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1. Introduction

In the spring of 2002 while the Willamette River was at a high elevation, David Evans and Associates, Inc. (DEA) conducted a series of current monitoring transects near the Portland area. This study was a continuation of other survey work, bathymetric mapping, which DEA had conducted for Striplin Environmental Associates for characterization of the lower 15 miles of the Willamette River. This report summarizes the data collection and presents processed profiles of the transects.

2. Acoustic Doppler Current Profiling (Theory of Operation)

The ADCP estimates horizontal and vertical velocity as a function of depth by using the Doppler effect to measure the radial relative velocity between the instrument and scatterers in the water column. Three acoustic beams in different directions are the minimal requirement for measuring the three velocity components. A fourth beam adds redundancy and an error estimate. The ADCP transmits a ping from each transducer element roughly once per second. The echo arrives back at the instrument over an extended period, with echoes from shallow depths arriving sooner than ones from greater ranges. Profiles are produced by range-gating the echo signal, which means the echo is broken into successive segments called depth bins which correspond to successively deeper depth ranges. The operator configures the length of each depth bin and the transmit pulse, which determines the degree of averaging in the vertical, depending on whether one is interested more in vertical resolution or profile penetration. The relative velocities are rotated from the transducers to the earth's reference frame using the units internal compass or an externally supplied heading. Finally, relative velocities and various ancillary parameters are stored on the survey vessel as raw data files. In shallow areas, such as in rivers, the ADCP can “lock on” to the bottom and use the bottom track as a very stable reference point from which to calculate absolute speed and direction of the unit. This information on the instrument speed and direction is then subtracted from the relative current information to produce true current velocity and direction.

3. Field Operations

On April 19, 2002 David Evans and Associates used its 30-foot survey vessel the John B. Preston to conduct Acoustic Doppler Current Profile (ADCP) measurements along 16 transects across the lower Willamette River near Portland, Oregon. A RD Instruments 1200 kHz Workhorse Sentinel ADCP was deployed from a pole mounted on the starboard side of the vessel. The unit has an internal compass which was calibrated in the field with the resulting heading error reduced to less than 1 degree (0.9). A magnetic variation of 18.5 degrees was added to correct the data to true north. A draft correction of 1.33 feet was logged and applied to the ADCP data. The system was configured to collect data at 50 cm (1.64 feet) depth intervals and had a blank after transmit set to 25 cm (0.82 feet) to reduce spurious readings from close to the transducers. The 50 cm bin setting corresponds to approximately 7 cm / second precision on the readings. The set of depth bins recorded with each transmission cycle is referred to as an ensemble. Transit speed was kept to bare minimum to reduce the magnitude of the vessel vector relative to the river currents. This also enabled more along track soundings to be averaged in post processing to improve the signal to noise ratio.

The 16 transect locations had been determined in advance and corresponded to specific areas of interest along the river. The river elevation was logged at gauges near transect locations whenever possible. Also, river elevation data from the Morrison Bridge Gauge was downloaded from the Army Corps of Engineers web site and is included in the back of this report.

4. Line Naming Convention

The ADCP Winriver software, which was used to log the raw data in the field, saves the files in sequential series starting with 0 and augmented by 1 each time logging is commenced. If a line was aborted the ADCP file count still updated. The files recorded in the field are listed in the daily log that can be found in the back of this report. The r.000 files are raw ADCP files. The w.000 are configuration files stored during

acquisition, the w.001 files contain any post-processing changes to the data that may have been made. A summary of transect names, locations and ADCP file names is given below.

Transect	ADCP FILE	RIVER MILE	LOCATION DESCRIPTION
1	A109018R.000	1.0	
2	A109017R.000	2.0	
3	A109016R.000	2.5	
4	A109000R.000	3.1	Multnohmah Channel
5	A109015R.000	4.0	
6	A109001R.000	4.6	Into Terminal 4 Slip 3
7	A109012R.000	5.8	St. John's Bridge
8	A109010R.000	6.3	Off Gasco
9	A109002R.000	6.8	Into Willamette Cove
10	A109009R.000	7.8	Off Willbridge Terminal
11	A109005R.000	8.0	
12	A109003R.000		Swan Island Lagoon (mouth)
13	A109004R.000		Swan Island Lagoon (upper end)
14	A109008R.000	9.6	Across deep hole in channel
15	A109007R.000	10.0	
16	A109006R.000	11.0	

5. Data Processing

The raw ADCP files were replayed using WinRiver software. A 10 ensemble average was applied in the along track direction to improve the data quality. For calculation of Q values distances to the banks were measured from the ADCP transect tracklines which were drawn in AutoCAD. The distances measured were to the edge of the TIN model of the bathymetric data collected previously by DEA. The Q calculations extrapolate the closest bank velocities over the distance to the bank and assume a bottom shape as specified by the user. For these profiles a triangular bottom shape was applied for the region being estimated. The Q information is located in the lower right hand areas of each transect plot. In the upper right section of each transect plot is an X, Y graph depicting transect path and a depth averaged stick plot of the current vector. The upper profile of each transect plot shows a color plot of current velocities. The lower profile shows a color plot of the current direction which directly correlates to the velocity data above. A copy of the WinRiver software and all of the raw data files have been included on a CD located in the back of this report.