



**Environmental Consulting & Technology, Inc.**

CITY MANAGER'S OFFICE

MAR 06 2009

March 4, 2009

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County Administrator  
Grand Traverse County  
400 Boardman Ave.  
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Mr. R. Ben Bifoss  
Traverse City Manager  
City of Traverse City  
400 Boardman Ave.  
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Re: Summary of Hydroelectric Power Generation at the Boardman Dams

Dear Sirs:

This letter represents a summary of the analysis that was performed on the hydroelectric potential of the Boardman dams, in particular the power generation potential for Sabin, Boardman and Brown Bridge dams.

The Consultant Team independently analyzed the potential for restoring power generation capacity at the dams. The study was completed using information generated by others when the dams were being used for power generation as well as new information collected on the safety of the dams and the condition of the dams.

## PROCESS

The process for assessing the potential for power generation consisted of reviewing previous studies, conducting independent measurements and studies of Sabin, Boardman, and Brown Bridge dams, preparing independent cost estimates of the probable cost of required improvements to the dams, and independent assessments of the revenue potential for generating power given the current cost of electricity and the recent legislation in Michigan regarding renewable energy. While the studies prepared for Traverse City Light and Power were reviewed in the study process, those studies were not the sole source of information and the majority of information contained in the Consultant Team assessment is new information developed during the study process. In addition, the Consultant Team has had discussions with Mr. Charles Petersen of Petersen Machinery regarding his approach to licensing the dams and restoring power generation at the dams. The discussions between Mr. Petersen and members of the Consultant Team did not include a detailed plan regarding cost/benefit studies prepared by Mr. Petersen.

## BASIS FOR RECOMMENDATIONS

The recommendations presented below were informed and shaped by three primary factors: 1) science-based data and information contained in the Engineering and Feasibility Study; 2) studies of the Brown Bridge Dam prepared by STS Consultants for the City of Traverse City; and 3) revenue estimates prepared by the socioeconomic consultant on the Consultant Team.

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*Boardman River Dams Disposition Study-Summary of Hydroelectric Power Generation Potential*

The Consultant Team studied the question of power generation and a detailed discussion is presented in the Final Detailed Analysis of Alternatives Report. The process of restoring power generation at the dams starts with the licensing process administered by the Federal Energy Regulatory Commission (FERC) and would require numerous improvements to be made to the dams and spillways before power could be generated. The Consultant Team estimated that the cost to repair and restore hydroelectricity generating capacity at all three dams could range from \$8,260,000 to \$15,030,000. The revenue estimate from the sale of electricity from the three dams is approximately \$8,600,000 (Present value over 30 years). The tasks associated with restoring hydroelectricity and the costs are summarized in Table 1.

Table 1. The tasks and probable costs necessary to restore hydroelectric power generating capacity at Sabin, Boardman and Brown Bridge dams. Note that Union St. dam is not included in this analysis.

<b>Task</b>	<b>Probable Cost</b>
FERC Licensing Process	\$ 600,000 - 750,000
Repair Dams	\$500,000 – 1,800,000
Provide fish passage	\$5,500,000 - 7,000,000
Mitigate warm water impact	\$ 200,000 - 400,000
Upgrade flood control spillway	\$ 1,020,000 - 4,300,000
Operation and maintenance	\$390,000 – 780,000
<b>Total Estimated Cost</b>	<b>\$8,260,000 – 15,030,000</b>
<b>Total Cost ( Present Value over 30 years)</b>	<b>\$16,800,000</b>
<b>Total Revenue ( Present Value over 30 years)</b>	<b>\$ 8,600,000</b>

The FERC licensing process is estimated to cost between \$600,000 and \$750,000. This estimate was developed after reviewing the cost of relicensing existing hydroelectric facilities in the state, including hydroelectric facilities operated by Michigan based utilities, as well as, the cost incurred by several communities in Michigan who recently relicensed their hydroelectric facilities.

The cost to repair the dams was based on several factors. First, both Boardman Dam and Brown Bridge dams have required repairs based on the most recent studies prepared by the Consultant Team, the U.S. Army Corps of Engineers and STS Consultants. The repairs are detailed in the detailed analysis, but include items such as concrete repair and replacement, building maintenance, slope stabilization and other maintenance items.

The cost to provide fish passage at the dams was based on the cost to install fish passage at other dams in Michigan that were of comparable size and capacity. These fish passage structures were either installed or designed to be installed on rivers such as the St. Joseph, Tittabawasee, and Saginaw rivers. One of the objections to this cost item being included in the cost to license hydroelectricity at these dams is based on the view that the natural resource agencies will not require fish passage at the dams. While an argument can be made to block fish passage, the final decision regarding fish passage would be made during the permit process after a complete hearing of the pros and cons of the issue of allowing fish passage. Given the uncertainty associated with this issue, it seems prudent to include the cost item for now and eliminate it in the event the licensing process determines that fish passage is not required.

The cost to mitigate the warm water discharge from Brown Bridge Dam is based on an independent assessment of the warm water impact and various methods to mitigate the impact. This item is required because it has been documented in several studies that there is a warm water discharge from Brown Bridge impoundment that has a significant adverse impact on the coldwater fish population in the Boardman River immediately downstream from Brown Bridge Dam. In order to obtain a license to generate electricity at Brown Bridge Dam, we anticipate that FERC will require that the warm water impact be mitigated. The proposed mitigation method was to construct a discharge system that collects colder water from the bottom of the impoundment and discharges the colder water into the Boardman River. Unlike the fish passage requirement, the requirement to mitigate warm water discharge would most certainly be a part of any licensing agreement.

There is also a need to improve the emergency flood capacity of the dams at Boardman Pond and Brown Bridge Pond. Both dams are currently out of compliance and would need to be improved in order to meet federal requirements for flood control. The spillway capacity at Boardman Dam and Brown Bridge Dam need to be improved and the cost estimate for modernizing the spillway capacity was independently developed by the Consultant Team.

The revenue estimate was based on the product of projected generation and electricity prices. Calculations of hydropower potential employed are the product of a horsepower conversion constant, hydraulic head, and expected future flow rates. The constant is the weight of water (64.6 lb/ft<sup>3</sup>) divided by horsepower constants of 550 ft lbs multiplied by 0.7457 kWh. The head for Sabin Dam (20 feet), Boardman Dam (41 feet), and Brown Bridge Dam (33 feet) were reported in the dam brochure from Traverse City Light and Power. The flow rate of the water was taken from the USGS Surface-Water Daily statistics for the Boardman River, site #04126970, which is located above Brown Bridge Road on the Boardman River at Latitude 44°39'24", Longitude -85°26'12". The daily flow rate is given in cubic feet per second and is the mean value for each day. This mean value was used for each of the 24 hours in a day. No minimum flow rate needed to produce power was employed. Maximum power output was limited to equipment nameplate capacity for each site (Sabin - 0.5MW, Boardman - 1MW, and Brown Bridge - 0.725MW). Turbine and generator inefficiencies (these can range between 5% and 20%) were not included in these calculations. The generators were assumed to operate continuously with no down time for maintenance. Hourly generation was projected forward for thirty years. This hourly generation was multiplied by hourly price. Hourly prices were based on MISO hourly prices for the year 2007 with a 3% annual escalation. A renewable energy price was added at \$15 per megawatt hour beginning in the year 2015. This value was also escalated by 3% annually. The thirty year stream of revenues was discounted using a rate of 7%. This process returns the following total generation and present value projections.

Sabin Dam - 1,910 MWh at \$1,828,000  
Boardman Dam - 3,915 MWh at \$3,747,000  
Brown Bridge Dam - 3,151 MWh at \$3,016,000

Total Generation - 8,976 MWh at \$8,591,000

The revenue estimate in this summary is somewhat lower than in the final report due a change in the price estimate for electricity used to calculate the revenue that could be expected from the sale of electricity from the facility. The revenue estimate may also change depending on changes in the

assumptions listed above, however, we believe that the revenue estimate is reasonable and based on a set of prudent assumptions.

As background for understanding the cost analysis prepared during the study, payback periods in the power generation industry for a regulated utility with 10% expected return on investment would generally be approximately seven years. Matt Bingham at Veritas believes that an expected return of 8.5% (which is pretty common) would have a payback period of approximately eight and a half years. During the detailed analysis of the Boardman dams, Veritas used 30 years to perform the revenue analysis. If we assumed that the equipment would not be replaced the revenue analysis could be extended further. Veritas estimates that the undiscounted payback period is around 50 years. If the generation units need to be replaced the cost of restoring power generation at the dams might never payback the investment.

Moreover, there is uncertainty in both costs and revenue. Long expected payback periods generally come with more certain investments (i.e. common stock versus money market). An independent power producer would not have the certainty of a regulated utility. Veritas has had conversations with someone representing a Canadian group who is looking to purchase United States hydroelectric generating assets and the rate of return that group expected was 25%. We hasten to add that that number is unqualified in that he said nothing about whether that expectation was related to the tax structure.

As we discussed above, our cost/benefit analysis was based on 2007 conditions and price structures. With respect to qualifying for a higher charge under new legislation, we did include additional revenue for renewable energy credits (RECs). As our society shifts its emphasis toward renewable sources of energy it may be that various programs and incentives will be created to offer advantages to renewable energy sources.

### ALTERNATIVE SCENARIO

There is an alternative scenario that may warrant discussion and that is to assume that FERC will not require fish passage at the dams in order to modify the dams to generate power. Although this alternative saves the cost of providing fish passage, the scenario still includes the cost of repairing the dams, modifying the spillways, and the cost of licensing the dams during the FERC process.

Table 2. Net revenue (or loss) generated by power generation with and without fish passage over thirty years.

Dam	Net Revenue With Fish Passage	Net Revenue Without Fish Passage
Sabin	\$ - 1,604,000	\$ - 437,700
Boardman	\$ - 1,394,000	\$ 105,200
Brown Bridge	\$ - 2,492,000	\$ - 992,800
Total	\$ - 5,490,000	\$ - 1,325,000

### SUMMARY

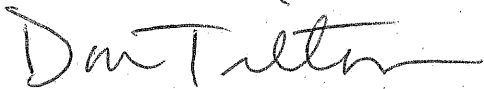
The potential to restore hydroelectric power generation at Sabin, Boardman and Brown Bridge dams was reviewed by the Consultant Team using information collected by the team, other consulting

engineering firms, and the U.S. Army Corps of Engineers. The results of the study show that, while the potential exists for generating power at the dams, the cost to license, repair and upgrade the dams in order to comply with state and federal rules and regulations, may outweigh the revenue to be generated by selling electricity generated at the dams. If the dams can be licensed without a requirement for providing fish passage, then the revenue gap is smaller but there is still a net loss after accounting for the costs of repair, modification and operation.

If you have any questions, please feel free to call me or anyone else on the consulting team to clarify issues we have raised in this summary.

Sincerely,

**ENVIRONMENTAL CONSULTING & TECHNOLOGY, INC.**



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