UNIVERSITY OF NEVADA
RENO, NEVADA

J. G. SCRUGHAM
PROFESSOR OF MECHANICAL ENGINEERING
G. D. POWERS
INSTRUCTOR IN MECHANICAL ENGINEERING
A. W. PRESTON
INSTRUCTOR IN MECHANICAL ENGINEERING

May 26th, 1911.

Mr. B. G. McBride,

Elko, Nev.

Dear Sir;

Relative to investigation of Lamoille Power Site owned by yourself and associates. For the sum of $55.000 you can install a complete generating plant, transmission line and distribution line from Lamoille Creek to Lamoille and Elko. Same to be capable of continuously delivering 250 Horse Power of electricity. By means of a storage dam double this amount of power can be obtained at a proportionately higher cost. However present conditions do not warrant an installation of more than 250 H.P. The present market for light and power at Elko and Lamoille at 10c per K.W. Hour amounts to an excess of $3000 per month. The expense of operation, maintenance, etc, should not exceed $1000 per month and with careful management this might be considerably reduced. The town of Elko is one of permanent character and will doubtless increase in population at a steady rate. A power plant investment for a town of such character should prove exceptionally safe and attractive.

Respectfully submitted,

J. G. Scrugham

Copy

Virginia City, Nevada. May 20, 1911.

Mr. B. G. McBride,

Elko, Nevada.

Dear Sir:-

I have been over the ground of your proposed Lamoille power scheme, and would say the following in a general way:-

It appears that the minimum flow obtainable for power purposes would be between 3½ to 4 seconds cubic feet, which could be used in several ways to produce power. The method that ~~at first sight~~ under present conditions looks the most feasible, would be to develope what power can be obtained without storage, which would be over 200 ~~K.W.~~ H.P. As the power requirements become more, a dam could be installed at the falls, which under the ~~appearent~~ probable operating conditions could double the availage power if necessary. I have in mind a very small dam, costing say something like $10,000.00, which would store water enough to carry the peak load ~~(which no doubt will occur with you the same as with other plants)~~ for about 3 or 4 hours in the evening when all the lighting of business houses is on. The normal flow of water I think would be sufficiant to produce power for the day load now in sight.

I have not the exact data to give fugures of value, but a plant with approxtimately 900 feet head capable of producing about 200 to 250 K. W. delivered at Elko would cost about $50,000.00 complete. The total income from Elko for lighting and power should be over $2,000.00 per month, and with the right management and policy it ought to be brought up to nearly $3,000.00 per month. The operating expense covering all ordinary contingencies ought to be less than $750.00 per month. The regular operating expenses amount to about $450.00 per month, allowing $300.00 of unforseen accidents, etc.

I mention above the sum of \$10,000.00 for a dam to increase the ~~pwk~~ output, but this does not mean that the expenditure of this alone will double the capacity. It would, howeverm, take comparatively littl~~le~~ to to do the rest of the work necessary, which would consist of a new flume line, pipe line, water wheel and generator, with transformers. The line would be constructed heavy enought to deliver the additional power, when first constructed, as it would not be advisable for mechanical reasons to build it too light, or the cost of operation would be too high from breakdowns and lost revenue.

The present plant at Elko operates with distillate, which is expensive, and would inevitably have to close down or sell out if it meet with water power competition.

Elko is a thriving town, and is growing rapidly. There are two railroads running through it, and one of the roads, the Western Pacific, ~~I understand~~, ~~intends to put~~ is installing ~~in~~ a machine shop. While the machine shop would be a profitable customer, the best source of income from its presence would be due to the population dependent on the machine shop. As Elko at present depends principly on its agricultural and other natural resources, with ~~t~~he excepting of mining, ~~it~~ which always introduces an element of uncertain life to ~~the~~ a town. There is not the uncertainly as ~~the~~ to the prosperity of Elko that exists with so many other towns in Nevada, which have to depend ~~largely~~ solely on the mining industry.

I do not believe that there is any small hydro-electric proprosition ~~of~~ Nevada that offers the attractions that your Lamoille Creek ~~delivering power to Elko~~ proposition does. ~~The big proprositions are all taken up, with the exception of Ely, and at present that is impractical on account of the large sum of money required and long transmission. The power would have to come from the Colorado River, no doubt, or the Trucke or Walker Rivers, all a long distance away.~~

As for the competition that you would have to meet with, practically all the present plants now operating in Nevada went into their district with more or less competition. ~~Take Reno, when the present company went into that district, a plant was in operation, but about the time the new company was ready to turn on the power, thxxxxxkx the old com any was willing to sell out at a satisfactory fugure. The same holds good with Virginia City, Carson City, Goldfield and Tonopah.~~ Considering the conditions, it seems to me as if the presence of a company with heavy ope ating expense ought to be considered as somewhat a favorable sign, as they have worked up a ~~want~~ market for electric lighting and power ~~, which they are not able to supply at a rate that you could aford to do if necessary.~~ at a rate much higher than need be charged for hydro-electric power.

Respectfully Yours,

F O Bröili

AN INVESTIGATION OF A HYDRO-ELECTRIC POWER DEVELOPMENT.

Lamoille Creek is situated in the Ruby Mountains, in Elko County, Nevada. Plate No. 4 is a Government map of Elko County. The rod lines show the location of Lamoille Creek with respect to Elko and Carlin. The site of the proposed power station is about twenty-two miles South of the Town of Elko. A good wagon road leading almost direct from Elko makes transportation comparatively easy.

The elevation of the Ruby Mountains is about 13,000 feet, as shown by a Government map. They are partially covered with snow the year around. The melting snow, together with a number of springs, form the water supply for Lamoille Creek.

Map No. 2 is taken from a survey made by B. G. McBride in 1908. It gives the location os Lamoille Creek, its branches and dam site. In Tract A is shown the proposed station site.

The stone house, as shown in Tract A, is a structure 28' wide and 30' long. This house was built some years ago for power purposes but was never completed. The walls which are 2' thick and 11' high, still remain.

The proposed flume and pipe line is also shown on this map. Just below the dam is shown the right branch of Lamoille Creek. By building a flume 3300' long, the flow of this branch can be brought to the reservoir.

Map No. 3 shows the proposed dam site. It also shows where the right branch of Lamoille Creek will have to be tapped in order to convey the water to the reservoir.

Sketch No. 1, on Map No. 2, shows the length of the stream above the stone house. Due to snow, the upper portion was not surveyed, but was taken from a Government map. The area of the water-shed is estimated between twenty and twenty-five square miles.

The enclosed numbered photographs were taken in June, 1908.

No. 2 is looking up the first branch along the proposed ditch line, as shown on Maps Nos. 2 and 3.

No. 7 was taken near the head of the main branch looking in a Southwesterly direction.

No. 8 was taken about a mile from the head of the main branch.

No. 9 was taken near the head of the main branch.

These photographs will convey some idea of the ruggedness of the mountains, the amount and character of the vegetation and the depth of the snow.

A M O U N T O F W A T E R.

The yearly rainfall in the mountains is estimated at thirty inches, while that in the Valley is considerably lower. Due to the melting snow, the maximum run-off occurs in June, July and August.

According to the people living in that section up untill the fall of 1910, the lowest the stream flow has been for the last twenty years was during the fall of 1903. At that time, a large ranch in the Valley changed hands and the new owner brought suit to determine his right on the stream. According to Court records, the stream flow as measured near the stone house, was 8.36 cubic feet per second. The year 1910 was exceptionally dry in that section of the country, and in October, the stream flow went down to 3.93 cubic feet per second. This was the lowest the stream had ever reached according to the residents of Lamoille. Stream gaugings have not been taken regularly. The following measurements were taken at the stone house by B. G. McBride.

Feb. 10, 1908	-------------	55.00	cu. ft. per second.
May 26, 1908		113.00	" " " "
July 5, 1908		306.00	" " " "
Aug. 29 1908		46.00	" " " "
Oct. 25, 1910		5.49	" " " "

Plate L is a curve showing discharge from readings taken in 1908, 1910, 1911. It will be noted that the discharge varies from a minimum of 3. 93 cubic feet per second in November, 1910, to a maximum of 306 cubic feet per second in July, 1908.

A M O U N T O F F A L L .

The difference of elevation of the proposed station site and the foot of the proposed dam is 955'.

S T O R A G E .

The largest lake at the head of the main branch covers an area of about seven acres, but it is not practicable for storage. There are several small lakes above this one, which cover an approximate area of eight acres which have not been examined for storage. However, it is not probable that these can be used on account of freezing.

There is a natural dam site just above the Lamoille Falls. By building a dam, (as shown on Map No. 3) 730 feet long and 158.5 feet high, the water would be backed up a distance of 4300 feet, on land known as "The Meadows."With this dam, the reservoir would hold approximately 4634.5 acre feet of high water which is equivolent to 75.9 cubic feet per second for a period of one month, and 30000 H. P. could be developed. On account of first cost, danger of failure and lack of market for this amount of power, this dam will not be considered.

The following table shows the storage capacity of 40', 50' and 60' dams.

Dam	Sec. Ft. 30 days.	Total Sec. Ft/ 30 days.	Approximate H. P. to line.
40'	1.7	5.7	451.5
50'	3.0	7.0	526.7
60'	5.0	9.0	667.25

It is not recommended that the above dam be installed at this time on account of the lack of present market for the larger amounts of power.

It is recommended that a small dam be built at the proposed dam site and a flume to convey the water from the branch creek to the dam. By so doing, 4 cubic feet per second may be obtained at all times.

Having allowed for losses in flume, pressure pipe, water wheel and generator, 301 H.P. or 224 K.W. will be delivered to line. Losses calculated are as follows:

Flume 15,500' long to have a carrying capacity 4 cubic feet per second; velocity of water 4' per second.

Q= F x V   Where Q= quantity disch.
F= Area cross Sec. sq. ft.
from which F - X - 1   V= Velocity.

The slope of the flume was figured according to Chezy's formula - $Q = VC\sqrt{rs}$ in which V = velocity
Q= quantity discharge in Cu. ft. per Sec.
V= Velocity in feet per second.
C= Coefficient obtained from Kutter's formula
R= Hydraulic Radius.
S= Slope

S= ¾" in 16.5' or 58' in 15,500'.

The lost head pressure pipe 1500' long, 16 inches in diameter carrying water at a velocity of 4 feet per second, figured according to the formula.

$$H' = \frac{fl}{6} \frac{v^2}{2g}$$ in which

H = Lost Head
F = Coefficient of roughness = .0241
l = Length of Pipe = 1500
d = Diameter pipe in feet = 1.33
v = Velocity in feet per second.
g = 32.2

H' = 67.8 ft.

Difference in elevation of station site and dam	955'
Head Lost due to drop of flume --------------	58'
Head lost due to friction pressure pipe -----	67.8
Total loss -----------	125.8'
Available Head ----------------------------	829.2'

Horse Power developed calculated as follows:-

$$H.P. - \frac{Q \times w \times h}{550}$$

H.P. = Horse Power
Q = Quantity Disch. cu. ft. per second = 4
W = weight of 1 cu. ft. of water = 62.5
h = head = 829.2

$$H.P. = \frac{4 \times 62.5 \times 829.2}{550}$$

$$= 379.9$$

Allowing 80% for the efficiency of the water-wheel and generator 301.52 H.P. or 224 K.W. can be delivered to the line.

With the delivery of 200 K.W. to the town of Elko, a line loss approximately 7 K.W. calculated according to the formula derived by Professor Ernest J. Berg of the General Electric Company.

$$P = \frac{W \times L \times 1500}{\text{circ. mils.} \times (E_2)^2}$$

W = Total watts delivered at the end of the line = 200,000.

E = Voltage required at the end of the line.
1500 = constant for three wires, three phase, with motors and lights.
L = Distance in feet which power is transmitted = 116160.
Circ. Mils. = Size wire = 26250 No. 6 wire.

P = 3.31
200 x .0331 = 6.62 K.W. Lost.

A margin of 17 K.W. remains to cover incidental losses such as transformer, line leakage, etc.

E S T I M A T E S .

1 Flume 6" x 7", 3300' long	1150.00
1 Dam 10' high 40' long	4500.00
1 Flume 12" x 14", from dam to power house, sides and bottom 1½" material, Top 1"	
92150' lumber @.25	3650.00
Hauling $6.00 per ton	700.00
Grading, etc.	2610.00
Total	6960.00
1 steel pressure pipe 1500' long 18" dram.	3225.00
concrete work and excavation	400.00
Power station 20' x 20' walls 2' thick (masonry)	3000.00
Double water wheel	700.00
225 K.W. Generator 60 cycle phase	2500.00
Woodward Compensating Governor	250.00
Freight and installation	100.00
Switch board marble	75.00
Voltmeters	50.00
Ammeters	100.00
Tirrel Regulator	250.00
Wattmeters	75.00
Frequency indicator	50.00

2 air brake switches for line and generator -----------	250.00
Switches at each end of line -----------	300.00
	23935.00

T R A N S M I S S I O N   L I N E .

Twenty-two miles, 22000 volts, 200 K.W. Three conductors, 26250 circ. mils, No. 6 wire. Following figures for one mile.

18 poles per mile	@ $7.50 ------	135.50	
18 poles 5 deep	@ 95	17.10	
18 cross-arms	@ 75	13.50	
36 braces	@ 06	2.16	
54 Pine Eucalyptus	@ 15	8.10	
(4 linemen wiring(2 groundmen		12.50	
Framing and raising poles		40.40	
Insulators	@ .30	16.20	
Guy wire		4.00	
Line Hardware, bolts, lag screws etc.		9.00	258.26
5% for extras			12.91
No. 6 cu. wire @ $30.00 per 1000'		475.3	271.17
Total cost per mile including Telephone Line		746.47	
Cost 22 miles ------------------------------			16422.34
2 miles distributing line @ $2500.		5000.00	
Substation at Elko, corrugated iron		160.00	
6 transformers, 3 at each end		6000.00	51517.34
~~2 miles distributing line @ 2500.00~~			
Total Cost --------------------			$ 51517.34.