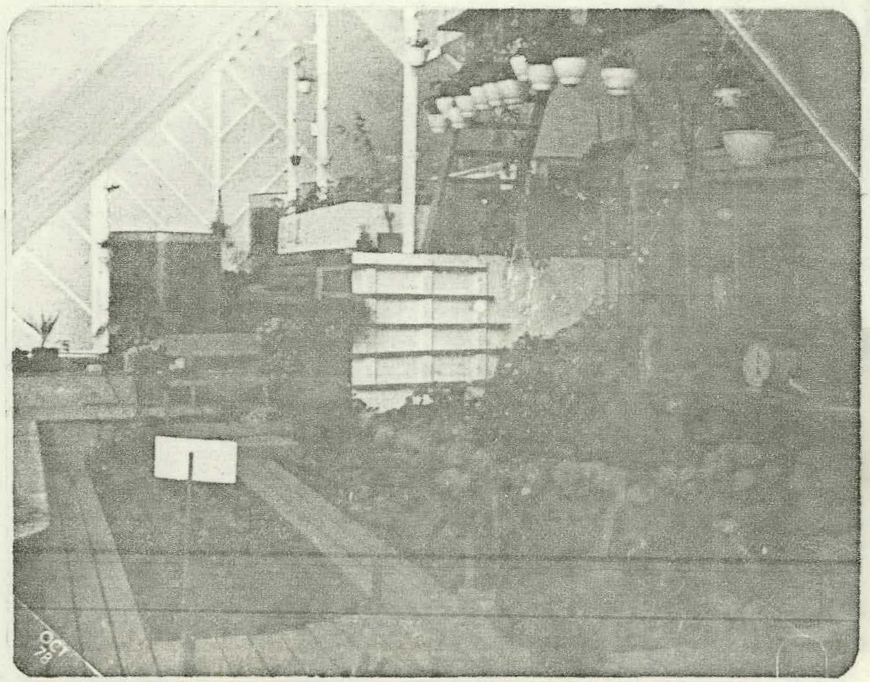


EXHIBIT O

LOAD MANAGEMENT FORECAST

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR/Total
Ave KWH produced (62' head, Ossberger turbine)	403	505	484	340	340	441	661	706	607	402	297	309	
Ave Load Projections/KWs													
Freezer	51	43	47	57	61	50	50	50	48	52	50	50	438 MWH
Lettuce	300	400	400	250	250	350	400	400	200			100	2196 MWH
Veal	6	7	7	8	7	8	7	7	8	11	9	9	67 MWH
Tomato	10	5	5	0	5	5	5	10			10	10	46 MWH
Sales/external	36	50	25	25	17	28	199	239	351	339	228	140	1267 MWH
													4014 MWH

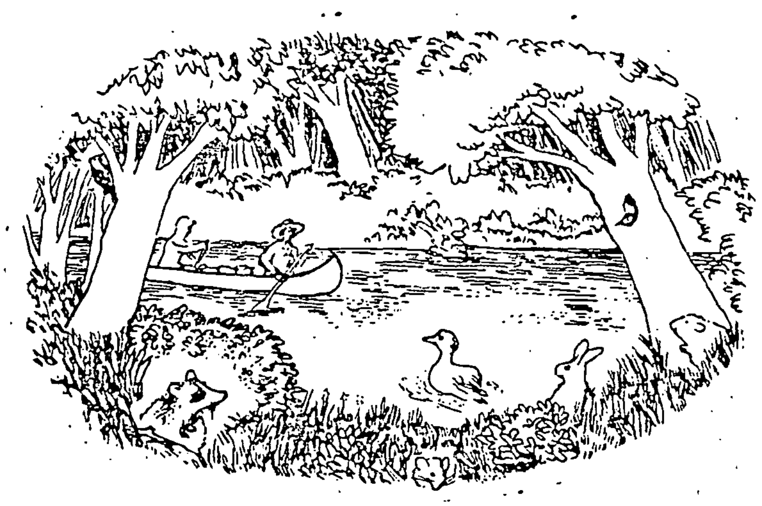
• **Agricultural Production/Month**

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR/Total
Lettuce/pounds	58200	77400	77400	48600	48600	67800	77400	77400	38400			16000	590000
Veal/dressed pounds			120000				118500				78750	120000	437250
Tomato/pounds		50000	48000					100200	84000				282200
													1309,450 Lbs.

Labor Hours/Month

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YR/Total
Tomato	848	966	966	867	867	1993	867	1171	1171		848	1462	12800 Hrs *
Veal	850	850	850	850	850	850	850	850	850	850	850	850	10200 Hrs
Lettuce	1080	1440	k440	900	900	1260	1440	1440	720			360	10980 Hrs *
Freezer	433	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	5196 Hrs
													39176 Hrs

* 11.3 new jobs will be created as a result of on-site, CEA



Environmental Considerations

The Mink Farm has maintained a very open and direct posture with regard to environmental quality. Indeed, the whole concept of using renewable energy for local needs...and in particular for food production is an outgrowth of contemporary concern over environmental impact and the sustainable use of resources.

The Farm believes that its hydro reactivation can be successfully integrated into current use of the project area, as well as into programs to improve the existing environment. This philosophy is indicative of the incorporation of environmental values into business decisions and is also reflective of the flexibility which can occur if concerns are addressed before the final planning and design phases of the project.

As is stressed in the section on Licensing, a significant effort has been made to communicate with and enlist the aid of environmental officials and public interest people in addressing all concerns.

DESCRIPTION OF ENVIRONMENTAL SETTING

The Ammonoosuc River originates at the Lake of the Clouds on Mount Washington. It flows in a westerly direction for approximately 55 miles before entering the Connecticut River at Woodsville, N.H. In this distance there is a drop of approximately 4,520 feet. After a precipitous drop off the mountain slopes, the fall from Bretton Woods to the confluence is about 1,000 feet. The average gradient is about 82 feet/mile.

Above the Bethlehem Dam the river is a typical fast flowing, rocky stream. The stream banks are mostly undeveloped with shrub alder or forest type cover. There are rapid changes in water level, with heavy run-off causing scouring and bank erosion. The stream make-up is a series of pools and riffles with a boulder-rubble bottom. The water runs clear and cold with summer temperatures in the mid sixties (F°) in the upper reaches but rising to the mid seventies (F°) in the stretch from Twin Mountain to Bethlehem. These high summer readings are usually of short duration. There are many miles of tributary streams entering the upper reaches of the river, descending from the White Mountain Range. Many would be classed as intermittent to ephemeral, either drying up to small pools or completely disappearing in the summer.

There is very little open land as most of the upper watershed is within the White Mountain National Forest. The watershed cover is over 90% forestland which is either coniferous or northern hardwoods.

FISHERIES RESOURCES

The lower section of the river below Bethlehem flows through farmland. The river then becomes a series of long pools separated by long flats and riffles. Water temperatures are considerably warmer than the upper section due to the slower flow and a series of four dams which create pondlike conditions. These dams are located at Woodsville, Bath, Lisbon and the Apthorp Dam above Littleton. The river below Littleton often reaches temperatures lethal to trout.[1]

The upper section of the river flows through one of the top recreational areas of the state. Salmonoid fishing plays an important role in this recreation. The 1961 Fisheries Report states that at that time this section "received light to moderate fishing pressure (87.0 man/hours/acre), had a good success rate (0.97 fish/hour), and an adequate return of stocked trout (51.5 percent of the brook trout and 41.7 percent of the rainbow trout)."

Brook trout reproduce in most of the watershed except for the lower reaches of the mainstream. The heavy demand for recreational angling necessitates the release of hatchery fish. The total Ammonoosuc river system receives 10,000 to 17,000 catchable trout annually.

Brown trout reproduce successfully and there is possibly some rainbow trout reproduction.

Several other fish species are found in the watershed. The 1939 Survey Report No. 4 reports a total of 21 species in the Ammonoosuc. Non-native species such as the Montana grayling were stocked, but never became established.[2] "According to a survey conducted in 1973, the dominant fishes in the river were Longnose and Blacknose Dace (D34). Very few salmonoids were found in the mainstream below Bethlehem Dam. The following species list indicates the diversity observed:"[3]

Longnose Dace	Blacknose Dace	Longnose Sucker
Slimy Sculpin	Fallfish	Tesselated Darter
Common Shiner	Creek Shub	Yellow Perch
Brown Bullhead	Smallmouth Bass	Brook Trout
Banded Killifish	Brown Trout	Rainbow Trout

Historically, Atlantic salmon and American shad migrated up the Connecticut River to spawn. Shad were unable to pass the Bellows Falls but with fish ladders will hopefully enter the upper river system. Salmon were able to reach the upper Connecticut and "ascended the Ammonoosuc as far as the Fabyan place in the White Mountains."

At the present time the Ammonoosuc is proposed as part of the Connecticut River Atlantic Salmon Restoration Program. A report is being prepared on the proposed management of salmon in the Ammonoosuc watershed. At present, the management plan has not been finalized. The following information can only be estimated.

The Atlantic salmon smolt potential shows that approximately 60% of the nursery habitat occurs in the mainstem of the river. A total of 21,423 units (100 square yards per unit) has been suggested for the total watershed. In the area of concern for this report, the following units are suggested:

RIVER TRIBUTARY		NURSERY UNITS
Ammonoosuc River (mainstem)		15,019
Little River		422
Zealand River		281
	Total	15,722

The remaining 5,701 units are located in other tributaries. A figure of 40% (6,289 units) of the potential smolt habitat will be located above the Bethlehem dam. Present planning estimates a production of 50,000 plus smolts being produced in the Ammonoosuc with 30-40% (15,000-20,000) smolts being produced above the dam site. Present thinking is that adult spawning salmon will be transported to these spawning areas after being trapped in the downstream Connecticut River (personal communication, Larry Stolte USF & WS; Peter Brezosky - N.H. Fish and Game Dept.).

If this system of handling spawning adults or stocking hatchery fry is used, there would appear to be little need for a fishway. The main concern would be the downstream passage of smolts. This will have to be addressed whether a fishway is required or not and will require further study. Smolts can safely pass over the dam in normal flows, but with the installation of a turbine, measures will have to be taken to discourage entrance to the proposed penstock.

Regarding the need for a fish ladder, consideration should be given for future needs. Under present planning for Atlantic salmon a fishway will be completed at the Vernon Dam on the Connecticut River (1983) and the Wilder Dam (1985). The Bellows Falls Dam will also have to be passed. There are presently four dams on the Ammonoosuc below the Bethlehem dam that will require either breeching or a fishladder. The Lisbon dam at 14 feet high may not hamper natural salmon passage. In light of the time schedule for downstream fish passage (which wouldn't bring spawning adults to the Bethlehem site until the mid to late 1980's) and with the question of transporting fish still in the planning stage, it would seem that a fishladder at Bethlehem dam is not needed at this time. If future findings require a fishladder, then the best suited type of structure can be designed to fit the site.

At the present time the Bethlehem dam has no adverse effect on the downstream movement of fish. Trout are the only migratory fish in the system and there is sufficient habitat above and below the dam to maintain the species.

WATER QUALITY

The upper reaches of the Ammonoosuc have changed from a Class "C" stream to a Class "B" rating (personal communication, D. W. Zeaman, N.H. Water Supply & Pollution Control). The following table gives some of the water quality readings taken at stations just above the Bethlehem dam (Sta. 22) and at other locations near Twin Mountain and Bretton Woods (Stas. 27, 28 and 30).

In general the elements of water quality that affect aquatic life are typical of cold, well oxygenated mountain streams that are ideal for salmonoid fishes. The upper reaches of such streams are low in food organism productivity. The coliform and fecal bacteria readings are low. These were taken in October and would probably be higher at the height of the recreational season with more activity in the watershed. BOD readings are low and oxygen readings high, as expected with the cold water readings of October. In comparing readings between 1978 and 1938, the summer readings at comparable stations

[1] *Trout Stream Management Investigations of the Ammonoosuc River Watershed*, R.G. Seamans, Jr. & H.C. Nowell, Jr., 1961 N.H.F&G.
[2] *Biological Survey of the Connecticut Watershed*, Survey Report No. 4 N.H.F&G Dept. 1939.
[3] *Unpublished Data* N.H.F&G Dept.

EXHIBIT P

WATER QUALITY OF UPPER REACHES

OF THE AMMONOOSUC RIVER

Indicators	Unit	Sta. 22	Sta. 27	Sta. 28	Sta. 30
Temperature	0° C				
Air		14.5°	8.5°	14°	14°
Stream	10/10/78	9.0°	6°	7°	7°
Total Coliform	Count/100ml	110	168	146	96
Fecal Coliform	"	22	2	28	2
BOD	mg/1	1.2	1.4	1.1	2.0
Dissolved Oxygen	mg/1	11.5	12.2	12.2	12.0
Iron Fe	mg/1	0.12	0.10	0.07	0.03
pH	units	6.6	6.5	6.3	6.4
Specific Conductivity	uMHOS	43.6	25	24	12
Hardness	$CaCO_3$	14.0	9.6	8.0	6.0
Alkalinity		9.0	5.0	4.0	4.0

The following readings are taken from the Biological Survey Report #4 - 1938 at comparable stations. Readings were taken on 7/25/38.

Temperature				
Air	77°	78°	75°	74°
Water	70°	73°	66°	68°
pH	7.0	7.3	7.0	6.9

show that these streams can warm considerably during the warmest days of summer.

The nutrient analysis is low and so were trace metals (not included in Table) such as copper, lead, zinc, etc. Under physical/mineral analysis the specific conductivity is low, alkalinity denotes soft water and the pH is in a good range to support aquatic life. Turbidity at the time of reading (Oct.) was extremely low, but could become quite high during spring freshets when sediments enter the stream from scouring and bank erosion.

The present dam at Bethlehem has a limited effect on the downstream water quality. The flow through the small pool behind the dam is rapid enough to cause little temperature warm-up. The pool depth is not sufficient to create stagnation of bottom water. The wooded shoreline below the dam tends to return any raised water temperatures created by the pool back to normal stream temperatures. Studies carried out on small watershed dams (PL-566) in New Hampshire on similar streams substantiate this fact.

The penstock which is planned to carry water from the dam site to the generator would have little effect on water quality, except for the possibility of a very small rise in temperature. During construction every effort should be made to leave existing vegetative cover between the penstock and the parallel stream bank to provide shade. Discharge waters should be directed back into a shaded reach of stream if possible. As the penstock will be constructed above the stream bed there should be no adverse effect on the stream. Efforts will have to be made to control any sedimentation during construction of the penstock.

PLANT AND ANIMAL RESOURCES

The watershed area above the Bethlehem Dam is better than 90% forested. Few farms are to be found and the remaining open land is either in recreational use (golf courses, camping, etc.) or is reverting to woodland. Much of the watershed is within the White Mountain National Forest.

The forest is classified as three dominant types: Northern hardwoods, conifer and mixed conifer-hardwoods. The hardwoods make up a large percentage of the forest cover. Tree species are sugar or hard maple, red maple, white and yellow birch and beech. The lesser tree species are mountain maple, striped maple, basswood, ash and elm. The maples and birches are favored browse for deer, moose and snowshoe hare. Grouse bud the birches and aspen. In the deciduous forest there are at least 12 species of birds that use this as primary nesting habitat. These are screen owls, warblers (3), scarlet tanager and rosebreasted grosbeak.

Racoons, gray squirrels, chipmunks, flying squirrels; dormice, shrews, bats, bobcats and black bear are found. Along the streams are: beaver, mink, muskrat, otter, and weasels. Occasional species are lynx, coyote and martin.

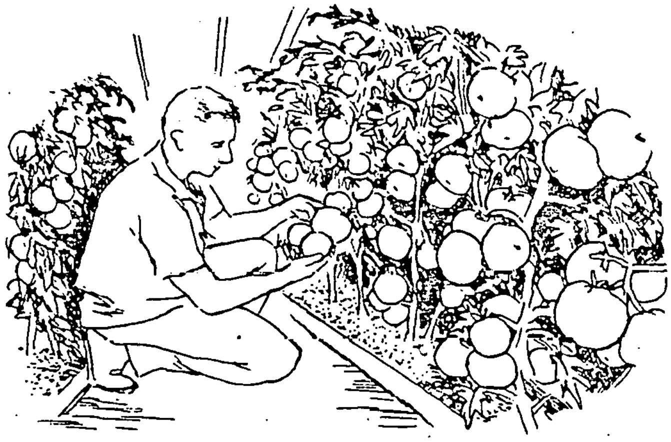
Pure stands of softwoods or conifers make up a smaller percent of the forest. Most of these are tree species found on the mountain summits: white, red and black spruce, fir, white pine, hemlock and white cedar. Larch or tamarack are found in the swamps. There are 44 bird species listed for this cover such as owls (6), woodpeckers (4), flycatchers (3), gray or Canada jay, raven, nuthatches, thrushes (3), warblers (14), finches, crossbills and pine siskins. Spruce grouse may be found at the higher elevations (3,000 feet or over).

Game species are not common in pure evergreen stands except for winter shelter or deer yarding. White cedar is a prime winter food. There are several important deer yards within the watershed. Non-game species found in this habitat are red squirrels, mice, hare and porcupine.

The rest of the forest cover is mixed hardwoods and conifers, with birds and mammals as found in the other two forest types.

RARE AND ENDANGERED PLANT AND ANIMAL SPECIES

Endangered mammals for New Hampshire are the Eastern cougar and Indiana bat. No cougar has been taken in New Hampshire since 1853. The Indiana bat lives in or near limestone caves and no such caves are in the region. The Bald Eagle may pass through the area. The Peregrine Falcon once nested on rocky ledges in the White Mountains and occasional sightings are made in New Hampshire each year. Rare animals within the watershed are the Pallid Red-backed Mouse and the Yellow-nosed Vole. Both are found on Mt. Washington which also supports a few of the rare species of plants. None of the rare and endangered species listed above are located in or around the Bethlehem Dam. No migratory routes of birds or mammals will be affected by the dam or any construction.



Social Impacts

The 500-acre Bethlehem Mink Farm has been an integral part of New Hampshire's North Country since 1937, serving as a source of jobs and revenue in the area. Those who have developed plans for BMF's dam reactivation and use are longtime area residents and therefore especially sensitive to the community's needs.

BMF has evolved since 1971 from producing a non-food export crop (mink) to producing food for regional and local consumption. The planned agricultural use of the power at the dam is a natural step in BMF's evolution. Mink Farm employees are prime organizers of a local farmers' market in Littleton and are active participants in the LIFE (Locally Integrated Food Economy) Project, an effort by six North Country communities to become more agriculturally self-reliant by encouraging production, processing, storage and sale of locally-grown food.

WORKING MODEL

Controlled Environment Agriculture is an innovative idea that could serve as a model for others in New Hampshire and New England concerned with promoting food and energy independence in an area which now imports 90 percent of its food. Successful year-round production of lettuce, tomatoes and fish in the rugged climate of the White Mountains could be a catalyst for similar production in the less extreme climate of Southern New England.

BMF projections show enough lettuce could be produced at the farm annually to feed 20,000 people. One indication of BMF's concern for local impact are plans to cut production in summer months because of low streamflow and to avoid competition with area farmers' field-grown produce.

EDUCATION

The Society for the Protection of New Hampshire Forests is developing a Farm and Forestry Museum on an old estate abutting BMF. The dam site will serve as a natural extension of this museum which is expected to draw thousands of visitors annually. The original owner of the museum site, John Glessner, built the Bethlehem Dam in 1927 to produce electric power for the town.

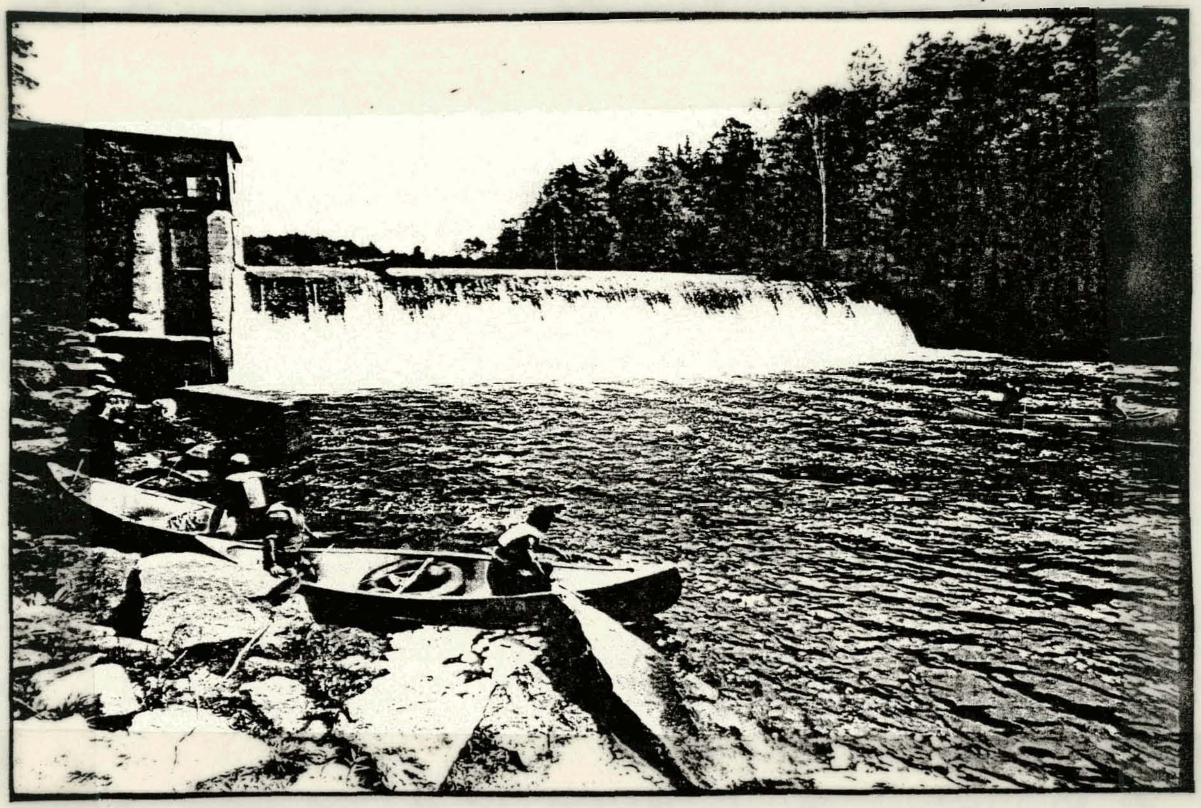
Besides the educational experience of visiting a working hydro facility, tourists will be able to compare farming methods of the future (controlled environment agriculture) with the museum's exhibits of farming methods and implements of the past.

BMF already is well known in the area by school children who have toured its facilities and by University of New Hampshire students and faculty who have worked with BMF on various agriculture projects. Those projects have included a study aimed at improving heating efficiency in calf barns, improving feed conversion in calves, marketing analysis of BMF's 3-million-pound freezer and a computer model for streamflow analysis at low-head, run-of-the-river dams.

RECREATION

The Ammonoosuc River and the surrounding area draw thousands of canoeing, fishing and hiking enthusiasts from throughout New England annually. BMF has discussed plans for the dam with the Appalachian Mountain Club, the U.S. Department of Interior and others concerned with preserving the natural integrity of the area. These discussions and the research of consulting engineers and biologists indicate reactivation of the dam will have little—if any—negative impact on recreational resources in the area.

In fact, considering the continuing littering and vandalism of the area around the dam and old powerhouse over the years, the reactivation may help clean up the environment, making it a more attractive site for naturalists and others to visit. BMF plans to create picnicking and camping areas as part of its renovation of the site in hope of inhibiting abuse.



White water canoeists put into water below the dam during spring run-off.

BMF will also improve the portage for canoeists between the dam and the powerhouse as part of its retooling the entire facility.

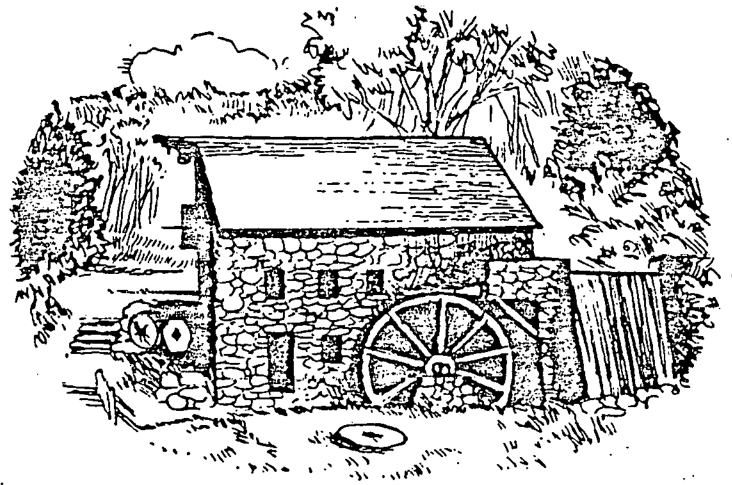
White water canoeing downstream from the dam currently is limited to a short period during spring run-off. Reactivation of the dam inevitably will decrease the speed of water during that time, but since the plant is not designed to ever take advantage of maximum flow, it is expected that there will still be good canoeing in the downstream area after the plant is on-line.

BMF has been in touch with the U.S. Department of Interior and state Fish and Game officials to discuss the possible impact of the reactivated dam on fishing, especially the salmon restoration program currently underway in the Connecticut River into which the Ammonoosuc feeds. The farm is willing to help in the restocking effort, including providing areas for smolt runout ponds and egg processing facilities and making provisions for a fish ladder at the dam. Water released at the powerhouse will be aerated by the turbine and therefore provide a healthier habitat for fish in the area downstream.

JOBS AND TAXES

When the Bethlehem Dam goes on-line, it is anticipated a property tax re-evaluation would add $18,500 to Bethlehem's tax revenue. The development of controlled environment agriculture would further increase the value of the property and therefore boost the town's tax revenue.

Reactivation of the dam is not expected to directly create any new jobs in the area since most of its retooling and all of its maintenance and operation will be done by BMF employees. However, the agricultural development would create 11 new jobs directly and another 3 to 4 jobs related to sale and distribution of the crop. Since Bethlehem's population is only 1600 and employment is predominantly in tourist related industries which are seasonal, the creation of 14 full-time jobs will have a significant impact on area employment.



Government Relations and Regulatory Considerations

THE BETHLEHEM ATTITUDE

Since the entire process of Federal regulation and licensing of small hydro re-development has been generally indicted as one of the most serious barriers to getting sites back on line, it is of particular importance to examine Bethlehem's experience to date with government agencies.

Rather than simply taking the word of analysts that licensing was a "problem" and then seeking to avoid the problem for as long as possible, Bethlehem Mink Farm mapped out a strategy of action based on directness and openness. It was felt that state and Federal agencies should be contacted from the very start of work on the feasibility study. A comprehensive list of relevant regulators, as well as interested agencies, was prepared, and a general letter indicating an "intent to develop" the site along with a Fact Sheet describing the site (see Appendix).

The Fact Sheet proved to be a very valuable tool in so far as it answered basic questions such as site location, operation, potential capacity and use of power etc., thus giving readers a more tangible sense of the project. The Fact Sheet has also proved useful as a general public relations tool when it was desirable to leave some information in a person's hand.

The letters of intent, apart from expressing a desire for information, made it quite clear that BMF sought to involve agencies from the very start of the project and would work in a cooperative spirit to meet various criteria. We felt that this tone was not only good business policy but good "person" policy, since it is obvious, although often forgotten, that bureaucracy is made up of people who work hard, become frustrated, etc.

The response from the agencies has, for the most part, been straightforward and useful. There has been a general sense of appreciation that Bethlehem is trying to create a healthy atmosphere for involvement.

Contact with "regulators" is outlined below:

STATE AGENCIES

Water Resources Board, Special Board, and Water Supply and Pollution Control Commission: These agencies are grouped together because of their interrelated nature in the context of state government. Response from the Water Resources Board made it clear that maintenance functions were to be distinguished from re-construction as far as permitting is concerned...and it appears that the work needed to restore that dam will not need a permit from the Board.

The Special Board, which contains representatives from a number of agencies, is primarily concerned with dredge and fill and again, "construction." It appears that a permit from this Board will not be necessary.

The Water Supply and Pollution Control Commission basically operates via the Special Board, although it is technically separate, so it also appears that no permit is necessary here.

These three agencies will be kept informed of activity from time to time to insure that there is no question about the necessity of a permit from any of them.

Fish and Game Department: As might be expected, the Fish and Game Department responded to the inquiry in a very cautious, non-commital fashion. A range of problems generally associated with small hydro development was pointed out, including some which were obviously not of concern, based on information included in the Fact Sheet (such as artificial fluctuation of water level).

The agency's general response was followed up by a phone call to straighten out certain facts, re-express the desire to work together, and set a date for informal site inspection.

A site inspection was conducted in conjunction with a representative from the U.S. Fish and Wildlife Service. At this time it was learned that the letter had not actually come from the Division Chief of Inland and Marine Fisheries, but from one of his staff biologists and it was clear that it was this person who would be making basic decisions for the state.

The site inspection covered a wide range of matters. Overall, there seemed to be agreement that there were few, if any, wildlife considerations other than overt habitat disturbance during construction. It was pointed out rather strongly that the Ammonoosuc River was considered a very important water body in the scheme for salmon restoration, although no timetable was laid out for just when a fish ladder might become necessary. Downstream fish migration and minimum instantaneous streamflows were also key areas of concern.

As it stands, the Fish and Game Department has not sent anything since the initial correspondence and appears to be letting the U.S. Fish and Wildlife Service take the ball for now. To some extent, this may reflect the use of the Federal licensing procedure by a state agency to achieve its goals. While this situation is not problematic, it is incumbent upon Bethlehem to continue following up with the agency and force a more direct and specific response.

Public Utilities Commission: The Commission was informed of our activity because of the likely possibility that power would not be used on-site in the first few years of the project. This is relevant because of New Hampshire's "Limited Electrical Energy Producers Act" which, as already mentioned, requires a franchised utility to buy power from independent producers at a price set by the Commission if the installed capacity of the site is less than 5000 KW (see Appendix D). The upcoming regulations of the Public Utilities Regulatory Policies Act and the possibility of more state legislation bearing on the wheeling and utility interface must be dealt with.

FEDERAL AGENCIES

U.S. Army Corps of Engineers: Since the Army Corps' regulatory interest is primarily in matters concerning dredge and fill, a permit will not be necessary.

Environmental Protection Agency: EPA's focus is on water quality and the necessary minimum streamflow needed to assure acceptable quality levels. The agency responded to inquiry with a statement calling for a minimum instantaneous flow of 26 cfs. This quantity was determined by an analysis of minimum flows for 5 consecutive days in ten year periods. It will be necessary to compare this flow requirement with that set by the U.S. Fish and Wildlife Service and enter into negotiations as to its appropriateness at all times of the year (in particular, during the winter months).

U.S. Fish and Wildlife Service: The Fish and Wildlife Service was approached separately from the N.H. Fish and Game Department, but as mentioned, the two agencies are in communication about the Bethlehem Dam. The response resulting from the site visit basically reiterated the issues which were raised in discussion: fish passage and streamflow. Matters concerning water quality and public access were also raised.

Some frustration with the Service is felt because of its lack of specificity in identifying areas of concern. Bethlehem was aware of the general environmental issues before any agency contact was made and it was hoped that we might get down to "nuts and bolts" during the preliminary discussions. However, it seems that in order to get concrete responses, queries will have to be phrased in a detailed manner. It is not clear whether a final answer on various matters will be issued until the FERC licensing procedure forces such determinations.

Federal Energy Regulatory Commission: Since the Bethlehem Dam is under 1,500 KW of installed capacity, it is eligible for consideration under FERC's new short-form license. Judging from the forms, the licensing procedure does not seem insurmountable. The only area which may cause some nuisance is that all state permits must be had before the application is submitted. The minor license procedure is untested but the agency sounds optimistic about a shorter time frame. We feel that extensive personal contact with those officials responsible for the site will be a key to avoiding unnecessary paperwork, time delay, and expenditure of funds.

The full list of all regulatory agencies contacted can be found in Appendix A.

OTHER PARTIES

In addition to "regulators," other government agencies and officials were contacted. This was done so as to create communication channels and prep various people as to the nature of the project, should help be needed in lubricating the licensing process. Included in this category were:

New England Regional Commission
New England River Basins Commission
Department of Energy - Regional Office
Senator John Durkin
Senator Gordon Humphrey
Congressman James Cleveland
Congressman Norman D'Amours

Furthermore, a number of private organizations were contacted up-front, in order to assure their awareness of the project and head off any possible moves toward formal intervention:

New Hampshire Environmental Coalition
Audubon Society of New Hampshire
Society for the Protection of New Hampshire Forests
Appalachian Mountain Club

THIS PAGE

WAS INTENTIONALLY

LEFT BLANK

BIBLIOGRAPHY

Andrews, Leighton, Latrense, *Marketing Agricultural Products in New Hampshire, Vol V* (University of New Hampshire: Durham) September 1976.

Applied Physics Laboratory, *Problems in Redevelopment of Old Hydroelectric Power Dams: Second Report on New England*, (Johns Hopkins University, Laurel, Md., February 1978.

Archer & Huke, "Vermont Yankee Fish Farming Simulation for Vermont Yankee Nuclear Power Corp." (Dartmouth College: Hanover, N.H.) circa 1976.

Bangs & Osgood, *Business Planning Guide* (Federal Reserve Bank of Boston: Boston, Mass.) 1976.

Bliss & Engalichev (with unpublished Hydro Assisted Notes by Sloat), *Drying of Lumber in New Hampshire on an all year Basis* (North Country Resource Conservation and Development Project: Meredith, NH) June 1976.

Burns, "Things You Should Know If You Want to Build a Hydropower Plant," (NH Governor's Council on Energy: Concord, N.H.) 1978.

Dunne & Leopold, *Water in Environmental Planning* (Freeman, San Francisco) 1978.

Department of Agriculture, "Business & Industrial Loans, FHA 449-1," Washington, D.C., 1976. (Farmer's Home Administration).

Franklin Pierce Law Center, *Fundamental Economic Issues in Development of Small Scale Hydro*, Concord, N.H., January 1979.

Franklin Pierce Law Center, *Legal Obstacles & Incentives to the Development of Small Scale Hydroelectric Power in New Hampshire*, Concord, N.H., January 1979.

Franklin Pierce Law Center, *Federal, Legal Obstacles & Incentives to Development of the Small Scale Hydroelectric Potential of the 19 North Eastern States*, Concord, N.H., January, 1979.

Gabler, *New England White Water River Guide, Tobey Publishing, CT, 1975.*

Gladwell & Warnick, *Low Head Hydro: An examination of an alternative energy source*, Idaho Water Resources Research Institute: Moscow, ID, September 1978.

Gosz et al., "The Flow of Energy in a New Hampshire Forest Ecosystem," Scientific American, Vol. 238, #3, March, 1978.

Governor's Commission on Hydroelectric Energy, *Report on Hydro Electric Energy in New Hampshire*, Governor's Office, Concord, N.H., April 1977.

Griffin & Taylor, *Tomato Production Under Plastic Greenhouses in New Jersey*, Rutgers/Cook College, New Brunswick, N.J., June 1976.

Halliday & Resnick, *Fundamentals of Physics*, Wiley & Son: NY, 1974.

"Horticultural Lighting," in the *IES Lighting Handbook*, Section 25, date unknown.

Institute for Man & Environment, *Adaptive Re-Use for Controlled Environment Plant Growth*, University of Mass: Amherst, Mass., June 1977.

Institute of Gas Research, *Hydrogen Production from Falling Water*, Penn Gas & Water Company, IGR: Chicago, Ill., 1977.

Klotz & Manasse, *Low Head/Mall Hydroelectric Workshop*, New England Center: Durham, N.H., September 1977.

Kuhn, *The Structure of Scientific Revolution*, Vol II, University of Chicago: Chicago, Ill. 1971.

Master, David, *Small-Scale Hydroelectric Re-Development in New Hampshire*. A study of the economics, regulation, and impacts of a renewable energy resource technology, unpublished, Dartmouth College Economics Dept., Hanover, N.H., June, 1978.

Master, David, *Promoting Small-Scale Hydroelectric Power Development in New England* for the New Hampshire Environmental Foundation and the New England Energy Congress, January, 1979.

McDonald, Richard. *Estimate of National Hydroelectric Power Potential at Existing Dams.* U.S. Army Corps of Engineers: Virginia, July, 1977.

Morrison, "The State of Food & Agriculture 1976," Scientific American, No. 239, #2, August, 1978.

McGuigan, *Harnessing Water Power for Home Energy.* Gardenway, Charlotte, VT 1978.

National Energy Act: 1979, GPO: Washington, 1979.

North Country Council, *Economic Base: North Country*, Franconia, NH, August 1974.

North Country Council, *Overall Economic Development Program*, Vol. II, NCC: Franconia, NH, March 1976.

Northeast Kingdom Area Resource Development Committee, "Increasing Maple Syrup Production in Caledonia County VT: A feasibility study," Dept. of Agriculture Extension Service: St. Johnsbury, VT, 1971.

Parker, Change, "Is There Food in Bethelehem's Future," in the Bethlehem Star, Bethlehem, N.H., 1979.

Preston, *AMC River Guide: Central/Southern New England.* Vol II, AMC: Boston, 1971.

Prince & Bartok, "Can Leaf Lettuce Be Grown Under a Controlled Environment," University of Connecticut: Storrs, September 1977.

Public Service Co. of New Hampshire, "A 28 Year Comparison: 1950–1978," Box 330, Manchester, N.H. Date unknown.

Rothman, *Planning & Organizing for Social Change: Action Principles from Social Science Research*, Columbia Univ., NY 1974.

Sylvester, *Big Dreams for New England Little Dams*, Yankee Magazine, November 1977.

TVA, *Using Power Plant Discharge Water in Controlled Environment Greenhouses, Progress Report II*, Muscle Shoals, Tenn., December 1976.

Temperatures at St. Johnsbury, VT, EROS/Fairbanks Museum, unpublished: St. Johnsbury, 1886 to date.

USDA, "Vegetable Situation," Dept. of Agriculture Quarterly Reports, Washington, D.C.

USDA, *Here Today, Doubtful Tomorrow: The energy supply*, Farm Index, Washington, D.C., February 1979.

USDOE *Solar Energy for Agricultural & Industrial Process Heat: Program Summary*, GPO, Washington, D.C., September 1978.

USDOE: *EDP, Solar Agricultural & Industrial Process Heat*, GPO, Washington, D.C., March 1978.

USDOE, *Solar Energy Applications Centers*, GPO, Washington, D.C., January 1978.

USDOE, *Flywheels: Storing Energy as Motion*, GPO, Washington, D.C., 1977.

USDOE, *Hydrogen Fuel*, GPO, Washington, D.C., 1978.

U.S. Federal Energy Regulatory Commission, "Simplified Procedures for Certain Water Power Licenses," FERC, Washington, D.C., Issued 5 September 1978.

"Proposed Short Form Licenses: Notice of Proposed Rule Making," FERC, Washington, D.C., April 1978.

U.S. Geological Survey, "Ammonoosuc River at Bethlehem Junction, Daily Discharge in CFS, Water Year Mean Value & Notes - Vols 1939–77," USGS (obtained NH Water Resources Board: Concord, N.H.).

U.S. Geological Survey, "Ammonoosuc River at Bethlehem Junction, 15 minute digital means on bi-hourly basis, Water Years 1965–75," USGS unpublished computer printouts (obtained N.H. Water Resources Board, Concord, N.H.).

Wilson, *Bethlehem New Hampshire: 1774–1974*, Town of Bethlehem: Bethlehem, N.H. 1974.

APPENDIX MATERIAL LIST

A	Partial List of People and Companies Contacted
B	Replies from Penstock and Gate Suppliers
C	Bethlehem Hydroelectric Dam — Fact Sheet
D	Limited Electrical Energy Producers Act
E	Letters of Support

PARTIAL MAILING LIST

NH Water Resources Board
37 Pleasant Street
Concord, NH 0331

NH Governors Commission on
Hydroelectric
(same as above)

Special Board
(same as above)

NH Public Utilities Commission
Concord, NH 0331

Fish and Game Department
34 Bridge Street
Concord, NH 03301

Dept. of Resources and E. Development
P.O. Box 856
Concord, NH 0331

Water Supply & Pollution Control
Commission
105 Loudon Road
Concord, NH 03301

Governor's Council on Energy
26 Pleasant St
Concord, NH 0331

North Country Council
P.O. Box 40
Franconia, NH 03580

Section of Applications
FERC
825 No. Capitol St
Washington DC

Head of Licensed Projects
FERC
26 Federal Plaza
New York, NY

The Audobon Society of NH
Silk Farm Rd
Concord, NH 03301

Permits Branch -Operations Div.
US Army Corps of Engineers
424 Trapelo Rd
Waltham, MA 02154

Northeast Power Plant Activities
US Fish and Wildlife Service
One Gateway Center
Newton Corner, MA 02158

Energy Resource Development
DOE
Analex Building
150 Causeway St
Boston, NA 02114

Permits Branch
EPA
RoOm 2203 JFK Bldg
Boston, MA 02203

US GS
Water Resources Division
NH Sub Distict
55 Pleasant St
Concord, NH 03301

New England Regional Commission
53 State St, Room 400
Boston, MA 02180

New England River Basins Commission
55 Court Street
Boston, MA 02108

NH Environmental Coalition
Old Hancock Rd
Hancock, NH 03449

Director of Conservation
Appalachian Mt. Club
Five Joy Street
Boston, MA 02108

Society for the Protection of
NH Forests
5 South State St.
Concord, NH 03301

Senator John Durkin
3230 Dirkson
Washington, DC 20510

Senator Gordon Humphrey
Senate Office Building
Washington, DC 20510

Congressman James Cleveland
2269 Rayburn House Office Bldg
Washington DC 20515

Congressman Norman D'Amours
House Office Building
Washington, DC 20515

Governor Hugh Gallen
State House
Concord, NH 03301

Selectmen
Town of Bethlehem,
Bethlehem, NH

Vermont Structural Steel
Burlington, VT

Owings-Corning Fiberglass
Toledo, OH

Rodney Hunt Co.
Orange, MA

T. W. Dick Co.
Gardiner, ME

Johns-Mansville, Inc.
Denver, CO

Isaacson Structural Steel, Inc.
Berlin, NH

Forest Technology Sales
North Billerica, MA

Public Service Company of NH
Manchester & Lancaster NH

Green Mountain Power Co.
Montpelier, VT

Central Vermont Power Co.
Rutland, VT

F.W.E. Stapenhorst
Pointe Claire, Que

Ossberger Turbinenfabrik
Weissenburg i Bay, Germany

Hydro Quebec
Montreal, Que

New England Electric Co.
Boston, MA

Woodward Governor Co.
Rockford, IL

Barnet Brothers Manufactureing
Columbus, WI

General Electric Co
Schenectady, NY

Allis Chalmers,
York PA

Cambro Corp
Littleton, NH

University of New Hampshire
Durham, NH

University of Conn
Storrs, CT

Dartmouth College
Hanover, NH

Franklin Pierce Law Center
Concord, NH

University of Mass
Amherst, MA

Advance Cooling
Clifton Park, NY

APPENDIX B

MEMORANDUM

SUBJECT: Investigations of the Penstock

The penstock, being one of the single largest items in the restoration of the hydroelectric project, received the most attention. Many people were contacted and much discussion took place concerning types of material, availability, delivery, etc. In the final analysis, three kinds of material seemed to be suited to the job: The original old standby, woodstave penstock, 6' in diameter, of treated western fir, with the required hoops for necessary pressure strength; molded fiberglass pipe, with O ring type joints; and conventional steel penstock with the increased strength in steel it appeared that a 3/8 wall thickness was more than adequate. In fact, this is over-engineered under some circumstances at the upper end of the penstock. But for structural properties where the penstock is empty the 3/8 thickness was selected.

In comparing the types of material, the woodstave penstock proved to be frightfully expensive. Not only was its cost per foot expensive but the installation cost requring an on-site foreman and a rather large crew, considerable material handling, and so forth, was indeed a consideration ranking it as the most costly of all materials to use for the project.

Next in line was the fiberglass penstock with a wall thickness of approximately 1 1/8". Due to shipping and handling, and the long transportation involved from a factory in Texas, an extreme cost was encountered, considerably more per foot than steel, even though steel had more on-site costs. After all factors were considered, steel was still a considerable amount of money under the fiberglass. However, several interesting points took place in various discussions concerning penstock and the handling.

The original concept of penstock generally was riveted steel pipe or wood stave pipe, both of which were shipped to the job site knock down, usually by freight car. A considerable quantity of material could be placed on a single car. Under present concepts, most of the material with the exception of wood stave is shipped ready to assemble, in lengths 40 to 55 feet long. With 6-foot penstock this prohibited the use of two lengths of pipe or three langths of pipe per truck as they were over the road limits.

As a letter attached hereto indicates, I suggested to the manufacturer that we compare the cost of a slightly larger penstock for half of the distance, plus the cost of a transition section and the standard dimension for the lower part of the penstock. By doing this it was possible to put one piece of penstock inside a second piece which in turn cut the frightful shipping charges in half. In spite of the increased cost per foot of the larger diameter pipe there was an effected savings in the fiberglass pipe alone of some $26,000...impressive indeed! Although the supplier of steel pipe is fairly close by, and shipping charges are not a large item, still a cost reduction will be possible when the project enters the engineering phase. Again, by properly dimensioning the pipe with varying diameters of approximately $1\frac{1}{2}$ inches, three lengths of pipe will be placed upon a single truck, one inside another. Thus, each truck will be loaded with 19 tons of payload rather than 6 tons of payload. These pipes will be arranged in descending order with one third of the penstock being slightly larger and one third being slightly smaller. The diameter difference is very minimal with steel pipe. Additional savings can also be incurred by using slightly lighter gauge pipe in the upper end of the penstock, particularly where it is going to be supported in saddles. Savings can also be incurred by lengthening the sections as each 40-foot section is composed of five 8-foot sections.

Field welding is considerably more expensive than shop welding. Therefore, an additional cost savings will be obtained by specifying the pipe in 48 or 56 foot lengths, both of which will be easily shippable.

A steel penstock certainly has one of the poorer co-efficients of friction. However, the cost of enlarging the diameter slightly would be offset against the more expensive cost of the other materials. Wood, which would have the least co-efficient of friction, is so frightfully expensive that it must be abandoned at all costs.

An additional note is that the steel can be laid directly on normal bedding material. The wood penstock can also be laid on normal bedding material, however, it is recommended by the manufacturer that it be placed on saddles which adds an additional cost of many thousands of dollars. The fiberglass penstock also poses a problem in that it is not recommended for above-ground installation and should be reasonably well buried in bedding material of some type. This not only would require a great amount of material to cover the penstock but also poses great difficulty in getting the material to the penstock after it is installed. It is strongly recommended by this investigator that any plants involving long penstocks thoroughly investigate the concept of prefabrication and modular shipment.

Bethlehem Steel Corporation

BETHLEHEM, PA 18016

TUBULAR PRODUCTS AND TOWER SALES
F. D. KENNEDY, P.E. MANAGER OF SALES
L. J. LUCKENBACH, JR. ASST. MANAGER OF SALES

February 9, 1979

Mr. Bruce T. Sloat
Consultant
Box 424
Lancaster, NH 03584

Dear Mr. Sloat:

Subject: Penstock for Bethlehem Municipal Hydro
Whitefield, New Hampshire
Our FTP293

This will confirm our telephone conversation of February 6, 1979 regarding the subject project.

Assuming:

1,500 ft. - 72" OD x .375" Steel Pipe with bell and spigot lap-welded field joints
Workmanship - AWWA C200
Material - ASTM A283 Grade C
Coating - Exterior - Koppers 300M Coal Tar Epoxy, 16 mils. dry
Interior - Bare

Our Present Day Price for budget purposes, f.o.b. cars, Whitefield, New Hampshire, in 40 ft. lengths is $128.00 per ft. and in 80 ft. lengths is $145.00 per ft., providing we are able to get rail clearance.

In addition, you requested the following prices:

2 - Dresser Couplings, 72", Style 38, with 1/2" x 10" middle ring

PRICE: $1,100.00 each

2 - 125 lb. Lightweight, Slip On Flanges, flat face, 72" diameter

PRICE: $960.00 each

We recognize that you are investigating other products for this project and assume that you will consider the long service records of steel pipe as compared to fiberglass as well as the superiority of steel considering strength and toughness, durability and long service life, economy of installation and maintenance, permanent high carrying capacity, ductility and adaptability, reliability and resiliency and watertight joints.

Bethlehem Steel Corporation

Please keep us informed as to the progress of this project and if we can be of any further assistance to you, do not hesitate to call.

Very truly yours,

BETHLEHEM STEEL CORPORATION
F. D. Kennedy, Manager of Sales

By: A. D. Elberson

ADElberson:ns

FIBERGLAS

OWENS-CORNING FIBERGLAS CORPORATION FIBERGLAS TOWER, TOLEDO, OHIO 43659, (419) 248-8000

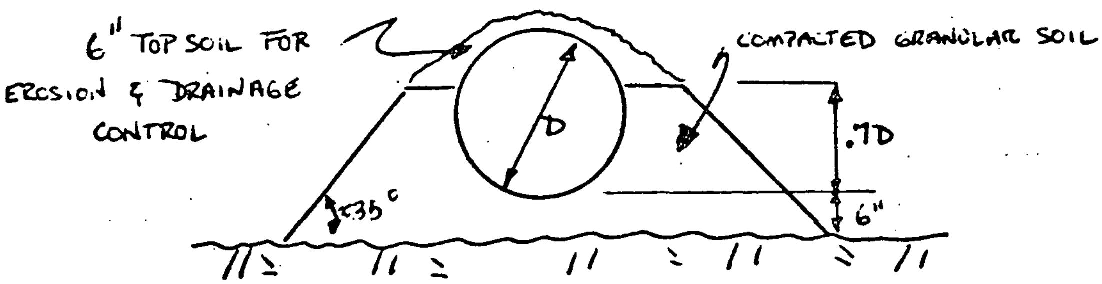
February 28, 1979

Mr. Bruce P. Sloat
P.O. Box 424
Lancaster, New Hampshire 03584

Re: Bethlehem Mink Farm

Dear Mr. Sloat,

My apologies for not having responded sooner to your recent request regarding the installation of Fiberglas Flowtite Pipe on the Bethlehem Mink Farm penstock pipe. My design engineers have reviewed your suggestion of supporting the pipe a on 6" sand berm with no side support. Their feeling is that it would be more desireable to install the pipe as illustrated below.



In fact, this may be the most economical system when you consider the design and resulting cost of the pipe for the system you referenced in our telephone conversation on February 12, 1979. The above installation would allow for a more economical pipe design which would affect the additional backfill cost.

We have also looked at the feasibility of nesting Fiberglas Pipe with bell & spigot "O"-ring joints. The minimum difference in pipe size with this type of joint which would allow full nesting is 6". Based on this, we have developed some budget prices for 72" and 78" diameter pipe.

February 28, 1979

Mr. Bruce P. Sloat
Page Two

Assuming 40 ft. lengths with bell & spigot "O"-ring joints, the approximate price for 1500 ft. of 72" diameter pipe would be $190 per linear foot, F.O.B. jobsite. Surprisingly, the price for delivery by railcar to the nearest rail siding would be about the same. In this case, delivery by truck to the jobsite would be preferable for all concerned.

Now, if we break the job down so that half of the pipe is 72" and half 78", the price for the 72" pipe would be $165/LF and the 78" pipe $180/LF.

Nesting the pipe, therefore, results in an approximate savings of $26,250. We think the savings involved justifies consideration of this approach.

There are two last considerations which should be addressed. First, any elbows located along the proposed line would have to be thrust blocked. The use of an above-ground installation precludes the use of a soil restrained system to resist thrust thus necessitating the concrete thrust blocks. Secondly, if this area is subject to flooding and simultaneously evacuation of the water from the pipeline, then flotation of the pipe could occur. I doubt if this would be the case on your job but did want to make mention of it in case you have overlooked this potential.

Once again, sorry for the delay. I do hope I have addressed all your questions adequately. If you have any further questions, please feel free to contact our local representation, Mr. Don Curry of Portland Sales at (207) 799-4811, or myself in Toledo, Ohio at (419) 248-8066.

Very truly yours,

OWENS-CORNING FIBERGLAS CORPORATION

Robert S. Morrison
Market Manager
Power and Industrial Pipe

RSM:at

Tanks & Specialties
Smoke Stacks
Flame Shape Cutting

Fabrication of
Bar, Plate and
Structurals

Telephone 582-5350
Area Code 207

Established 1890

T. W. Dick Co., Inc.

Warehouse Service STEEL Fabrication

23 SUMMER STREET

Gardiner -:- Maine

Galv. & H.R. Sheets
Steel Pipe

Galv. Steel and
Aluminum Roofing
C. R. Steel—
Rounds & Squares

February 28, 1979

Bruce P. Sloat
Box 424
Lancaster, New Hampshire, 03584

Re: 3/8 Plate Penn Stock

Sir:

Confirming our telephone conversation this date on fabricating 1500 ft. of Penn Stock 3/8 Plate 6 ft. outside diameter.

This quotation is only a proposed feasible study price, and is not firm, but it will be a fairly close estimate.

Based on rolling and welding 5 - 8 ft. long cylinders to make a 40 ft. cylinder 6 ft. diameter, the price would be $3,904.00 for a 40 ft. section.

Added to this price, would be a price of $300.00 per 40 ft. section for delivery, giving you a total of $4,204.00 per 40 ft. section delivered to Lancaster, This figures about $106.00 per ft.

Also, calculating 1 section 6 ft. diameter x 12 ft. of pipe, cut to a bevel or a degree to make a bevel which is unknown at the present time, the price for one of these would be approximately $2000.00 delivered.

The flanges, required for this job from 1" plate, we figure about $350.00 - 400.00 each.

Again, I say this is not a firm quote due to the varibles that exist.

If this job is a go, a firm price would be given, according to submitted prints.

We thank you for this opportunity of giving you a figure on this project.

Yours truly,

T. W. DICK CO., INC.

By [signature]
Gordon Watson - Vice Pres.

GW;cse

QUOTATION

RODNEY HUNT COMPANY
ORANGE, MASS. 01364 TEL. 617-544-2511
WATER CONTROL EQUIPMENT DIVISION

PLEASE REPLY TO:

March 5, 1979

Bruce P. Sloat
P. O. Box 424
Lost Nation Road
Lancaster, N. H. 03584

Subject: The Bethlehem Dam Project
Ammonoosuc River
Bethlehem, New Hampshire
Timber Gate Components
Rodney Hunt Quotation #94284

Dear Bruce:

We are pleased to offer the following proposal covering timber gate components for replacement gates at the Bethlehem, New Hampshire Gate House as follows:

Item #1

Components for two (2) - 84" x 96" head gates.
The components will consist of stainless steel operating stems, 2 3/4" diameter by approximately 15'-5" long.
Stem connector of fabricated steel painted with black asphalt paint.
Bronze clevis with pin.
Stainless steel gate rods, threaded each end, for hex nuts and cast iron washers.
S-5012, two speed, crank operated floorstand equipped with RPC-P plastic pipe cover indicator.
Note: It will be necessary to fabricate some sort of hoist support to mount the floorstand to and we have not included this in our proposal.

Price, each........................ $3,804.00
Price for two (2)................... $7,608.00

Item #2

Components parts for timber gate with 30" opening by 36" high.
Stainless steel gate stem, $1\frac{1}{2}$" diameter by approximately 10 ft. long.
Stainless steel gate rods.
Fabricated steel stem connector with bronze clevis and pin.
Cast iron washers for gate rods.
S-5002, crank operated floorstand equipped with RPC-P plastic pipe cover indicator.
Note: Fabricated steel hoist support is not included.

Price............................ $2,348.00

RODNEY HUNT

TAXES: State Sales and/or Use Taxes are not included in this quotation.
TERMS: This quotation is subject to terms and conditions on reverse side. Terms are 30 days net unless otherwise indicated.

RODNEY HUNT

Total Lump Sum Price, ... $9,956.00

Above price is f.o.b., Orange, Massachusetts, with freight prepaid and allowed to Bethlehem, New Hampshire.

Shipment, after notice to proceed, 6 to 8 weeks.

It is our understanding that the existing guide channels are to be utilized and that the gate disc will be manufactured of timbers procured in the area.

I am enclosing two copies of the following drawings which indicate the type of stem connector and type of construction that we have based our gate rod design on.

As you proceed with the project, we would appreciate receiving a drawing or sketch advising of the correct length of gate rods required for each of the two items.

The drawings are E-10099 - Detail: Stem Clevis & Swivel Connector for Wood Gate. D-13110 - Detail: Disc for 96" x 96" Timber Gate.

We wish to apologize for the delay in getting this proposal to you. However, should you require any additional information, please feel free to contact us.

We are sending, under separate cover, the plan sheets that you left at our office.

Very truly yours,

RODNEY HUNT COMPANY

R. E. Spooner

R. E. Spooner, Sr. Application Engineer
Water Control Equipment Division

RES/bj

Encl.

APPENDIX B8

ISAACSON STRUCTURAL STEEL, INC.

Jericho Road
Berlin, New Hampshire 03570
Telephone 752-2044

Date Jan. 26, 1979

To Bruce P. Sloat
Street Box 424
Lost Nation Rd.
City Lancaster, N.H. 03584

Structure

Location

Architect or Engineer

WE PROPOSE TO FURNISH THE MATERIALS REQUIRED FOR THE ABOVE STRUCTURE WHICH IS DESCRIBED BELOW IN ACCORDANCE WITH THE RULES OF STANDARD PRACTICE OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION. THE FOLLOWING TERMS AND PROVISIONS INCLUDING THOSE PRINTED ON THE REVERSE SIDE OF THIS SHEET ARE AGREED TO AND ACCEPTED BY YOU UPON ACCEPTANCE OF THIS PROPOSAL.

We are pleased to quote as follows:

1500± Linel Ft. 72" OD 3/8" Wall x 40' bevel or plain ends rolled & welded pipe

For the sum of $121.00 per linel ft.

F.O.B. Delivery Point

Prices are f. o. b. ....

Terms: Net cash 30 days, payable in New York exchange or its equivalent or ....% discount for cash if paid in 10 days from date of each invoice.

Cash discount will be allowed only on the discount base as stated on the invoice, being the prices of the materials less the transportation charges taken into account in arriving at such prices.

Date of invoice shall be date of shipment.

Prompt acceptance of this quotation by you and our written approval shall constitute a binding contract.

THE ABOVE PROPOSAL IS ACCEPTED

....

by ....

Date ....

ISAACSON STRUCTURAL STEEL, INC.

By ....

This quotation is sent to you in duplicate. If accepted, sign and return original, and retain the duplicate for your files.

APPENDIX B 9

FOR-TEK ©
FOREST TECHNOLOGY SALES
Area 617-667-6011 Telex-094-596
IRON HORSE PARK, NORTH BILLERICA, MASS. 01862

January 29, 1979

Mr. Bruce P. Sloat
P.O. Box 424
Lost Nation Road
Lancaster, N.H. 03584

Dear Bruce,

Confirming our phone conversations, our estimates on the 1600' Penstock are as follows:

200 man hours per hundred lineal feet

10 man crew which is supervisor and 9 men

As I said the Supervisor would be $250.00/day plus expenses.

Attached are the two price sheets I had given you. I tallies the tables and gave them the information that I promised.

For untreated deduct 8.00/lf.

Thank you for the opportunity. We'll be in close touch.

Very truly yours
FOR-TEK

Richard B. Drisko

James M. Reger

JMR:mc

1/9 -

6' Ø ID

FOR-TEK 617-667-6011

MATERIALS ONLY

3" NOMINAL STAVES DOUGLAS FIR

BLACK DIPPED MILD STEEL BANDS

MALLEABLE SHOES

SLOTTED STAVES WITH GALVANIZED SCREWS

PRESSURE TREATED WITH 8# CREO.

PRICE KNOCKED-DOWN F.O.B MILL

CONTINUOUS WOOD STAVE PIPE

HEAD	WEIGHT/FT	PRICE/FT	RAIL EST/FT	TRK/EST FREIGHT
40'	198.5 #	215.00	8.00	20.00
50'	203.5 #	224.00	8.50	21.00
60'	210 #	235.00	9.00	22.00
70'	216 #	246.00	9.50	23.00

CRADLES - PER DIA. PAGE 92

ITEM	WEIGHT	PRICE/EA	RAILEST	TRUCKED
CRADLE	400 # /ea	395.00	15.00	38.00

148 × 395 + 15 = 410 = $60,680

1500 × 232.50 348,750

300 @ 31.25 9,375

2700 @ 5.00 13,500

432,305 / 1500

$288 = Ft

APPENDIX C

BETHLEHEM MINK FARM

BOX 348 • LITTLETON, NEW HAMPSHIRE 03561

Telephone 603 — 444-2453

Bethlehem Hydroelectric Dam Reactivation - Fact Sheet

Name: Bethlehem Dam

Owner: Dr. Arnold Polonsky, President of the Bethlehem Mink Farm, Inc. The Bethlehem Mink Farm is a third generation family business. Currently the Farm produces about 400,000 pounds of Prime Fancy Veal a year from 400 stalls. It is seeking ways to diversify its food production in a manner which is appropriate to the region. The Polonsky's also own Saranac Refrigerated Warehouse, New Hampshire's only public refrigerated warehouse, located in Littleton, NH.

Location: Ammonoosuc River, in Bethlehem NH, near River Road, one mile downstream from Pierce Bridge (Rt. 302). The watershed of 90 square miles, starts from the western slopes of Mt. Washington and includes several mountain communities bordering the White Mountain National Forest.

Site Description: The present reinforced concrete slab dam was built in 1925 and replaced a crib dam which was built around 1900 to supply the town of Bethlehem with electricity. The present dam has no equipment to generate power. It is called a "run-of-the-river" facility because of its small pond.

The site includes 50 acres of land, generally defined by a 4300 foot horseshoe bend in the river and a straight road. There are several buildings at the site, including a downstream powerhouse. All are in poor repair, but appear to be structurally sound.

In the past, the 18-foot high dam collected water which was sent via a 6-foot steel penstock some 1,500 feet to the downstream powerhouse. The total working head was 42 feet, excluding the 4-foot flashboards used in the summer.

Stream Flow Description: The river has an average flow of approximately 200 CFS. A USGS gaging station just above Pierce Bridge has produced daily/bi-hourly stream flow records since 1939. Flows range from the recorded high of 10,800 CFS to the recorded low of 16 CFS. Typical low stream flows (70 - 100 CFS) occur in January, February, August, and September. May and June flows typically exceed 250 CFS.

Site Duplication: The Bethlehem Dam is considered the first dam on the Ammonoosuc River. There are at least three other inactive dams along the approximately 40 mile portion of the river (Aptos, Lisbon, Bath). There are no active sites in this portion.

Telephone 603 – 444-2453

Bethlehem Dam

Power Potential: Three power generating locations are being considered. One option is to put a generating facility some 200 feet downstream from the dam. The previous generating site is the prime candidate for re-activation. A third site, further downstream from the powerhouse, might provide 60 feet of working head.

The powerhouse site, as the likely candidate for the location of the turbine and generator, might reasonably be expected to generate an average of 2.5 million kilowatts per year, given an installed capacity of 500 KW.

Use of Power: There are three basic options for utilization of power. The most obvious is to sell the power to Public Service of NH, via their power lines which cross the site. Another possibility is to "wheel" (rent lines) to our operations at other locations. The third option is to use the power onsite. Each option or combination of options has its advantages and disadvantages and these are currently being explored.

The key to a run-of-the-river dam is to match end use of energy with the flow of the river. The goal of the Farm is to use the energy onsite to aid in the production of food for a local/regional market. It is anticipated that controlled environments will offer flexibility to deal with seasonal flows without causing the necessity for large amounts of backup power.

Conservation of Energy Impact: The recommissioning of a 500 KW plant would eliminate the need for 198,000 barrels of oil per year. Onsite use of power would tend to add the local energy pool by economic multipliers associated with reduced energy imput into food production and distribution.

Feasibility Study Funding: Support for the preparation of the feasibility study is being provided by the U.S. Department of Energy as part of the Department's overall program to stimulate small hydro development throughout the country. Some of the materials generated from this study will be used in the technical analysis and information dissemination programs planned by the government.

Please address all comments and questions to: Richard Polonsky,
Principle Investigator

APPENDIX C

BETHLEHEM MINK FARM

BOX 348 • LITTLETON, NEW HAMPSHIRE 03561

Telephone 603 – 444-2453

14 December 1978

SPECIFICATION NUMBER: BMF 101

Alternator 500 and 750 KW

Power Output (optional)	500 KW @ .85 PF
Power Output (optional)	750 KW @ .85 PF
Frequency	60 Hz
Speed (operation)	1,200 RPM
Runaway Speed (one hour)	2,400 RPM
Voltage	2,400/4,160 4 wire
Ambient Temperature	40 C
Protection	Drip proof, Fan cooled
Exciter/Regulator	Solid State
Mounting Arrangement	Single shaft extension for drive

Information Requested

Outline dimensions and mounting
Installed weight
Insulation class
Insulation resistance
Temperature rise on windings
Lubrication requirements and schedules
Operating efficiency (including exciter) at:
110%,100, 90, 80, 70, 60, 50, 40, 30, 20, 10% of rated output at 90% power factor and ambient temperature of 25 C.

Contact

Roger French
Box 158
Jackson, NH 03846

RFF:rcc

APPENDIX C

BETHLEHEM MINK FARM

BOX 348 • LITTLETON, NEW HAMPSHIRE 03561
Telephone 603 – 444-2453

18 January 1979

SPECIFICATION NUMBER: BMF 102

Generator Control Package

SCOPE: The generator control package shall include the electrical circuits for the starting, synchronization, operation, protection and monitoring of the hydroelectric generator.

SPECIFICATION:

Power	750 KW 60 Hertz
Voltage	24000/4160, 4 wire 30 system, gnd neutral
Enclosure	Metal enclosure for safe indoor use
Ambient temperature	20 to 100 F
Line breakers	Vacuum type, magnetically controlled
Required Protective Functions	
	Phase over-current
	Ground over-current
	Reverse power
	Loss of excitation
	Over-voltage
	Under-voltage
	Over-speed
	Under-speed
	Over-temperature
Instruments (4½" rectangular 2250° scales, 1% Class)	
	Volts with phase switch
	Amperes (3 instruments)
	Kilowatts
	Kilowatt hours
	Kilovars
	Synchroscope
	Temperature
	Frequency
	Strip chart recorder on KWs

NOTE: automatic starting or restarting not required.

APPENDIX C

BETHLEHEM MINK FARM

BOX 348 • LITTLETON, NEW HAMPSHIRE 03561
Telephone 603 – 444-2453

18 January 1979

SPECIFICATION NUMBER: BMF 103

Utility Intertie Package

SCOPE: The utility intertie package shall include the electrical equipment (but not the poles and structural supports) for connecting the generator control package (Specification #102) to the utility transmission line. Option I provides only for the sale of energy to the utility. Option II also provides for onsite use of power and purchase of power from the utility.

SPECIFICATIONS:

Primary Service	19.9/34.5 KV 3-phase with grounded neutral
Generator	750 KW, 2400/4160 V 3-Phase with grounded neutral
Outdoor Equipment	3-19.9 KV ganged disconnect switches & fuses 3-250 KV power transformers 3-lighting arrestors (primary side) Instrument transformers, including 3 current transformers, and 3 potential transformers preferably in a single package with only 3 pot heads
Indoor Equipment	Indicating instruments (4½" rectangular, 250° scale, 1% class) Kilowatt KVAR Integrating instruments (Option I) KWH/KW with demand interval 15 min KWAH/KVA " " " " " Integrating instruments (Option II) KWH/KW (Sending) strip recording* KWH/KW (Receiving) " " KVAH/KVA (Sending) " " KVAH/KVA (Receiving) " " Sensors and transfer relays to switch between sending and receiving instrs. Enclosure metal enclosure for safe indoor equipment Ambient Temperature 20 to 100 F

* strip recording type with demand interval of 15 minutes

APPENDIX C

Mr. Roger F. French
Consultant
P.O. Box 158
Jackson, N.H. 03846
U.S.A.

March 13, 1979

Subject: Bethlehem Mink Farm
Our Project # S-1916

Dear Mr. French:

As requested by Mr. Bruce Sloat, we are pleased to submit for your consideration, our prices for hydroelectric power generating equipment for the Bethlehem Mink Farm Project:

1) One (1) - Complete 510 KW synchronous generating set, consisting of the following:

- 1 - 6' 0" I.D. Butterfly Valve, (manually operated)
- 1 - Intake Transition Section with a loose flange for welding to the customer's penstock,
- 1 - Ossberger Cross-flow Turbine, designed and built for 39.4' net head and 200 cfs operation. Output of the turbine will be 743 HP at 135 RPM.
- 1 - Set of High Speed and Low Speed Flexible Couplings,
- 1 - 750 HP Speed Increaser, with AGMA service factor of min. 1.5,
- 1 - 550 KW, 1200 RPM Three Phase Brushless Generator of desired voltage up to 4.16 KV. Electrical output of generator at rated turbine output of 743 HP will be approx. 510 KW.
- 1 - Foundation Frame for the turbine,
- 1 - Plate Steel Straight Draft Tube, up to 12 feet long,
- 1 - Speed Governor, complete with oil pump, servomotors, linkages etc.
- 1 - Flywheel to increase the moment of inertia of generator,
- 1 - Generator Control Panel, with basic monitoring and protection devices,

Page 2.....

- Necessary foundation bolts, piping, wiring devices etc. to complete the installation.

PRICE:............................. U.S. $246,000.

2) One (1) - Complete 740 KW synchronous generating set, consisting of the following:

1 - 6' 0" I.D. Butterfly Valve (manually operated),

1 - Intake Transition Section with a loose flange for welding to the customer's penstock,

1 - Ossberger Cross-flow Turbine, designed and built for 57' net head and 200 cfs operation. Output of the turbine will be 1075 HP at 161 RPM.

1 - Set of High Speed and Low Speed Flexible Couplings,

1 - 1100 HP Speed Increaser with AGMA service factor of min. 1.5,

1 - 750 KW - 1200 RPM - three phase brushless generator of desired voltage up to 4.16 KV. Electrical output of generator at rated turbine output of 1075 HP will be approx. 740 KW.

1 - Foundation frame for the turbine,

1 - Intake transition section with a loose flange for welding to the customer's penstock,

1 - Plate steel straight draft tube, up to 12' long,

1 - Speed Governor, complete with oil pump, servomotors, linkages etc.,

1 - Flywheel to increase the moment of inertia of generator,

1 - Generator Control Panel with basic monitoring and protective devices,

Page 3.....

F.W.E. STAPENHORST INC.

[illegible] POINTE CLAIRE, QUE. [illegible] • TEL. [illegible] • TELEX [illegible]

Mr. Roger F. French
Consultant

March 13, 1979

- Necessary foundation bolts, piping, wiring devices etc. to complete the installation.

PRICE:..................................U.S. $346,800.

Both prices are F.O.B. site, all import duties paid, but no local and state taxes, if any, included.

Prices are firm for 30 days.

We hope that you will find the prices quoted and information given satisfactory, but should you have any further questions, please do not hesitate to contact me.

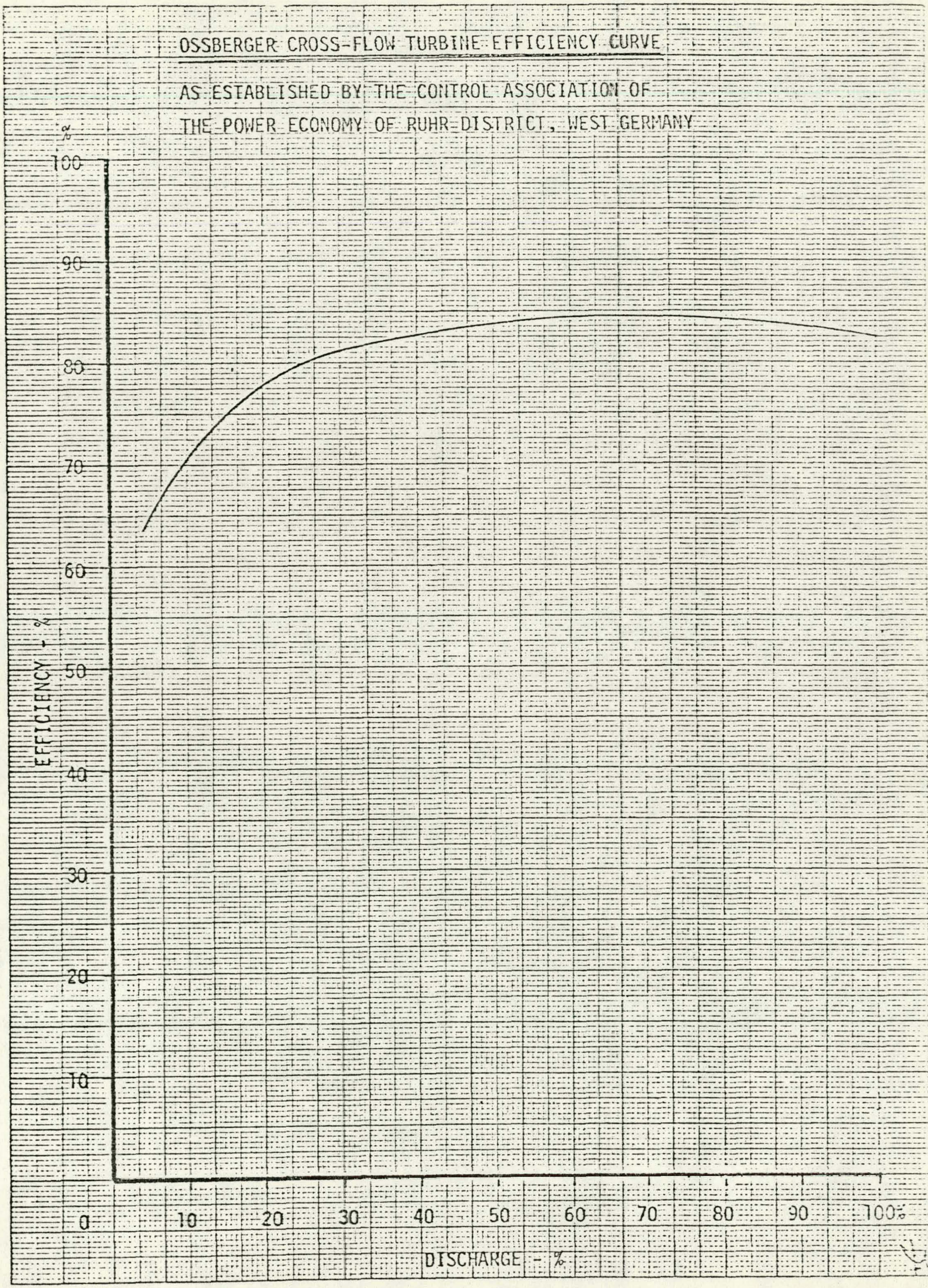
Yours very truly,

F.W.E. STAPENHORST INC.

F. Kanger, P. Eng.

CC: Mr. Bruce Sloat

FK/hr


OSSBERGER CROSS-FLOW TURBINE EFFICIENCY CURVE
AS ESTABLISHED BY THE CONTROL ASSOCIATION OF
THE POWER ECONOMY OF RUHR-DISTRICT, WEST GERMANY
%
100
90
80
70
60
50
40
30
20
10
0
EFFICIENCY - %
10
20
30
40
50
60
70
80
90
100%
DISCHARGE - %

REF: 1466

Brown Boveri Corporation

MECHANICAL AND ELECTRICAL POWER EQUIPMENT • SINCE 1891

NORTH BRUNSWICK, N. J. 08902

AREA CODE 201 - 932 - 6000
MY DIRECT DIAL NUMBER IS 932- 6117

IN REPLY PLEASE
REFER TO File 0304 EL

January 31, 1979

Mr. Roger French
Post Office Box 158
Jackson, NH 03846

Reference: Bethlehem Mink Farm

Dear Mr. French:

We acknowledge with thanks receipt of both your letters dated December 26, 1978.

As explained to you during our telephone conversation last week, we are quoting you hereunder our complete package, inclusive of turbines, generators, speed increaser, control panels, etc., rather than giving you separate prices for generators and turbines.

We have indicated hereunder the salient technical data for the generators and turbines. Alternative 1 is the solution for the 500 KW package and alternate 2 is the package for the 750 KW output.

TURBINE TECHNICAL DETAILS

	Alt. 1	Alt. 2
Type	Francis	Francis
Construction	Horizontal	Vertical
Power (KW)	500	750
Speed (RPM)	300	420
HE (M)	12	17.7

Further technical details, such as efficiencies, etc., will follow.

GENERAL DESCRIPTION - TURBINES (BOTH ALTERNATIVES)

Turbine

Horizontal shaft with runner fitted directly to the overhung generator shaft through a speed increaser.

The spiral casing (stay ring for alternative 2) covers and runners are all welded from unalloyed plate steel.

The wicket gate bearings are of self-lubricated type.

The sealing rings are renewable.
The shaft seal is of nontouchable, two-step construction.
The turbine for alternative 2 has a thrust bearing.

TURBINE CONTROL UNIT

The turbine control unit is designed for automatic and manual starting up and parallelling, remote and local output regulation and automatic, remote or manual closing down of turbine. The unit is not designed for frequency governing when operating on an isolated network.

A common oil pressure unit for operation of the turbine control unit will be provided.

GENERATOR

	Alt. 1	Alt. 2
Item 2		
Type	WAB 500 B 6	WAB 500 E6
Rated Output (KVA)	600	900
Construction	Horizontal	Vertical
Voltage	440	440
Speed (RPM)	1200	1200
Runaway Speed	2400	2400
Frequency	60	60

Efficiency of Generator:

	Alt. 1	Alt. 2
1/1 Load (0/0)	93.8	94.5
3/4 Load	94.0	94.6
1/2 Load	93.3	93.8

PRICES AND DELIVERIES

Our firm price for a complete package delivered to job site, inclusive of transport, freight, customs duty, etc., but without erection supervision, erection, commissioning, etc., are as follows:

A. For alternate 1, 500 KW unit with horizontal Francis Turbine, generators, switchgear, etc.

. . . . U.S. Dollars $ 364,000.

B. For alternate 2, 750 KW unit with vertical Francis Turbine, generators, switchgear, etc.

. . . . U.S. Dollars $ 378,000.

The above prices are budgetary and are subject to negotiation based on actual dimensions of existing powerhouse and adaptibility of the turbines to the existing location.

Delivery is based on the present factory load, which is about 12 months ex-works from the date of a clear-cut order.

We felt that the solution with a Francis Turbine would be more economical and compact rather than using tubular turbines.

Our designers are working on the technical information which we still owe you, but we presume the above price information will be of assistance to you. To give you better estimates, we need drawings of the existing powerhouse.

Mr. French
Page Four
January 31, 1979

Should you have further qeustions and require additional clarification, we are always at your service.

Very truly yours,

BROWN BOVERI CORPORATION

S. Mookerjee
Sales Manager
Electrical Division

SM:ms

Brown Boveri Corporation

MECHANICAL AND ELECTRICAL POWER EQUIPMENT • SINCE 1891

NORTH BRUNSWICK, N.J. 08902

AREA CODE 201 - 932 - 6000

MY DIRECT DIAL NUMBER IS 932- 6117

IN REPLY PLEASE
REFER TO File 0304 EL

February 9, 1979

Mr. Roger French
Post Office Box 158
Jackson, NH 03846

Reference: Bethlehem Mink Farm

Dear Mr. French:

Further to our letter of January 31, 1979 and persuant to our telephone conversation this morning, we have the pleasure in confirming herewith the various efficiencies:

Alternate 1: Flow at rated output of 500 KW = 170 cfs

Flow ratio: Q/Q max:

0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

Efficiency in %:

28	50	68	81	87	90	90.5	87.5

Alternate 2: Flow at rated output of 750 KW - 173 cfs.

Flow ratio Q/Q max:

0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0

Efficiency in %:

28	50	68	87 ? 81	87.5	90.5	91	88

Mr. Roger French
Page Two
February 9, 1979

The efficiencies for flow ratios of 0.7 to 1.0 are guaranteed, based on model tests in laboratory. The other efficiencies are expected values.

We hope the above information is of use to you.

Very truly yours,

BROWN BOVERI CORPORATION

S. Mookerjee
Sales Manager
Electrical Division

SM:ms

ALLIS-CHALMERS

BOX 712 • YORK, PENNSYLVANIA 17405 / 717 792-3511

YORK PLANT
HYDRO-TURBINE DIVISION

February 9, 1979

Mr. Roger F. French
Consultant
P. O. Box 158
Jackson, NH 03846

SUBJECT: Bethlehem Mink Farm
A-C Inquiry 6-33050

Dear Mr. French:

This letter is in reply to your letter dated December 26, 1978 requesting information relative to hydro-turbines for your Alternate #1 and Alternate #2.

ALTERNATE #1

For a net head of 39.4' (12m) and a rated flow of 185 cfs we would propose one (1) 1000mm 5XA (adjustable) standard TUBE unit. At these rated conditions, the turbine output would be rated 545 KW. For your maximum conditions of 39' and 200 cfs flow the turbine output would be about 580 KW. At this maximum output the unit centerline could be set up to about 1m above tailwater.

In order to set the machine as high as your existing floor elevation of 14' above tailwater, the turbine output must be limited to about 375 KW.

Our present day price for one (1) 1000mm 5XA standard TUBE unit F.O.B. York, PA is . . .

THREE HUNDRED FOUR THOUSAND DOLLARS $304,000

This estimate includes butterfly inlet valve, turbine, speed increaser, 900 RPM synchronous generator, blade positioner, hydraulic power unit and electrical controls.

ALTERNATE #2

For the rated net head of 57' (17.4m) and 200 cfs flow, we would propose one (1) 1000mm 5XA TUBE unit. This unit would be arranged similar to our standard unit, however, would not be considered a standard because it exceeds our standard head limit of 15m.

At these rated conditions, the turbine output would be about 850 KW. At this output the centerline of the unit could be set up to about 0.85m above tailwater.

MAILGRAM SERVICE CENTER
MIDDLETOWN, VA. 22645

Mailgram

0105224276 10/03/73 TWX ALIOCHAL B YRK MANA
1996 YORK PA 10.03.73

ATTN: ROGER FRENCH
ATTA CORP.
117 SILVER STREET
DOVER, NH 03820

SUBJECT: LITTLETON HYDROELECTRIC PROJECT
OUR INQ. NO. 6-33050

FURTHER TO OUR LETTER TO YOU DATED 9-13-73, PRELIMINARY PRICE FOR ONE (1) 350KW, 0.8PF, 200 RPM, 3/60/4160 V, VERT. SYNCH. GENERATOR INCLUDING EXCITATION SYSTEM AND OPEN TYPE ENCLOSURE $170,000 FOB FACTORY.

TRANSFORMER AND BREAKER PRICES ARE NOT READILY AVAILABLE. HOPEFULLY YOU CAN OBTAIN THESE.

IF WE CAN ASSIST YOU FURTHER, PLEASE ADVISE.

RON MILLER 2996 ALLIS-CHALMERS YORK PA
1:11
TELEX 840435

1217 EST

MGMCOMP MGM

170
450
25
645

TO REPLY BY MAILGRAM, SEE REVERSE SIDE FOR WESTERN UNION'S TOLL - FREE PHONE NUMBERS

ALLIS-CHALMERS

BOX 712 • YORK, PENNSYLVANIA 17405 / 717 792-3511

YORK PLANT
HYDRO-TURBINE DIVISION

September 13, 1978

AETA Corporation
117 Silver Street
Dover, New Hampshire 03820

ATTENTION: Mr. Roger French

SUBJECT: Littleton Hydroelectric Project
A-C Inquiry No. 6-33050

Dear Mr. French:

We refer to your telephone coversation of August 22 with our Mr. Howard Mayo, Jr.

As I understand it, you requested a price for a replacement unit similar to the previous 47" vertical Francis turbine including governor and generator.

Our present-day price to design and manufacture one (1) 47" vertical Francis turbine including pressure case and governor, rated 460 horsepower under 46' net head and operating at 200 RPM, FOB factory is -

FOUR HUNDRED FIFTY
THOUSAND DOLLARS $450,000.00

We will send you prices for transformer, breaker, and generator as soon as they are available.

It is also my understanding that you requested a price for one (1) 1250 mm standard TUBE turbine unit for a potential site downstream with 15 meter head. Assuming 300 cfs would be available approximately 25% of the time, the turbine would be rated at 1100 kw. The unit centerline could be set up to approximately 1 meter above tailwater.

Our present-day price to design and manufacture one (1) 1250 mm, adjustable five-blade, fixed vane, standard TUBE turbine unit, FOB factory is -

THREE HUNDRED FORTY-TWO
THOUSAND DOLLARS ....$342,000.00.

This estimate includes the turbine, intake butterfly valve, speed increaser, air clutch, 900 RPM synchronous generator, blade positioner, hydraulic power unit, and electrical controls as described in our enclosed Bulletin 54B10241-02.

For our files and for our use in responding to any further requests or questions you may have, please send us a copy of the flow duration curves for these sites.

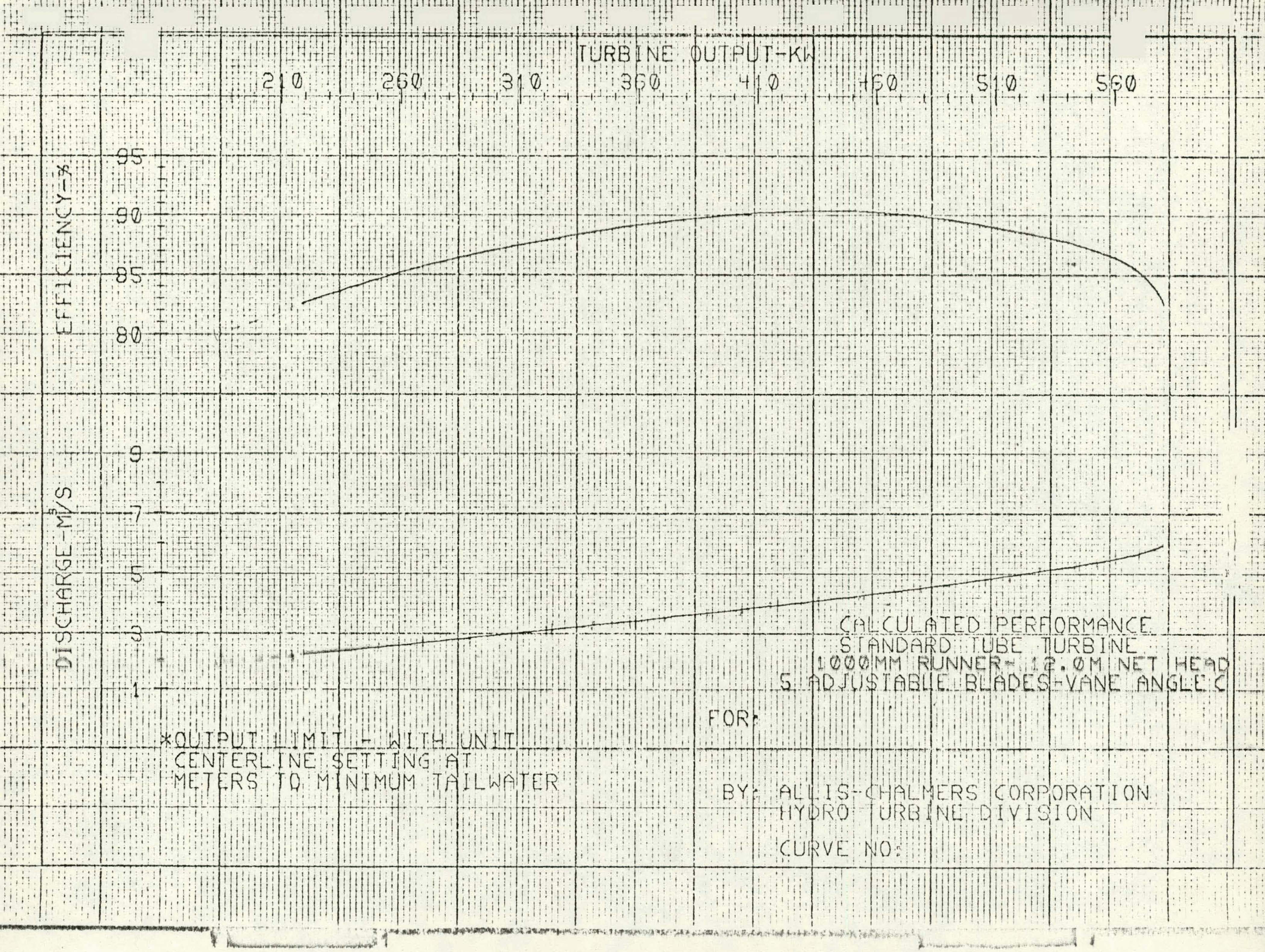
Very truly yours,

Ron Miller

R. P. Miller
Sales Engineer

RPM/ew
Enclosure

cc: C. R. Swaney Company, Inc., Hingham



TURBINE OUTPUT-KW
210
260
310
360
410
460
510
560
EFFICIENCY-%
95
90
85
80
DISCHARGE-M3/S
9
7
5
3
1
CALCULATED PERFORMANCE
STANDARD TUBE TURBINE
1000MM RUNNER- 12.0M NET HEAD
5 ADJUSTABLE BLADES-VANE ANGLE C
FOR:
*OUTPUT LIMIT - WITH UNIT
CENTERLINE SETTING AT
METERS TO MINIMUM TAILWATER
BY: ALLIS-CHALMERS CORPORATION
HYDRO TURBINE DIVISION
CURVE NO:

APPENDIX D

Chapter 32

HB 35

STATE OF NEW HAMPSHIRE

In the year of Our Lord one thousand nine hundred and seventy- eight

AN ACT

relative to providing exemptions from public utility status for certain electrical energy producers and setting rates for sale of power generated by those exempted producers.

Be it Enacted by the Senate and House of Representatives in General Court convened:

32:1 New Chapter. Amend RSA by inserting after chapter 362 the following new chapter:

CHAPTER 362-A

Limited Electrical Energy Producers Act

362-A:1 Declaration of Purpose. It is found to be in the public interest to provide for small scale and diversified sources of supplemental electrical power to lessen the state's dependence upon other sources which may, from time to time, be uncertain.

362-A:2 Exemption of Limited Electricl Energy Producers. Producers of electrical energy, not involving the use of nuclear or fossil fuels, with a developed output capacity of not more than 5 megawatts shall not be considered public utilities and shall be exempt from all rules, regulations and statutes applying to public utilities.

362-A:3 Purchase of Output of Limited Electrical Energy Producers By Public Utilities. The entire output of electric energy of such limited electrical energy producers, if offered for sale, shall be purchased by the electric public utility which serves the franchise area in which the installations of such producers are located.

362-A:4 Payment by Public Utilities for Purchase of Output of Limited Electrical Energy Producers. Public utilities purchasing electrical energy in accordance with the provisions of this chapter shall pay a price per kilowatt hour to be set from time to time, by the public utilities commission.

362-A:5 Settlement of Disputes. Any dispute arising under the provisions of this chapter may be referred by any party to the public utilities commission for adjudication.

32: 2 Effective Date. This act shall take effect 60 days after its passage.

Approved: June 23, 1978
Effective date: August 22, 1978

APPENDIX D

PUBLIC SERVICE Company of New Hampshire North Main St., P.O. Box 191, Lancaster, N.H. 03584
Telephone (603) 788-2567

April 6, 1978

Mr. Chris Collman
Bethlehem Mink Farm
Box 348
Littleton, New Hampshire 03561

Dear Mr. Collman:

As per your telephone request for information about power lines from the hydro location in Bethlehem to the Bethlehem Mink Farm and to the Saranac Refrigerated Warehouse in Littleton, this information is as follows:

Bethlehem Hydro to Bethlehem Mink Farm:

Bethlehem Hydro - Bethlehem S/S	2.44 miles, 19.9/34.5 KV Line.
at Bethlehem S/S - 300 KVA, 19.9/34.5 to 7.2/12.47 KV stepdown transformer bank.	
Bethlehem S/S to Bethlehem Mink Farm	3.37 miles, 7.2/12.47 KV Line.

Bethlehem Hydro to Saranac Refrigerated Warehouse, Littleton:

Bethlehem Hydro - Bethlehem S/S	2.44 miles, 19.9/34.5 KV Line.
Bethlehem S/S - Whitefield	10.90 miles, 19.9/34.5 KV Line.
at Whitefield S/S transformation 19.9/34.5 KV to 110 KV.	
Whitefield S/S - Moore S/S (New England Power)	16.4 miles, 110 KV Line.
at Moore Station (N.E.P.) transformation 110 KV - 13.8 KV - 34.5 KV.	
Moore Station (N.E.P.)-South St. S/S (Littleton Water & Light)	6.44 miles - 34.5 KV.
at South St. S/S (L.W.L.) transformation 34.5 KV to 2.4/4.16 KV.	
South St. S/S (L.W.L.) — Saranac Refrig. Warehouse	0.30 miles, 2.4/4.16 KV Line.

If there are any further questions, please contact me.

Very truly yours,

C. Dudley Johnson
No. Div. Electrical Engineer

CDJ/ad

cc - Robert F. Brecknock

APPENDIX E

United States Senate
COMMITTEE ON VETERANS' AFFAIRS
WASHINGTON, D.C. 20510

March 28, 1979

Mr. David B. Master
Bethlehem Mink Farm
Box 348
Littleton, New Hampshire 03561

Dear Mr. Master:

Thank you for contacting me and for sending information on your proposed small-scale hydroelectric facility on the Ammonoosuc River.

Under the Research and Development Program, funds are available for those who have already completed feasibility studies. In July or August, funds will become available for feasibility studies, however, money has not yet been appropriated for construction loans. You can be sure that I will be fighting hard on the Appropriations Committee to restore the funds for small-scale hydroelectric development that have been eliminated by the Administration in the 1980 budget.

I have had your name placed on the Department of Energy's mailing list for low head hydro grants. You should begin receiving information from the DOE shortly.

I appreciate hearing from you and I hope you will not hesitate to let me know if I may be of any further assistance.

Sincerely,

John A. Durkin
United States Senator

JAD:ahb

JAMES C. CLEVELAND
2D DISTRICT, NEW HAMPSHIRE

COMMITTEES:
PUBLIC WORKS AND TRANSPORTATION
HOUSE ADMINISTRATION
SELECT COMMITTEE ON CONGRESSIONAL OPERATIONS

Congress of the United States
House of Representatives
Washington, D.C. 20515

WASHINGTON OFFICE:
RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, D.C. 20515
TEL.: 225-5206

DISTRICT OFFICES:
316 FEDERAL BUILDING
55 PLEASANT STREET
CONCORD, NEW HAMPSHIRE 03301
TEL.: 228-0315

23 TEMPLE STREET
NASHUA, NEW HAMPSHIRE 03060
TEL.: 883-4525

April 5, 1979

Mr. David B. Master
Energy Development Consultant
Bethlehem Mink Farm
Box 348
Littleton, NH 03561

Dear Mr. Master:

Enclosed please find a copy of a letter I recently received from the Department of Energy concerning the licensing procedures for small-scale hydroelectric facilities. Apparently, the Department is presently examining means by which these processes could be simplified and shortened.

I hope that the enclosed information will prove useful to you. Please continue to keep me informed of any developments.

Sincerely yours,

James C. Cleveland
Member of Congress

JCC:hsh
Enclosure

APPENDIX E 3

North Country

RESOURCE, CONSERVATION
and DEVELOPMENT PROJECT, Inc.

HUMISTON BUILDING, MEREDITH, NEW HAMPSHIRE 03253 Phone 603-279-6546

10 April 1979

Mr. Richard Polonsky, V.P.
Bethlehem Mink Farm
Box 348
Littleton, N.H. 03561

Dear Richard:

I have been honored to serve individually as a consultant on your project, but the following is a policy statement of the Executive Board of the North Country Resource Conservation and Development Project.

The North Country Resource Conservation and Development Project heartily endorses the activities of the Bethlehem Mink Farm in its project to reactivate the Bethlehem Dam. This is a significant and cost effective step to provide inflation proof and environmentally sound power.

However, of even greater significance is the planned use of the power combined with effective passive solar energy to provide fresh produce throughout the year.

The North Country is at the end of the energy and food chains and is further confronted with significantly more severe weather and a shorter growing season.

We are all severely impacted by the triangular relationship of inflation, food, and energy. This local project should provide the inspiration and the synergistic combination of technology and resources to attack the problem and to provide great economic benefit to the area.

We are proud to add our support to this great start to solve these great problems of our area and our nation.

Sincerely,

Roger French

Roger French, Chairman
North Country RC&D Executive Board

APPENDIX E

April 1, 1979

Mr. Richard Polonsky
Principal Investigator
Bethlehem Mink Farm
Box 348
Littleton, New Hampshire 03561

Dear Mr. Polonsky:

Thank you very much for recently sending me your fact sheet on the proposed Bethlehem Mink Farm small hydro re-activation. The N.H. Solar Energy Association is very supportive of renewable energy developments that are environmentally sound and we were happy to learn more details of the project.

It may interest you to know that the Bethlehem Dam project has been under consideration by the Association for inclusion in our current "Solar Models Project." This activity, supported by a grant from the Center for Renewable Resources in Washington, D.C., is aimed at identifying model technology applications and energy programs throughout the state. In your case, we are interested not only because of the hydro site itself, but also because of the emphasis on localized food production.

The Solar Energy Association has maintained a long-standing interest in solar greenhouses and it seems that there may be some food-related areas of mutual interest which can be explored. In particular, it would seem that any physical structure used for vegetable production should incorporate passive solar elements in its design.

We will be most interested to follow your progress and discuss possible collaboration on greenhouse structures for controlled environment vegetable production. The best of luck with your efforts.

Very truly yours,

Chris Benz

Chris Benz, President

NEW HAMPSHIRE SOLAR ENERGY ASSOCIATION

Resource Policy Center
Thayer School of Engineering
Dartmouth College
Hanover NH 03755
603 / 646 - 3551

April 5, 1979

Mr. Chris Collman
Bethlehem Mink Farm
Littleton, N.H. 03561

Dear Chris:

I was fascinated by your plan to use the interruptible power produced by run-of-the-river small-scale hydro (SSH) in contolled-environment farming and think the Resource Policy Center (RPC) could contribute to your project by developing and implementing several or all of the mathematical models described below. The models can be as sophisticated as needed and are designed to aid in both the design and operation of the system.

1. Statistical Hydrology Model This model uses existing hydrologic data to generate monthly low flow duration curves or long-term synthetic streamflow traces at the site.

2. SSH Output Model This model takes the hydrologic output, and for a given turbine type, efficiency and dam configuration, determines the monthly SSH power output with confidence intervals.

3. Production/Load Management Model This is an optimization model and, in its most sophisticated form, would determine the best mix of monthly agricultural production (e.g. lettuce growing, veal raising, fisheries, etc.) and energy sources (e.g. SSH, natural sunlight, backup power, etc.) given the energy needs and costs of the agricultural activities, the costs and outputs of the energy sources, and the market value of the agricultural production.

4. Simulation Model The simulation model tests and refines the production/load management system designed above.

5. Operational Model This model is implemented after the system is desinged and is used in combination with weather forecasts to aid in the day-to-day operation of the system.

After the models have been developed and implemented for the Mink Farm, we would be anxious to work with you in generalizing the methodology and results for other rural areas.

Please keep us informed of your project and we hope to have the opportunity to work with you.

Sincerely yours,

Paul A. Kirshen

Paul A. Kirshen
SSH Project Director

jg

Northern Community Investment Corporation
BOX 396 • ST. JOHNSBURY, VERMONT 05819 • (802) 748-5101

March 1, 1978

Mr. Richard Polanski
Bethlehem Mink Farm
Box 348
Littleton, NH 03561

Dear Mr. Polanski:

I have reviewed your plans for the redevelopment of the hydroelectric power plant on the Ammonusic River in Bethlehem, New Hampshire. It is my understanding that you propose to produce power for sale as well as for on-site utilization for future agricultural and natural resource ventures.

I am glad to see that you have been able to develop a great deal of the background necessary to the revitalization of the dam and power plant. It was my recommendation of perhaps 8 months ago that you concentrate your efforts on this project after reviewing the current status of your physical assets and business potential. You now seem to have a good basis for conducting an in-depth feasibility study and business plan, for the entire project.

NCIC is interested in the creation of employment and profitable investment opportunities, utilizing local resources to the maximum extent possible. As such, this project would be of interest to us for further evaluation for its economic development potential.

As a member of the Board of Directors of the National Center for Appropriate Technology, I feel that this type of energy development tied to local economic development and food production is extremely appropriate for northern New England.

If I may be of further assistance in your efforts to undertake this project, do not hesitate to contact me.

Sincerely,

Fritz Griffin

w

FARM CREDIT SERVICE
FEDERAL LAND BANK ASSOCIATION
PRODUCTION CREDIT ASSOCIATION
34 SUMMER STREET. ST. JOHNSBURY. VERMONT 05819
TEL. 748-4006 & 748-8575

FARM CREDIT SERVICE

March 1, 1978

TO WHOM IT MAY CONCERN:

The Farmers Production Credit Association has assisted with the financing of agricultural enterprises for Bethlehem Mink Farm, Inc., for over twenty-five (25) years.

We would be willing, as in the past, to discuss any new or continuing agricultural endeavor.

Very truly yours,

Franklin E. Temple

Franklin E. Temple
General Manager