FISH PASSAGE CENTER

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MEMORANDUM

TO: Mitch Silvers, Regional Director to U.S. Senator Mike Crapo

FROM: Michele DeHart

DATE: April 9, 2007

RE: Relationship between Fish Travel Time and Water Transit Time in the Lower Snake and Lower Columbia rivers.

As you requested Fish Passage Center has summarized data regarding the relationship between fish travel time and flows in the hydro-system. Our analysis shows that Fish Travel Time shows good correlation with Water Transit Time in all reaches where these data can be measured. The relationship is highly significant for yearling Chinook and steelhead during spring migration, and also for subyearling Chinook when those fish are actively migrating in the summer. See below figures that summarize the relationship between fish travel time and water transit time for The Lower Snake River and Lower Columbia River.

Fish Travel Time is measured using detections of PIT-tagged fish at dams in the Lower Snake River and Lower Columbia River as well. Travel time for an individual fish is the time, measured in days, from first detection at an upstream dam, to detection at a downstream dam. Typically, median travel time is reported for a group of PIT-tagged fish. In the analysis presented here, median travel time was estimated for groups of fish detected during weekly time periods at Lower Granite Dam through the spring migration, and biweekly periods for summer migrants. For the Lower Columbia median travel time was estimated biweekly for yearling Chinook and monthly for steelhead due to fewer PIT-tags being available in the Lower Columbia Reach.

Water Transit Time is the average time it takes a particle of water to pass through a reservoir above a dam. Essentially this is the time it takes the volume of water stored in the pool to pass the dam based on the average flow at the dam and the average forebay elevation. The relationship between water transit time and flow in the Lower Snake River was plotted in figure

1. The figure shows the relationship between average total discharge at Little Goose, Lower Monumental and Ice Harbor dams, and the estimated Water Transit Time through the three pools the dams impound – the reach from the head of Little Goose Pool to Ice Harbor Dam. Figure 2 shows a similar relationship for the Lower Columbia River Reach from the head of John Day Pool to Bonneville Dam.

For juvenile salmon Water Transit Time is the best measure to compare to travel time since water velocity through the reservoirs is predominantly what out-migrating juvenile fish experience as they pass through the hydro-system. In addition to the rate of water transit through the reservoirs, flow characteristics occurring at the dam, such as spill proportion, and water temperature also are correlated to fish travel time. However, the primary effect on fish travel time, based on our analysis, is the rate of water movement through the reservoirs or Water Transit Time.

Thanks for the opportunity to provide you this data. Hopefully this answers your questions regarding the relationship between fish travel time and water transit time. If you have any further questions, don't hesitate to call us.

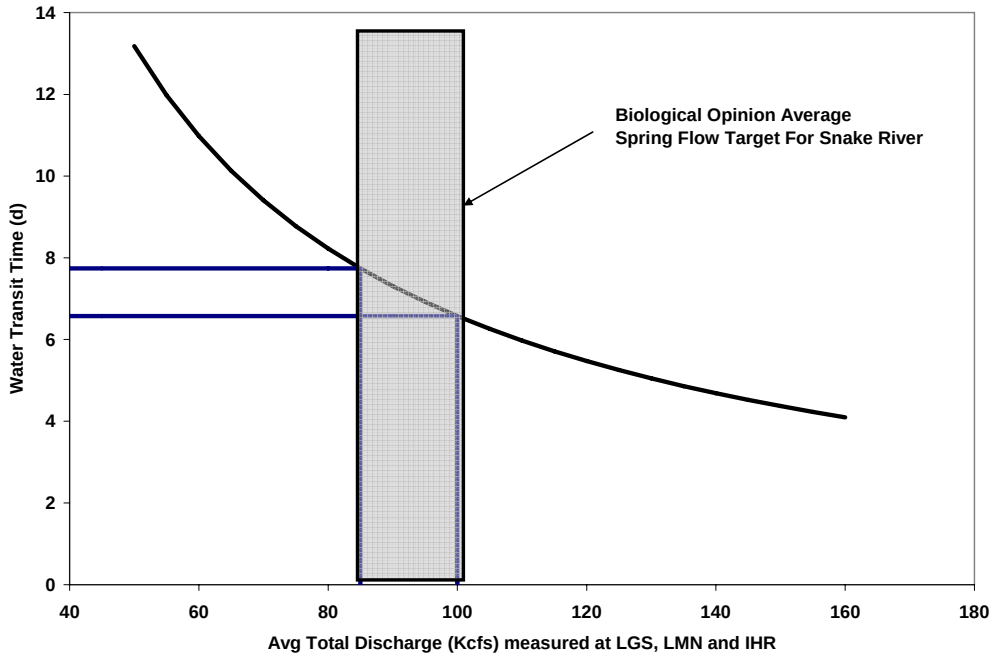

Figure 1. Relationship between Water Transit Time from the head of Little Goose Pool to Ice Harbor Dam plotted against Average Discharge or (River Flow) measured at 3 Snake River dams; Little Goose, Lower Monumental, and Ice Harbor. Lines depict the Biological Opinion Flow Targets for the Lower Snake River of 85 to 100 kcfs and corresponding Water Transit Times head of Little Goose Pool to Ice Harbor Dam.

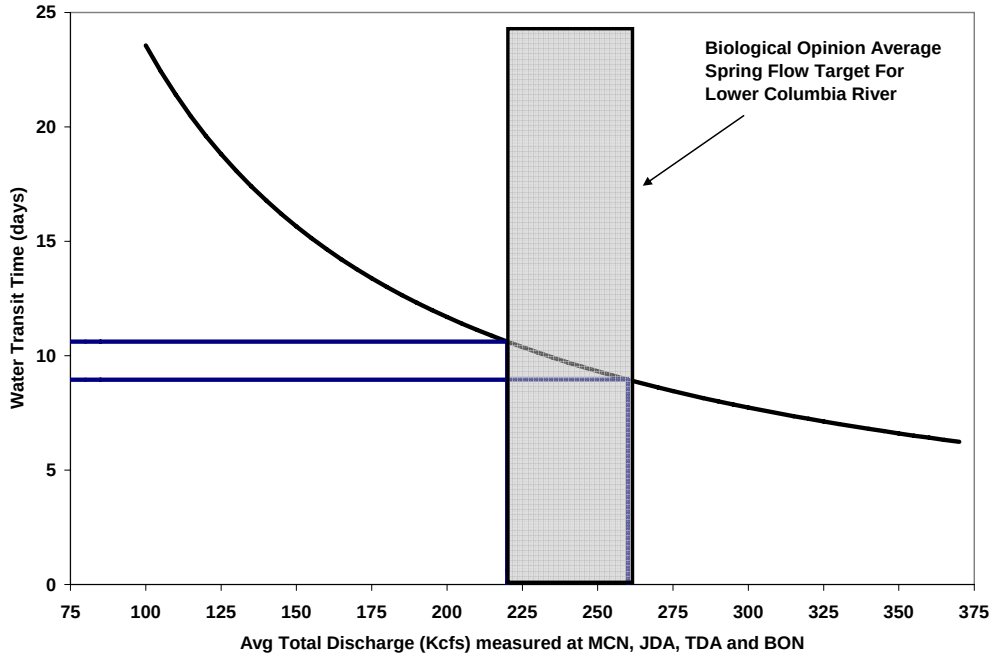

Figure 2. Relationship between Water Transit Time from the head of McNary Pool to Bonneville Dam plotted against Average Discharge or (River Flow) measured at 4 Lower Columbia River dams; McNary, John Day, The Dalles, and Bonneville. Lines depict the Biological Opinion Flow Targets for the Lower Columbia River of 220 to 260 kcfs and corresponding Water Transit Times head of McNary Pool to Bonneville Dam.

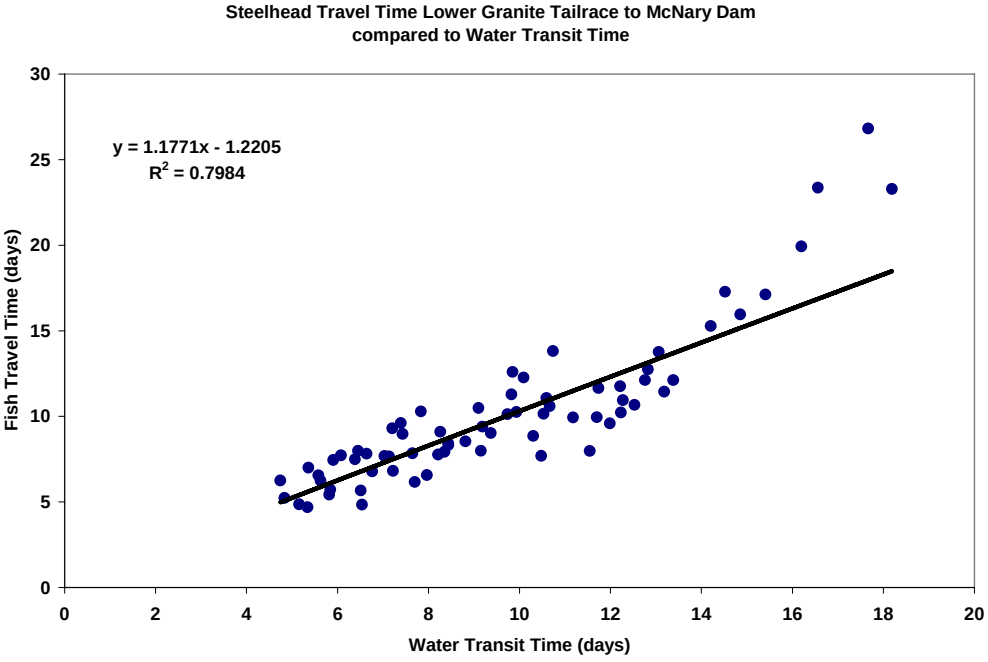

Figure 3. Juvenile Steelhead Travel Time from Lower Granite Dam to McNary Dam plotted against Water Transit Time in that same reach.

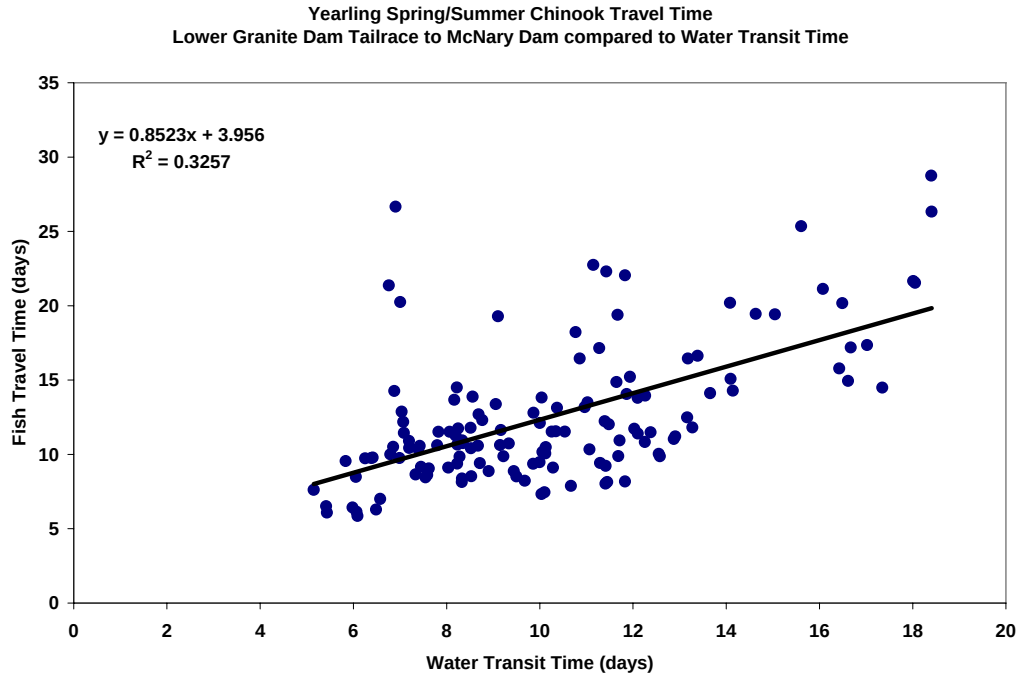

Figure 4. Juvenile Yearling Chinook Travel Time from Lower Granite Dam to McNary Dam plotted against Water Transit Time in that same reach.

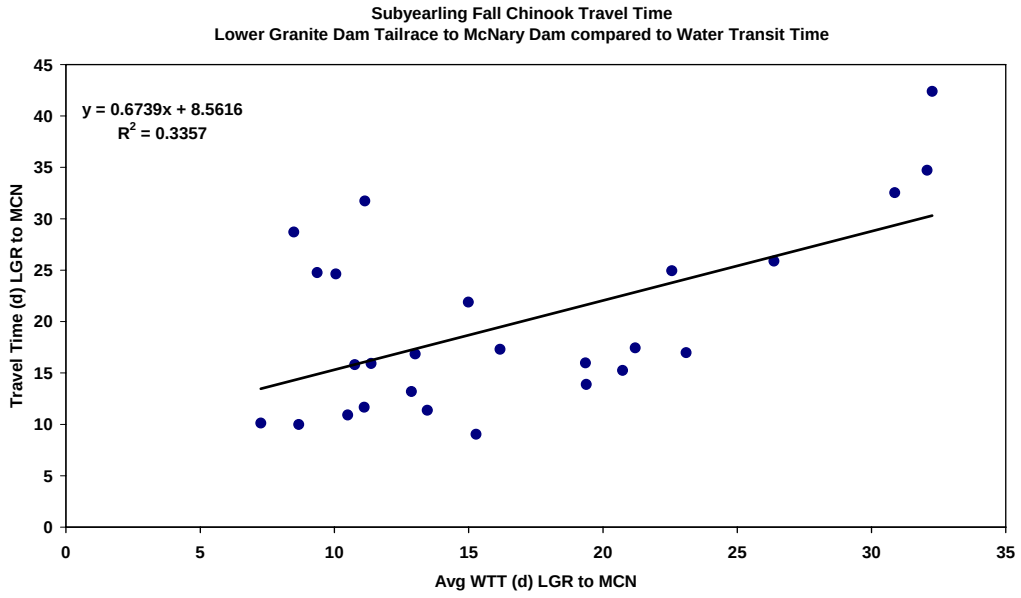

Figure 5. Juvenile Subyearling Fall Chinook Travel Time from Lower Granite Dam to McNary Dam plotted against Water Transit Time in that same reach.

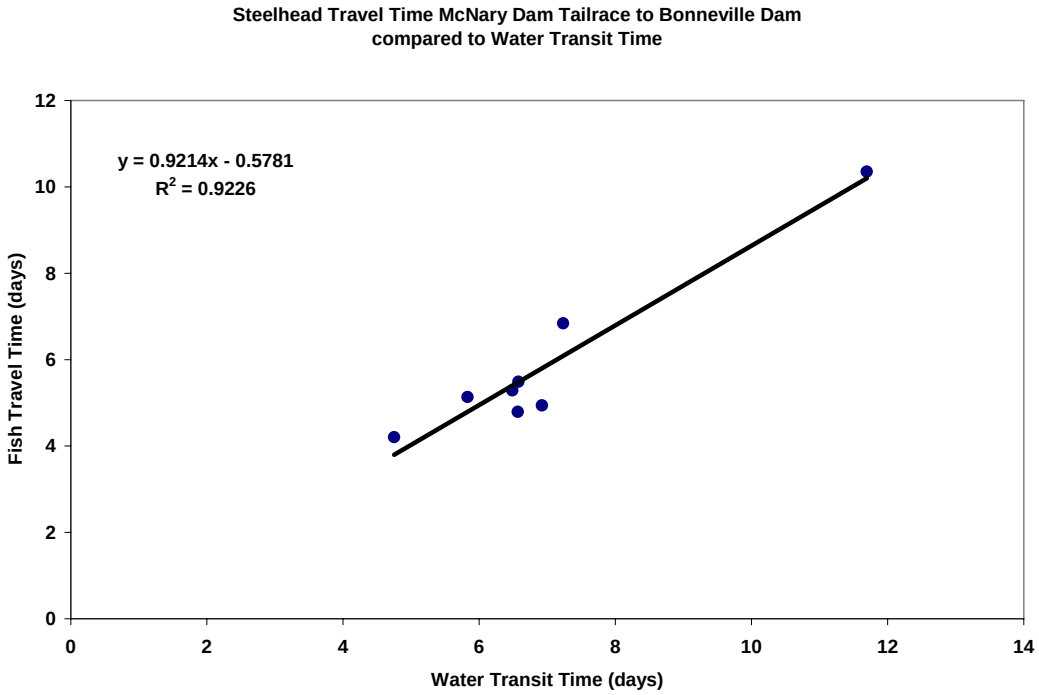

Figure 6. Juvenile Steelhead Travel Time from McNary Dam to Bonneville Dam plotted against Water Transit Time in that same reach.

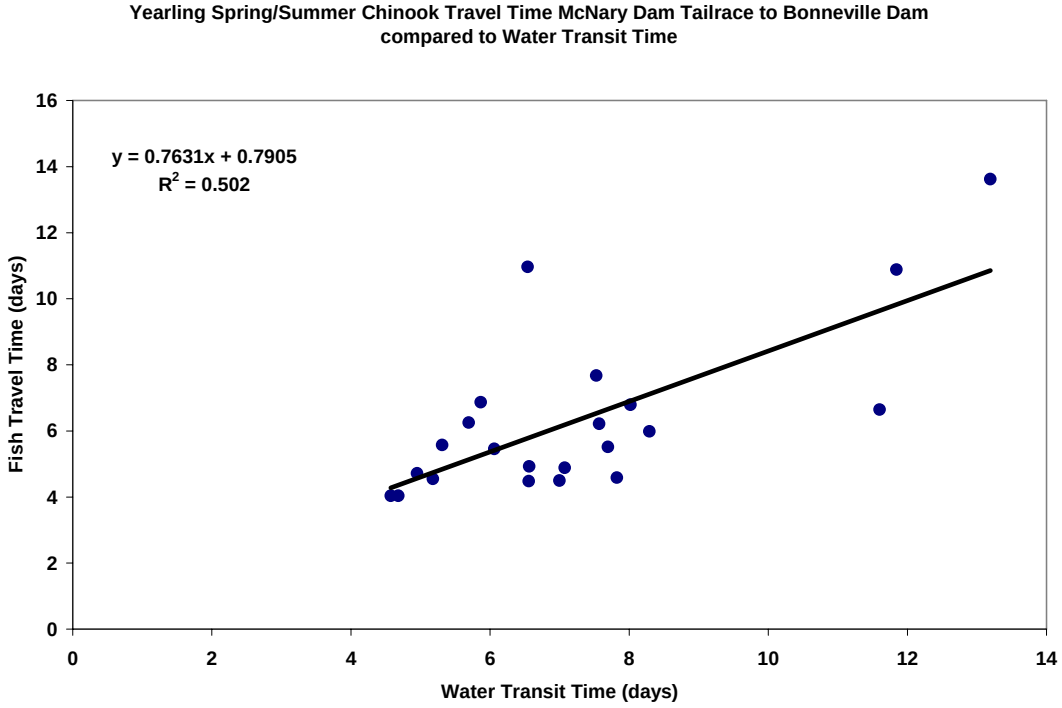

Figure 7. Juvenile Yearling Chinook Travel Time from McNary Dam to Bonneville Dam plotted against Water Transit Time in that same reach.