

Prepared in cooperation with the Bureau of Reclamation

Thermal Profiles for Selected River Reaches of the Methow and Chewuch Rivers, Washington, August 2011

Data Series 682

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By Andrew S. Gendaszek

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**U.S. Department of the Interior
U.S. Geological Survey**

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U.S. Geological Survey
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Conversion Factors and Datum

Conversion Factors

Multiply	By	To obtain
mile (mi)	1.609	kilometer (km)
cubic foot per second (ft ³ /s)	0.02832	cubic meter per second (m ³ /s)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$^{\circ}\text{F}=(1.8\times^{\circ}\text{C})+32.$$

Datum

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Thermal Profiles for Selected River Reaches of the Methow and Chewuch Rivers, Washington, August 2011

By Andrew S. Gendaszek

Abstract

Longitudinal profiles of near-streambed and near-surface temperatures were collected for selected reaches of the Methow and Chewuch Rivers, Washington, during August 2011 to facilitate development of a stream temperature model near the confluence of the Methow and Chewuch Rivers. Temperature was measured using a probe with an internal datalogger towed behind a watercraft moving downstream at ambient river velocity. For the Methow River, an additional temperature survey was completed using near-streambed and near-surface probes towed behind a second watercraft that traversed the channel to measure vertical and lateral temperature variability. All data were referenced to location that was concurrently measured with a Global Positioning System. Data are presented as Microsoft Excel® files consisting of date and time, water temperature, and Washington State Plane North easting and northing.

Introduction

Longitudinal profiles of near-streambed temperatures surveyed at ambient river velocity in a Lagrangian framework provide information about potential areas of groundwater discharge as well as salmonid habitat and thermal refugia (Vaccaro and Maloy, 2006). Longitudinal thermal profiles previously have been surveyed in several rivers in Washington, including the Yakima River and tributaries (Vaccaro and others, 2008), the Nooksack River (Cox and others, 2005), and the Stillaguamish River and tributaries (Gendaszek, 2011). In August 2011, the U.S. Geological Survey (USGS), in cooperation with the Bureau of Reclamation (Reclamation), surveyed stream temperatures to support development of a Reclamation stream temperature model in selected reaches of the Methow and Chewuch Rivers, Washington.

Purpose and Scope

The purpose of this report is to present longitudinal thermal profiles of stream temperature in selected reaches of the Methow and Chewuch Rivers. These data may be used to develop a model of stream temperature and as a tool to develop a better understanding of groundwater/surface-water interactions in the Methow and Chewuch Rivers.

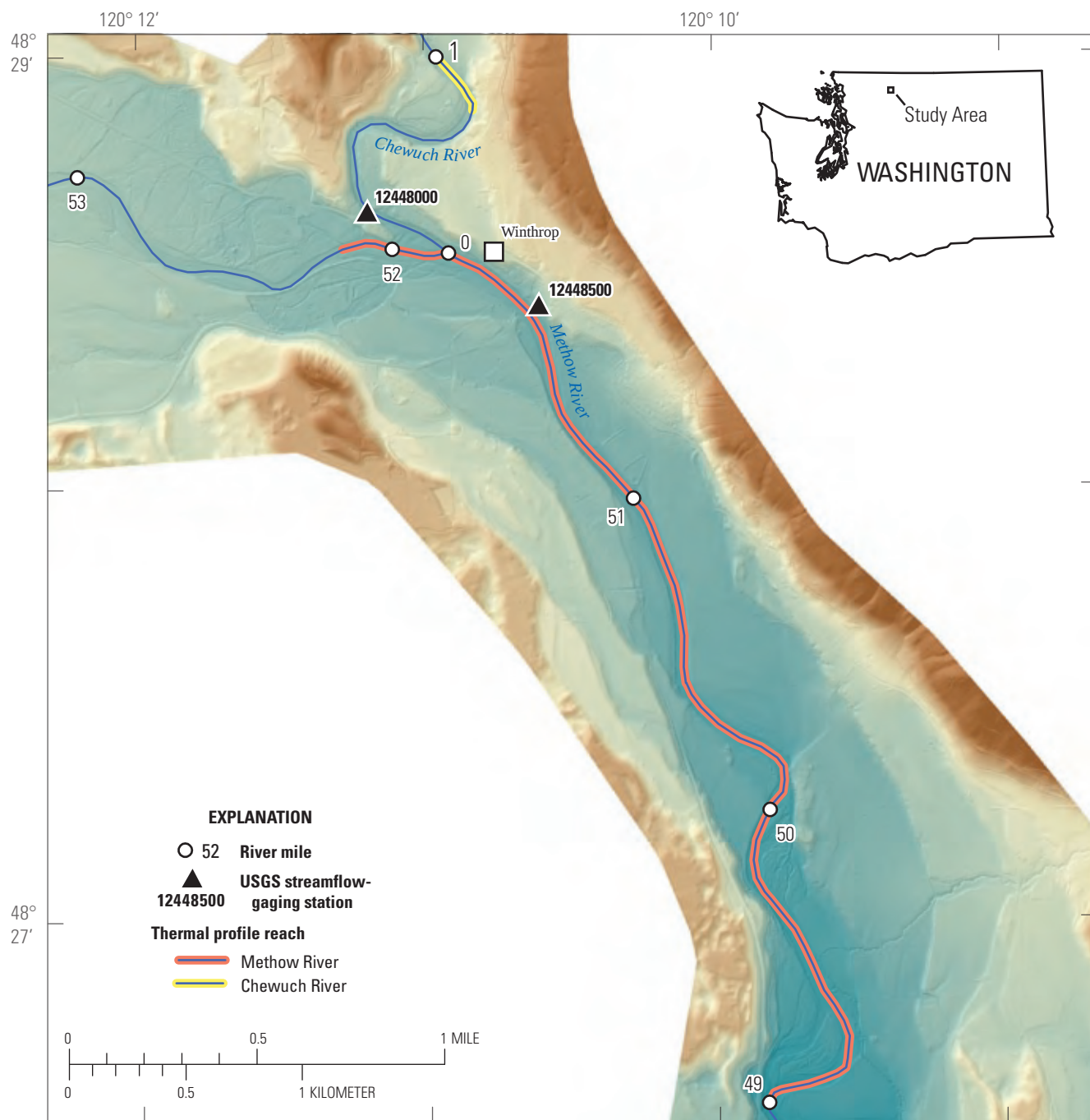
Description of Study Area

The Methow River, in north-central Washington, is joined by the Chewuch River at the town of Winthrop ([fig. 1](#)). Mean annual discharge of the Methow River (Methow River at Winthrop, Wash., USGS gaging station 12448500) for water years 1991–2010 was 1,167 ft³/s and mean annual discharge of the Chewuch River (Chewuch River at Winthrop, Wash., USGS gaging station 12448000) for water years 1992–2010 was 394 ft³/s. River miles (RM) referred to in this report were measured from 2011 stream channels.

Thermal Profile Survey

Continuous water temperature was measured at 3- to 5-second intervals using Solinst® LT Levellogger and Solinst® LTC Levellogger temperature probes verified by a National Institute of Standards and Technology (NIST) certified thermistor. Position data were concurrently measured using a Trimble R8 GPS or a Garmin® GPSmap® 60Csx GPS. Near-streambed temperature probes were towed behind a watercraft and dragged along the streambed except when in-stream obstacles prevented probe movement downstream.

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Hillshade image calculated from 1-meter LiDAR DEM, Puget Sound Lidar Consortium.
LiDAR data acquired 2006.

Figure 1. Location of study area where stream-water-temperature profiles were measured on the Methow and Chewuch Rivers, Washington.

Near-surface temperature probes were towed behind the watercraft within 1 ft of the water surface. The location of each temperature measurement was determined by relating the time stamps of the Global Positioning System (GPS) data to the temperature data. If a GPS location was not recorded at the time of a temperature measurement, the location of the temperature measurement was determined by linear interpolation of the two known GPS locations that bracket the time of the temperature measurement.

A profile of near-streambed temperature for the Methow River between RM 49.0 and 52.1 was surveyed on August 11, 2011, while in a watercraft drifting downstream at ambient stream velocity within the thalweg (table 1; fig. 2) using the method developed by Vaccaro and Maloy (2006). Profiling at ambient stream velocity in a Lagrangian framework tracks a parcel of water as it moves downstream during the day; departures from the diurnal heating cycle may be due to groundwater input, surface-water inflows, or riparian shading. Additionally, cross-stream temperature variability near the streambed and near the surface was characterized by a second watercraft towing probes while traversing the channel of the Methow River between RM 49.0 and 52.1 on August 11, 2011 (tables 2 and 3; fig. 3). During this traverse stream survey, the watercraft crossed the channel two to four times at a near perpendicular angle to the thalweg every 0.1–0.2 mi. Near-streambed and near-surface temperatures also were surveyed on August 11, 2011, between RM 0.8 and 1.0 of the Chewuch River while in a watercraft drifting downstream at ambient stream velocity (tables 4 and 5; fig. 4). Near-streambed and near-surface temperatures were not surveyed while traversing the channel due to boulder obstructions in the Chewuch River.

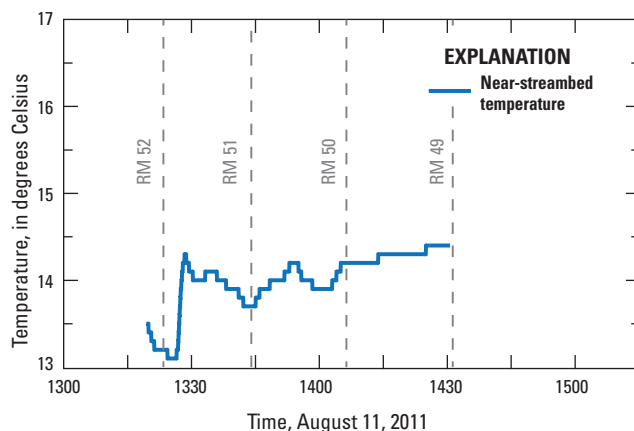


Figure 2. Near-streambed temperature during the ambient streamflow survey of the Methow River (river mile [RM] 49.0 and 52.1), Washington, August 11, 2011.

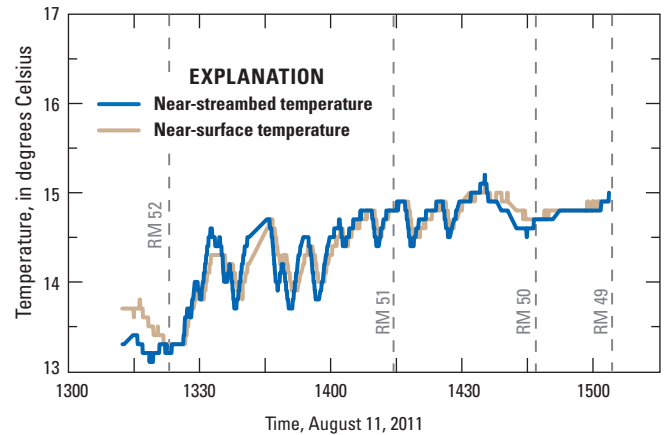


Figure 3. Near-streambed and near-surface temperatures during the traverse stream survey of the Methow River (river mile [RM] 49.0 and 52.1), Washington, August 11, 2011.

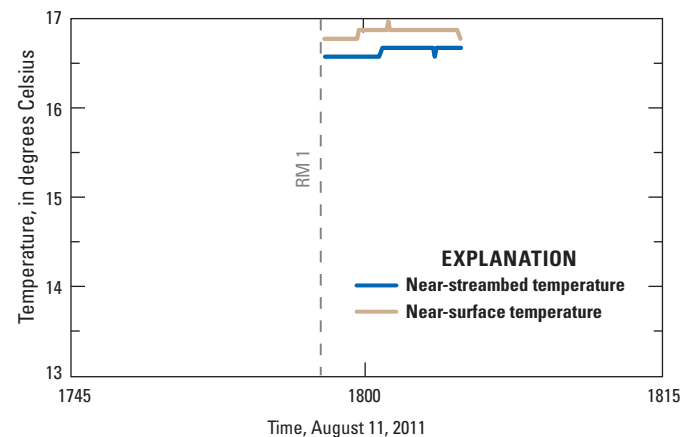


Figure 4. Near-streambed and near-surface temperatures during the ambient streamflow survey of the Chewuch River (river mile [RM] 0.8 and 1.0), Washington, August 11, 2011.

Distribution of Information

A Microsoft Excel® file of tables 1–5 that include the thermal-profile data for each longitudinal profile is available at <http://pubs.usgs.gov/ds/682/>.

Table 1. Near-streambed temperature and Global Positioning System location data during the ambient streamflow survey of the Methow River (river mile 49.0 and 52.1), Washington, August 11, 2011.

Table 2. Near-streambed temperature and Global Positioning System location data during the traverse stream survey of the Methow River (river mile 49.0 and 52.1), Washington, August 11, 2011.

Table 3. Near-surface temperature and Global Positioning System location data during the traverse stream survey of the Methow River (river mile 49.0 and 52.1), Washington, August 11, 2011.

Table 4. Near-streambed temperature and Global Positioning System location data collected during the ambient streamflow survey of the Chewuch River (river mile 0.8 and 1.0), Washington, August 11, 2011.

Table 5. Near-surface temperature and Global Positioning System location data collected during the ambient streamflow survey of the Chewuch River (river mile 0.8 and 1.0), Washington, August 11, 2011.

Acknowledgments

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