

## **WATER TEMPERATURE ASSESSMENT: ROCKY REACH RESERVOIR SCOPE OF WORK**

### **Background**

As part of the water quality-monitoring program for Rocky Reach Dam relicensing, the Washington Department of Ecology (DOE) has expressed interest in the effects of the reservoir on water temperature. It is improbable that the main flow of the mid-Columbia River passing through this run-of-the-river reservoir is significantly affected by solar heating, or that conditions ever approach lethal limits of any salmonids.

The main purpose for this study is to document compliance with the water quality standards in the Rocky Reach area in order to meet the Federal Clean Water Act requirements of 401 certification. The standard states that temperature shall not exceed 18°C due to human activities. When natural conditions exceed 18.0°C, no temperature increases will be allowed which will raise the receiving water temperature by greater than 0.3°C (WAC 173-201A-030).

The primary objective is to compare the existing water temperatures with the state's standards and determine any ongoing Project-related impacts on water temperature. DOE indicated that temperatures should be monitored in representative areas where waters are well mixed. Supportive information should be made available to show that sampling areas are representative of the project area (Conversation with Pat Irle, July 20, 2000). Therefore, most of the effort will be focused in representative pelagic (i.e., deeper midstream) habitats, areas upstream and downstream from dams, and areas upstream and downstream from major tributaries.

Rocky Reach receives inflow from one run-of-river reservoir and several storage reservoirs upstream that control water temperatures downstream. To a lesser degree, water temperatures in Rocky Reach are influenced by tributary and possibly groundwater inflows. Water temperature monitoring to date has included recording thermograph data from forebay and tailrace locations near mid-Columbia dams, and our instantaneous measurements of vertical temperature profiles during routine monitoring in Water Year 2000. The spatial variability of water temperatures in the reservoir will be investigated.

### **Approach**

The study approach includes the following two elements: (1) assess existing data to describe and characterize reservoir inflows, including groundwater; and (2) collect data at fixed stations with continuously recording thermographs to document water temperature variability during warm summer months.

## **Work Plan**

### **Existing Data Assessment**

Objective: Conduct preliminary assessment of existing water temperature data quality and results for Rocky Reach Reservoir and tailrace, using selected sources.

1) Analyze existing data for Rocky Reach Reservoir (Wells and Rocky Reach tailrace) for water temperatures during July, August and September from 1980 to present. C. Peven of CCPUD, from Army Corps of Engineers (ACOE) sources, assembled this data. We will examine these data for daily means, extremes and variability about the mean as well as weekly trends. A series of paired T-tests can be used to compare inflow to outflow data. This will provide some information regarding changes in water temperature after water passes through Rocky Reach Reservoir. We spent some time collecting data from online sources such as the ACOE web site, but these data are incomplete and not readily available or of known quality. We also spent time following up on published data sources and found them not readily available or not as useful as we initially thought. Examination of backup references for the Columbia River Model (Yearsly 1999) such as McKenzie (undated) show the difficulty in obtaining such data, so at this time we do not propose using other historical data until sources and quality can be better known. Instead, we will use the existing ACOE data, and if other suitable sources are available, note those in our report.

We will include a discussion of historical data and important anecdotal observations, including the energy/heat budget of Lake Roosevelt that controls in large part the water temperature conditions in Rocky Reach Reservoir. However, we do not propose to factor this highly variable influence into the examination of annual water temperature data. That would involve a detailed examination of Grand Coulee Dam operations and conditions in Lake Roosevelt. As part of this task, we will begin compiling quality control information regarding instrumentation used to collect historical water quality data. For example, information may be available regarding the accuracy of certain models of probes used in specific years, as well as any existing quality assurance studies or plans that were in place. In the case of certain equipment such as Common Sensing Inc. meters, we will contact the manufacturer to obtain additional unpublished insight into the reliability and accuracy of certain probes used in the past. We will compile available information on locations and operation of water quality sensors that may have influenced water temperature data collection and results.

2) Review readily available technical reports, geologic maps, and historical (pre-dam construction) maps for indications of groundwater discharge to the reach of the Columbia River above Rocky Reach Dam and below Wells Dam. Regional geologic maps indicate that the western bank of the river is comprised of metamorphic and igneous rocks, and the eastern bank is comprised of Columbia Plateau basalts. The references will be searched for indications of springs, seeps and groundwater flow maps that may indicate

groundwater discharge into the river. Information will be used to assess the potential impacts of groundwater on temperature in the project area.

3) Obtain data from recent bathymetric surveys (if available) and water current measurements to identify representative areas for placement of sampling equipment.

### **Field Work**

Objective: Monitor water temperatures from mid-July through mid-September at key locations in Rocky Reach Reservoir to describe the spatial variability of water temperatures.

Fieldwork will include:

- 1) Conduct calibration assessment of profiling probes and thermograph equipment before deployment. This involves the use of fixed temperature environment rooms at Parametrix and USBS certified thermometers. A rating curve for each unit will be developed. Spot checks of accuracy after deployment will also be made after downloading. All data collected will be corrected according to these calibration data.
- 2) Conduct a reconnaissance survey to select up to six locations where conditions are representative of the project area and to collect a range of vertical profile data that will be GPS indexed (Day 1). Profile information will be used to determine if there is measurable stratification. If stratification is detected, thermographs will be placed at the mean temperature depth.
- 3) Deploy fixed thermographs by diver, weight-tag line arrays or other means at each of the above mentioned transects (Day 2). As thermograph loss is a distinct possibility, thermographs will be anchored to concrete blocks and tethered to shore or will be placed on fixed structures or floating docks by divers. We will check on the thermographs if possible during the August surveys. Again, the thermograph locations will be GPS indexed.
- 4) Conduct one extra day of vertical profiling observations toward the end of August, in addition to our regular August water quality survey (Day 3). By observing weather patterns and on-line temperature results at the dams, we can expect to catch the near-peak of the annual water temperature. These data will be used to show that our thermographs either did, or did not, collect data from the most likely representative temperature locations.
- 5) Retrieve the recording thermographs during the normal September sampling and download the data, inspect and QA/QC the data for errors, malfunctions, or data gaps.

## **Data Analysis and Reporting**

Objectives: 1) Assess the effects of the Rocky Reach project on water temperature in the Rocky Reach reservoir; 2) If necessary, address the potential sources of warming; 3) Evaluate and report on the potential importance of spatial variability in Rocky Reach water temperatures during the critical summer heat; 4) Address the possible affects of cooling from groundwater or other sources in the Rocky Reach reservoir.

- 1) Conduct a technical and statistical analysis of the data obtained in this work, both existing and new data collected in this effort. Evaluate the significance of temperature differences between cooler and warmer areas. Discuss the limitations of the water temperature data set.
- 2) Discuss implications of the data with respect to compliance with water quality standards, both existing and possible future regulations.
- 3) Address the potential cooling effect of groundwater discharges to Rocky Reach both with and without impoundment.
- 4) Prepare a technical report that summarizes the methods, results, and recommendations of the water temperature assessment.

## **References**

- R2 Resources and Rensel Associates. 1999. Assessment of resident fish resources in Lake Pateros, Washington. Prepared for P.U.D. No. 1 of Douglas County, Washington.
- McKenzie, S. W. Undated. Assembly and review of available continuous temperature data. US Geological Survey. Portland OR. Unpaginated abstract, plots and figures, no raw data.
- Yearsley, J. 1999. Columbia River temperature assessment: Simulation methods. US EPA, Region 10. 38 pp and appendices.