



FISH PASSAGE CENTER

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MEMORANDUM

TO: FPAC

FROM: FPC Staff

DATE: July 25, 2013

RE: Lower Granite Dam Ladder Update

We wanted to take the opportunity to update FPAC regarding the operations and observations since last reviewed. All data is updated through the afternoon of July 25, 2013.

Fish Counts

The following (Table 1) displays hourly fish counts at Lower Granite Dam over the first eight hours of counting (5:00 AM through Noon). There is still considerable movement of fish up and down in the fishway. While we will have to consider the net count over the entire counting day, the fish counts through one-half of the day on July 25th, 2013 were greater than complete day counts recorded over the previous six days for all species shown at Lower Granite Dam. We will know by tomorrow if the improved passage trend continued throughout the day.

Table 1. Hourly Fish Counts at Lower Granite Dam from 5:00 AM through Noon on July 25th, 2013.

| Hourly Counts at LGR July 25th, 2013 5 am through Noon | | | | | | | | | | | | |
|--|---------------|------|---------------|------|-------------------|------|---------------------|------|---------------|------|--------------|------|
| Hour | Adult Chinook | | Adult Chinook | | Clipped Steelhead | | Unclipped Steelhead | | Adult Sockeye | | Jack Sockeye | |
| | Up | Down | Up | Down | Up | Down | Up | Down | Up | Down | Up | Down |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | -1 | 0 | 0 | 0 | 0 |
| 2 | 0 | -1 | 0 | 0 | 1 | 0 | 4 | -3 | 0 | 0 | 0 | 0 |
| 3 | 8 | -2 | 5 | -1 | 5 | 0 | 4 | 0 | 0 | 0 | 0 | 0 |
| 4 | 19 | -14 | 18 | -5 | 4 | -1 | 2 | 0 | 1 | 0 | 1 | 0 |
| 5 | 24 | -9 | 14 | -5 | 6 | 0 | 4 | -1 | 2 | 0 | 0 | 0 |
| 6 | 17 | -6 | 16 | -3 | 1 | 0 | 2 | 0 | 2 | 0 | 0 | 0 |
| 7 | 28 | -14 | 14 | -2 | 4 | 0 | 9 | -3 | 3 | 0 | 1 | 0 |
| 8 | 22 | -11 | 15 | -6 | 2 | -1 | 3 | 0 | 0 | 0 | 1 | 0 |
| Sum Total | 62 | | 60 | | 21 | | 24 | | 8 | | 3 | |
| *1.2 | 74 | | 72 | | 25 | | 29 | | 10 | | 4 | |

Ladder Temperatures

The following figure displays Lower Granite fish ladder exit temperatures from July 19th through July 25th, along with the Lewiston, Idaho, daily minimum and maximum temperatures through July 24th and the predicted temperature for today. This figure is similar to the figure posted on the COE agenda for tomorrow's meeting, with a few differences. We have included the air temperatures for Lewiston in order to provide a reference for the ladder temperature. In addition, we have included the data for the 19th of July, which shows that the lowest temperature occurred on that date. It was also a day where project operations were not altered.

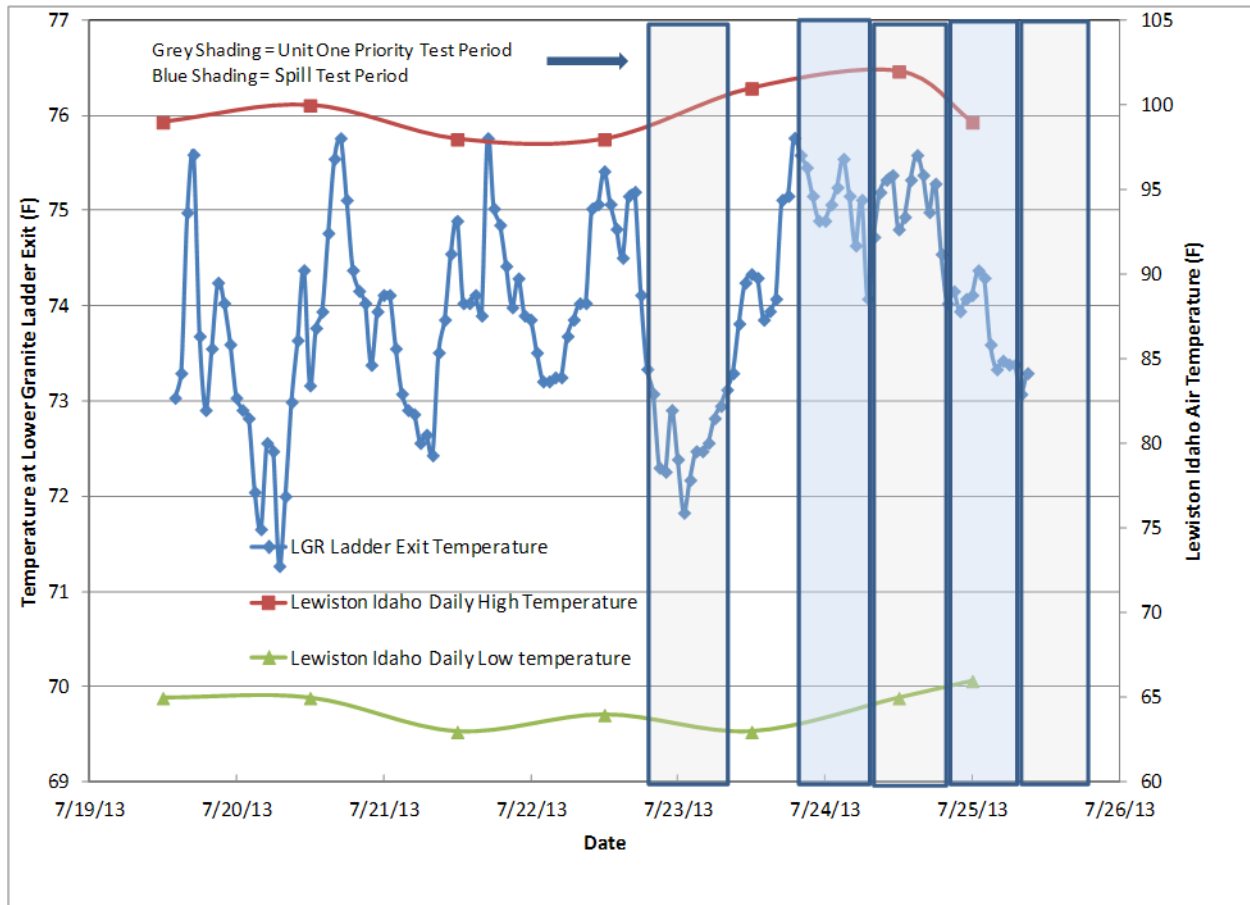


Figure 1. Lower Granite Fish Ladder Exit Temperatures from July 19, 2013, through July 25, 2013, along with Lewiston, Idaho, Daily Minimum and Maximum Temperatures through July 24, 2013.

From the data collected it is difficult to establish the relation between the project operations short-term test and the ladder temperatures. This is likely due to the diel changes in temperature, as well as the variation in air temperature with the test coinciding with the highest air temperatures observed in the time period. The predicted air temperatures at Lewiston are expected to be 102°F on Friday, moderating to the lower 90s over the next five days. It seems that a test of much longer duration would be needed to tease out the relation between ladder temperature, ambient air temperature, and project operations.

Potential Thermal Relief from Modified Upper Ladder Ops by Going to MOP

At yesterday's TMT call the COE determined that there would be no effect of MOP on the ladder temperature, since the forebay temperature was not changing. However, it was pointed out to the COE that the intent of MOP was to change the relative proportion of hot water from the forebay and cooler water from the diffuser intake, to have an overall net reduction in temperature. The following exercise provides an estimate of the amount of temperature reduction that could be expected.

In the COE’s “Alternative Analysis Report for Lower Granite Adult Fishway – Reduction in Temperature Differential” it states:

Near minimum operating pool (MOP), about 25 cubic feet per second (cfs) of surface water is supplied to the upstream portion of the fish ladder through the fish ladder exit. The fishway exit flow increases to about 58 cfs at the normal pool elevation of 738 fmsl. Additional water is supplied from the forebay to Diffuser #14 (in the upper portion of the fish ladder) to bring the total ladder flow up to 75 cfs.

Based on the information above, the relationship between the Lower Granite Forebay elevation and gravity flow through the exit into the upper ladder can be summarized by Figure 2.

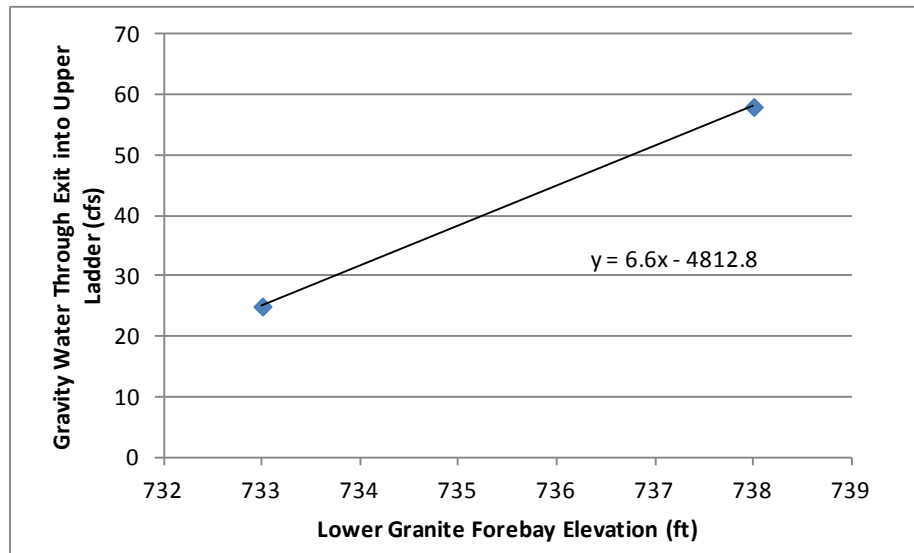


Figure 2. Relationship between the Lower Granite Forebay Elevation and Gravity Flow through the Exit into the Upper Ladder.

At the current forebay elevation of 735.5 feet, approximately 41.5 cfs of gravity water would be passing through the exit of the ladder into the upper fish ladder. The remainder of the 75 cfs that is needed in the upper ladder would be supplied by Diffuser #14. The current distribution of flows in the upper ladder at Lower Granite would be 41.5 cfs from gravity forebay water (at elevation 735.5 ft) and 33.5 cfs from Diffuser #14, with the total of the two contributions being 75 cfs.

In order to determine the temperature of the incoming water, the daily average temperatures in the Lower Granite forebay on 7/24/13 were considered relative to depth:

| Depth(M/FT) | Temp °F |
|-------------|---------|
| 0.5/1.6 | 77.3 |
| 1.5/4.9 | 75.6 |
| 3.0/9.8 | 74.0 |
| 5.0/16.4 | 71.3 |
| 10/32.8 | 68.5 |

The sill elevation of the ladder exit at Lower Granite Dam is 727 feet. At a forebay elevation of 735.5 feet this would result in a depth of water through the exit of 8.5 feet. For this exercise it is assumed that the average temperature of the column of gravity water at the exit would be best represented by the forebay temperature at 1.5 meters or 4.9 feet; this daily average temperature on 7-24-13 was 75.6 °F. The intake for the water supply to Diffuser #14 is at an elevation of 714 feet. At a forebay elevation of 735.5 feet the depth of the diffuser intake water is 21.5 feet. For this exercise it is assumed that the average temperature of water at the intake to Diffuser #14 would be best represented linearly interpolating between the forebay temperature at 5.0 meters or 16.4 feet and 10 meters or 32.8 feet. Assuming temperatures decrease linearly between a depth of 16.4 feet (5m) and 32.8 ft (10 m), at a depth of 21.5 feet (Diffuser #14 intake) the daily average temperature on 7/24/13 would be 70.4 °F.

The temperature of the mixed ladder water below Diffuser #14 could be estimated by the flow levels and assumed temperatures of the two sources of upper ladder water contributions. The following mass balance was used to estimate the temperature of mixed ladder water:

$$(\text{Gravity Flow} * \text{Temp Gravity Water}) + (\text{Diffuser \#14 flow} * \text{Diffuser \#14 Intake Temp}) = (\text{Flow below diffuser \#14, 75 cfs}) * \text{Mixed Ladder Temp below Diffuser \#14}$$

The temperature of the mixed ladder water below Diffuser #14 could be estimated by the flow levels and assumed temperatures of the two sources of upper ladder water contributions under current conditions of 41.5 cfs gravity water and 33.5 cfs through the diffuser.

41.5 cfs of exit gravity water at 75.6° F
33.5 cfs of diffuser #14 water at 70.4 F

This produces a total of 75 cfs of ladder water at a mixed temperature of **73.3° F**.

If the Lower Granite Forebay were reduced to an elevation of 733.0 feet (MOP) this would result in result in 25 cfs of gravity water through the exit and 50 cfs of water through Diffuser #14.

25.0 cfs of exit gravity water at 75.6°F
50.0 cfs of diffuser #14 water at 70.4°F

The ladder water below the diffuser would be at a mixed temperature of **72.1° F**. This represents a decrease of **1.2° F**.

Given that the COE said that they are presently only executing 2–3 lockages during a day, the impact and benefit of this operation may need to be reconsidered. This operation, together with any ladder modifications being considered by the COE, may affect overall ladder temperatures.