

# MEMORANDUM

**Date:** December 30, 2013  
**To:** Water Right File 77-7334  
**From:** medl  
**Re:** license review memo

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## **Applicant**

Clarification of the powerhouse ownership is needed.

The Federal Energy Regulatory Commission (FERC) has jurisdiction over this hydroelectric project. This hydro project is known to FERC as the Big Creek Project. The FERC project number is 10721. FERC issued a minor license in March 27, 1992 with a 30-year term. The FERC licensee is Big Creek Lodge & Outfitters, Inc. A copy of the FERC licensing order is attached.

The water right permit holder is USDA Payette National Forest. Big Creek Lodge burned down in 2008. Ownership of the remaining improvements changed in 2013 and the USDA Forest Service is in the process of issuing a Special Use Permit to J. Curtis Earl, Idaho Aviation Foundation (IAF). A copy of the Forest Supervisor's decision memo is attached.

## **Source and POD**

The source is an unnamed stream, locally known as McCorkle Creek.

The POD is the intake to the penstock which originates at a wooden headbox constructed on the creek. System diagrams show that the water is conveyed by gravity through dedicated piping which is buried from the headbox diversion to the powerhouse.

The POD is located in an unsurveyed area in the Payette National Forest. No GPS coordinates for the headbox are available. The actual QQ may either be in the NWSW or in the SWNW of section 26, Township 21 North Range 9 East. The POD is not visible in aerial photography. I created the POD shape based on the IDWR examiner's map. The location is consistent with the stated elevation change and length of penstock.

## **Water Use**

The IDWR field examiner did not take a flow measurement. In his narration he states that the powerplant was "operating at 10% power (25% flow)" which indicates beneficial use of water for power generation.

The IDWR examiner states that the turbine is a 36-inch diameter Pelton turbine coupled to a 120 Volt Dyna generator but does not provide nameplate rating or capacity information for either piece of equipment.

I requested and received additional information about the project from Mr. Steve Spencer, (Water Use Specialist, USDA Forest Service). The FERC inspection report, that Mr. Spencer provided, documents power generation at the project on August 25, 1999. The FERC inspector stated that "the plant was operating and producing approximately 12 kW" at the time of his inspection.

Photos of the micro-hydro turbine and generator are available in both the FERC and the IDWR reports. But neither the FERC inspector or the IDWR examiner recorded the size of nozzle that was being used in the turbine.

This turbine-generator unit is capable of producing electricity through a range of flows depending on the size of nozzle that is installed. I requested the nozzle size from Mr. Spencer who, in turn, requested it from his local staff. The Big Creek hydro primarily uses a 1 ¼ inch nozzle. According to the attached

nozzle discharge table, a single 1 ¼-inch bore nozzle discharges 342 gpm (0.76 cfs) at 55 psi. Photos of the powerhouse don't show a pressure gage near the turbine, and neither inspector record a pressure reading. Therefore, the pressure at the nozzle must be estimated.

The IDWR field examiner stated that the site provided 237 feet of head and that the penstock was 4-inch diameter PVC, 1321 feet in length. I used the Hazen-Williams equation to estimate the head loss due to friction and 120 as the Hazen-Williams coefficient C. I calculated the head at the turbine nozzle to be ~127 ft or ~54.9 psi which is consistent with the nozzle table.

Please refer to the attached spreadsheet for friction, and power generation calculations.

The attached spreadsheet shows that this turbine can use 0.75 cfs to generate ~ 6 kW of power. However, the FERC inspector recorded 12 kW being produced which is twice what the spreadsheet calculates. The turbine and the generator are not directly coupled together. Instead they are linked by a belt drive system. Exam photos show that the turbine's pulley wheel (sheave) has a larger diameter than the generator pulley wheel. Every rotation of the turbine sheave will produce more than one rotation of the generator sheave. So it is reasonable that the generator shaft will turn faster and generate more power than the spreadsheet predicts.

### **Season of Use**

Although the Big Creek Lodge is closed during the winter months, the permit authorized a year-round season-of-use and so will the license. The volume is not dependent upon the season-of-use.

### **Place of Use**

Exam photos show that the turbine and generator are enclosed in a small powerhouse. But the powerhouse is not visible in available aerial photography and its GPS coordinates have not been taken. I created the POU shape based on the field examiner's map.

### **Point of Discharge**

Discharge from the hydro turbine is returned through a short culvert pipe and open channel to the same unnamed stream from which it was diverted.

### **Status and Combined Use**

Effective March 29, 2012, the Beneficial Use Examination Rules exempt on-stream, run-of-the-river, power generation from the volume reporting requirement. Although it's an off-stream diversion, this hydroelectric facility is operated in run-of-river mode. Its operation meets the description for exemption from the volume requirement. Therefore, no volume is required and none is recommended for this right.

The examiner states that the POD is shared by WR 77-4213 but that right has been decreed disallowed in the SRBA. WR 77-7157, also held by the USDA Forest Service, authorizes irrigation water use and may have replaced 77-4213. The irrigation right and the power right do not share common piping. A combined limit is not needed.

### **Conditions**

I consider the turbine to be a measuring device. Knowing the nozzle size and the head or pressure at the nozzle, the flow rate used by the turbine can be determined. I calculated a head loss - pressure which was consistent with both the permitted flow rate and the reported nozzle size.

The place-of-use and point-of-diversion are in a remote location away from any utility service. All the power will be used within the Big Creek Public Service Site by the special use permit holder. IPUC has no jurisdiction over this project.

FERC issued minor license to this project in March 27, 1992. The term for this water right license will set to coincide with the expiration of the FERC license February 28, 2022.

This right will be made subordinate to any subsequent rights also served by this unnamed stream.

# DISCHARGE TABLE FOR SMOOTH BORE NOZZLES

## (U.S. Gallons Per Minute)

| NOZZLE<br>PRESSURE<br>(PSI) | NOZZLE DIAMETER IN INCHES |      |      |      |      |      |      |      |      |      |       |       |       |       |       |      |       |
|-----------------------------|---------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|------|-------|
|                             | 1/16                      | 1/8  | 3/16 | 1/4  | 3/8  | 1/2  | 5/8  | 3/4  | 7/8  | 1    | 1-1/8 | 1-1/4 | 1-3/8 | 1-1/2 | 1-3/4 | 2    | 2-1/4 |
| 10                          | 0.37                      | 1.48 | 3.32 | 5.91 | 13.3 | 23.6 | 36.9 | 53.1 | 72.4 | 94.5 | 120   | 148   | 179   | 213   | 289   | 378  | 479   |
| 15                          | 0.45                      | 1.81 | 4.06 | 7.24 | 16.3 | 28.9 | 45.2 | 65.0 | 88.5 | 116  | 147   | 181   | 219   | 260   | 354   | 463  | 585   |
| 20                          | 0.52                      | 2.09 | 4.69 | 8.35 | 18.8 | 33.4 | 52.2 | 75.1 | 102  | 134  | 169   | 209   | 253   | 301   | 409   | 535  | 676   |
| 25                          | 0.58                      | 2.34 | 5.25 | 9.34 | 21.0 | 37.3 | 58.3 | 84.0 | 114  | 149  | 189   | 234   | 283   | 336   | 458   | 598  | 756   |
| 30                          | 0.64                      | 2.56 | 5.75 | 10.2 | 23.0 | 40.9 | 63.9 | 92.0 | 125  | 164  | 207   | 256   | 309   | 368   | 501   | 655  | 828   |
| 35                          | 0.69                      | 2.77 | 6.21 | 11.1 | 24.8 | 44.2 | 69.0 | 99.5 | 135  | 177  | 224   | 277   | 334   | 398   | 541   | 708  | 895   |
| 40                          | 0.74                      | 2.96 | 6.64 | 11.8 | 26.6 | 47.3 | 73.8 | 106  | 145  | 189  | 239   | 296   | 357   | 425   | 578   | 756  | 957   |
| 45                          | 0.78                      | 3.13 | 7.03 | 12.5 | 28.2 | 50.1 | 78.2 | 113  | 153  | 200  | 253   | 313   | 379   | 451   | 613   | 810  | 1015  |
| 50                          | 0.83                      | 3.30 | 7.41 | 13.2 | 29.7 | 52.8 | 82.5 | 119  | 162  | 211  | 267   | 330   | 399   | 475   | 647   | 845  | 1070  |
| 55                          | 0.87                      | 3.46 | 7.77 | 13.8 | 31.1 | 55.3 | 86.4 | 125  | 169  | 221  | 280   | 342   | 418   | 498   | 678   | 886  | 1121  |
| 60                          | 0.90                      | 3.62 | 8.12 | 14.5 | 32.5 | 57.8 | 90.4 | 130  | 177  | 231  | 293   | 366   | 438   | 521   | 708   | 926  | 1172  |
| 65                          | 0.94                      | 3.77 | 8.45 | 15.1 | 33.8 | 60.2 | 94.0 | 136  | 184  | 241  | 305   | 376   | 455   | 542   | 737   | 964  | 1220  |
| 70                          | 0.98                      | 3.91 | 8.78 | 15.7 | 35.2 | 62.5 | 97.7 | 141  | 191  | 250  | 317   | 391   | 473   | 563   | 765   | 1001 | 1267  |
| 75                          | 1.01                      | 4.05 | 9.08 | 16.2 | 36.4 | 64.7 | 101  | 146  | 198  | 259  | 327   | 404   | 489   | 582   | 792   | 1037 | 1310  |
| 80                          | 1.05                      | 4.18 | 9.39 | 16.7 | 37.6 | 66.8 | 104  | 150  | 205  | 267  | 338   | 418   | 505   | 602   | 818   | 1070 | 1354  |
| 85                          | 1.08                      | 4.31 | 9.67 | 17.3 | 38.8 | 68.9 | 108  | 155  | 211  | 276  | 349   | 431   | 521   | 620   | 844   | 1103 | 1395  |
| 90                          | 1.11                      | 4.43 | 9.95 | 17.7 | 39.9 | 70.8 | 111  | 160  | 217  | 284  | 359   | 443   | 536   | 638   | 868   | 1136 | 1436  |
| 95                          | 1.14                      | 4.56 | 10.2 | 18.2 | 41.0 | 72.8 | 114  | 164  | 223  | 292  | 369   | 456   | 551   | 656   | 892   | 1168 | 1476  |
| 100                         | 1.17                      | 4.67 | 10.5 | 18.7 | 42.1 | 74.7 | 117  | 168  | 229  | 295  | 378   | 467   | 565   | 672   | 915   | 1196 | 1512  |
| 105                         | 1.20                      | 4.79 | 10.8 | 19.2 | 43.1 | 76.5 | 120  | 172  | 234  | 306  | 388   | 479   | 579   | 689   | 937   | 1226 | 1550  |
| 110                         | 1.23                      | 4.90 | 11.0 | 19.6 | 44.1 | 78.4 | 122  | 176  | 240  | 314  | 397   | 490   | 593   | 705   | 960   | 1255 | 1588  |
| 115                         | 1.25                      | 5.01 | 11.2 | 20.0 | 45.1 | 80.1 | 125  | 180  | 245  | 320  | 406   | 501   | 606   | 720   | 980   | 1282 | 1621  |
| 120                         | 1.28                      | 5.12 | 11.5 | 20.5 | 46.0 | 81.8 | 128  | 184  | 251  | 327  | 414   | 512   | 619   | 736   | 1002  | 1310 | 1659  |
| 125                         | 1.31                      | 5.22 | 11.7 | 20.9 | 47.0 | 83.5 | 130  | 188  | 256  | 334  | 423   | 522   | 632   | 751   | 1022  | 1338 | 1690  |
| 130                         | 1.33                      | 5.33 | 12.0 | 21.3 | 48.0 | 85.2 | 133  | 192  | 261  | 341  | 432   | 533   | 645   | 767   | 1043  | 1365 | 1726  |
| 135                         | 1.36                      | 5.43 | 12.2 | 21.7 | 48.9 | 86.7 | 136  | 195  | 266  | 347  | 439   | 543   | 656   | 780   | 1063  | 1390 | 1759  |
| 140                         | 1.38                      | 5.53 | 12.4 | 22.1 | 49.8 | 88.4 | 138  | 199  | 271  | 354  | 448   | 553   | 668   | 795   | 1082  | 1415 | 1790  |
| 145                         | 1.41                      | 5.62 | 12.6 | 22.5 | 50.6 | 89.9 | 140  | 202  | 275  | 360  | 455   | 562   | 680   | 809   | 1100  | 1440 | 1820  |
| 150                         | 1.43                      | 5.72 | 12.9 | 22.9 | 51.5 | 91.5 | 143  | 206  | 280  | 366  | 463   | 572   | 692   | 824   | 1120  | 1466 | 1853  |
| 175                         | 1.55                      | 6.18 | 13.9 | 24.7 | 55.6 | 98.8 | 154  | 222  | 302  | 395  | 500   | 618   | 747   | 890   | 1210  | 1582 | 2000  |
| 200                         | 1.65                      | 6.61 | 14.8 | 26.4 | 59.5 | 106  | 165  | 238  | 323  | 423  | 535   | 660   | 799   | 950   | 1294  | 1691 | 2140  |
| 250                         | 1.85                      | 7.39 | 16.6 | 29.6 | 66.5 | 118  | 185  | 266  | 362  | 473  | 598   | 739   | 894   | 1063  | 1447  | 1891 | 2392  |

## HYDROPOWER ANALYSIS SHEET

USFS Big Creek Lodge

Hazen-Williams EQ for headloss due to friction  
 $H_f (ft) = (3.022 \times V^{1.85} L) / (C^{1.49} D^{4.76})$   
Assumed C for plastic pipe  
design 130  
range 120-150Static Head ----- 237 feet  
Penstock Length----- 1321 feet  
Nominal Pipe Size----- 4 inch diameter, PVC penstock  
Turbine Type ----- 36 inch Pelton wheel0.3333333 = D in FEET  
120 = C  
1321 = L in FEETFLOW FLOW BYPASS POWER SPILL VELOCITY TOTAL NET HEAD NET HEAD POWER WEEKLY HEAD LOSS  
CFS GPM CFS CFS CFS FT/SEC EFF FT PSI WATTS WATT-HRS FT

|       |       |     |       |     |       |    |        |        |         |           |
|-------|-------|-----|-------|-----|-------|----|--------|--------|---------|-----------|
| 0     | 0     | 0   | 0     | 0   | 0.00  | 0  | 237.00 | 102.60 | 0.00    | 0         |
| 0.120 | 53.9  | 0.0 | 0.120 | 0.0 | 1.38  | 75 | 233.29 | 100.99 | 1777.86 | 330.681   |
| 0.140 | 62.8  | 0.0 | 0.140 | 0.0 | 1.60  | 75 | 232.07 | 100.46 | 2063.29 | 383.773   |
| 0.160 | 71.8  | 0.0 | 0.160 | 0.0 | 1.83  | 75 | 230.69 | 99.87  | 2344.02 | 435.987   |
| 0.180 | 80.8  | 0.0 | 0.180 | 0.0 | 2.06  | 75 | 229.15 | 99.20  | 2619.46 | 487.220   |
| 0.200 | 89.8  | 0.0 | 0.200 | 0.0 | 2.29  | 75 | 227.47 | 98.47  | 2889.07 | 537.366   |
| 0.220 | 98.7  | 0.0 | 0.220 | 0.0 | 2.52  | 75 | 225.63 | 97.67  | 3152.29 | 586.326   |
| 0.240 | 107.7 | 0.0 | 0.240 | 0.0 | 2.75  | 75 | 223.64 | 96.81  | 3408.59 | 633.997   |
| 0.260 | 116.7 | 0.0 | 0.260 | 0.0 | 2.98  | 75 | 221.51 | 95.89  | 3657.43 | 680.282   |
| 0.280 | 125.7 | 0.0 | 0.280 | 0.0 | 3.21  | 75 | 219.23 | 94.91  | 3898.30 | 725.083   |
| 0.290 | 130.2 | 0.0 | 0.290 | 0.0 | 3.32  | 75 | 218.04 | 94.39  | 4015.58 | 746.897   |
| 0.300 | 134.6 | 0.0 | 0.300 | 0.0 | 3.44  | 75 | 216.81 | 93.86  | 4130.66 | 768.304   |
| 0.320 | 143.6 | 0.0 | 0.320 | 0.0 | 3.67  | 75 | 214.25 | 92.75  | 4354.02 | 809.848   |
| 0.340 | 152.6 | 0.0 | 0.340 | 0.0 | 3.90  | 75 | 211.55 | 91.58  | 4567.86 | 849.621   |
| 0.360 | 161.6 | 0.0 | 0.360 | 0.0 | 4.13  | 75 | 208.72 | 90.35  | 4771.67 | 887.530   |
| 0.380 | 170.6 | 0.0 | 0.380 | 0.0 | 4.35  | 75 | 205.74 | 89.07  | 4964.96 | 923.482   |
| 0.400 | 179.5 | 0.0 | 0.400 | 0.0 | 4.58  | 75 | 202.63 | 87.72  | 5147.23 | 957.385   |
| 0.420 | 188.5 | 0.0 | 0.420 | 0.0 | 4.81  | 75 | 199.38 | 86.31  | 5318.00 | 989.148   |
| 0.440 | 197.5 | 0.0 | 0.440 | 0.0 | 5.04  | 75 | 196.00 | 84.85  | 5476.77 | 1.018.679 |
| 0.460 | 206.5 | 0.0 | 0.460 | 0.0 | 5.27  | 75 | 192.49 | 83.33  | 5623.06 | 1.045.889 |
| 0.480 | 215.4 | 0.0 | 0.480 | 0.0 | 5.50  | 75 | 188.84 | 81.75  | 5756.39 | 1.070.688 |
| 0.500 | 224.4 | 0.0 | 0.500 | 0.0 | 5.73  | 75 | 185.06 | 80.11  | 5876.28 | 1.092.989 |
| 0.520 | 233.4 | 0.0 | 0.520 | 0.0 | 5.96  | 75 | 181.16 | 78.42  | 5982.26 | 1.112.701 |
| 0.540 | 242.4 | 0.0 | 0.540 | 0.0 | 6.19  | 75 | 177.12 | 76.67  | 6073.86 | 1.129.739 |
| 0.560 | 251.3 | 0.0 | 0.560 | 0.0 | 6.42  | 75 | 172.95 | 74.87  | 6150.61 | 1.144.013 |
| 0.580 | 260.3 | 0.0 | 0.580 | 0.0 | 6.65  | 75 | 168.65 | 73.01  | 6212.04 | 1.155.439 |
| 0.600 | 269.3 | 0.0 | 0.600 | 0.0 | 6.88  | 75 | 164.23 | 71.09  | 6257.68 | 1.163.929 |
| 0.620 | 278.3 | 0.0 | 0.620 | 0.0 | 7.10  | 75 | 159.68 | 69.12  | 6287.08 | 1.169.398 |
| 0.640 | 287.3 | 0.0 | 0.640 | 0.0 | 7.33  | 75 | 155.00 | 67.10  | 6299.78 | 1.171.759 |
| 0.660 | 296.2 | 0.0 | 0.660 | 0.0 | 7.56  | 75 | 150.20 | 65.02  | 6295.32 | 1.170.930 |
| 0.680 | 305.2 | 0.0 | 0.680 | 0.0 | 7.79  | 75 | 145.27 | 62.89  | 6273.24 | 1.166.824 |
| 0.700 | 314.2 | 0.0 | 0.700 | 0.0 | 8.02  | 75 | 140.22 | 60.70  | 6233.10 | 1.159.357 |
| 0.720 | 323.2 | 0.0 | 0.720 | 0.0 | 8.25  | 75 | 135.04 | 58.46  | 6174.44 | 1.148.446 |
| 0.740 | 332.1 | 0.0 | 0.740 | 0.0 | 8.48  | 75 | 129.74 | 56.16  | 6096.81 | 1.134.007 |
| 0.750 | 336.6 | 0.0 | 0.750 | 0.0 | 8.59  | 75 | 127.04 | 55.00  | 6050.75 | 1.125.439 |
| 0.760 | 341.1 | 0.0 | 0.760 | 0.0 | 8.71  | 75 | 124.31 | 53.81  | 5999.77 | 1.115.957 |
| 0.780 | 350.1 | 0.0 | 0.780 | 0.0 | 8.94  | 75 | 118.76 | 51.41  | 5882.87 | 1.094.214 |
| 0.800 | 359.1 | 0.0 | 0.800 | 0.0 | 9.17  | 75 | 113.09 | 48.96  | 5745.67 | 1.068.694 |
| 0.820 | 368.0 | 0.0 | 0.820 | 0.0 | 9.40  | 75 | 107.30 | 46.45  | 5587.72 | 1.039.316 |
| 0.840 | 377.0 | 0.0 | 0.840 | 0.0 | 9.63  | 75 | 101.39 | 43.89  | 5408.59 | 1.005.998 |
| 0.860 | 386.0 | 0.0 | 0.860 | 0.0 | 9.85  | 75 | 95.36  | 41.28  | 5207.84 | 968.658   |
| 0.880 | 395.0 | 0.0 | 0.880 | 0.0 | 10.08 | 75 | 89.20  | 38.62  | 4985.03 | 927.215   |
| 0.900 | 403.9 | 0.0 | 0.900 | 0.0 | 10.31 | 75 | 82.93  | 35.90  | 4739.72 | 881.589   |
| 0.920 | 412.9 | 0.0 | 0.920 | 0.0 | 10.54 | 75 | 76.53  | 33.13  | 4471.49 | 831.697   |
| 0.940 | 421.9 | 0.0 | 0.940 | 0.0 | 10.77 | 75 | 70.02  | 30.31  | 4179.90 | 777.461   |
| 0.960 | 430.9 | 0.0 | 0.960 | 0.0 | 11.00 | 75 | 63.39  | 27.44  | 3864.51 | 718.799   |
| 0.980 | 439.9 | 0.0 | 0.980 | 0.0 | 11.23 | 75 | 56.64  | 24.52  | 3524.90 | 655.632   |
| 1.000 | 448.8 | 0.0 | 1.000 | 0.0 | 11.46 | 75 | 49.77  | 21.55  | 3160.65 | 587.881   |

|        |        |        |        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| 3.71   | 4.93   | 6.31   | 7.85   | 9.53   | 11.37  | 13.36  | 15.49  | 17.77  | 18.96  | 20.19  |
| 22.75  | 25.45  | 28.28  | 34.37  | 44.51  | 48.16  | 51.94  | 55.84  | 59.88  | 64.05  | 68.35  |
| 72.77  | 82.00  | 86.80  | 91.73  | 96.78  | 101.96 | 107.26 | 112.69 | 118.24 | 123.91 | 129.70 |
| 135.61 | 141.64 | 147.80 | 154.07 | 160.47 | 166.98 | 173.61 | 180.36 | 187.23 |        |        |