



IRRIGATION TRAINING AND RESEARCH CENTER
 California Polytechnic State University
 San Luis Obispo, California 93407
 www.itrc.org

Side Mounted Doppler Flow Meter for Canals

Irrigation districts, farmers and other agricultural and environmental water users need reliable and low-cost flow meters with integrated data-loggers to measure water velocity and depth with a high level of precision. The scientific management of California's water and energy resources requires that the volume of irrigation water that is delivered, spilled, reused, etc. throughout the state is measured accurately.

The Irrigation Training and Research Center working under a technical services agreement with the United States Bureau of Reclamation (USBR) Mid-Pacific Region has undertaken a performance review of advanced electronic flow measurement technologies in irrigation applications. An example is the SonTek Argonaut™ Side-Looking (SL) Doppler Flow Meter.

Principals of Operation

The SonTek Argonaut™ SL provides remote velocity sampling and integrated flow measurement based on the physical principle called the Doppler shift. The 1.5-MHz Argonaut SL is a monostatic Doppler current meter using two acoustic beams, each slanted 25° off the instrument axis. The Argonaut transducers measure the change in frequency of a narrow beam of acoustic signals in order to compute along-beam velocity data.

The Argonaut SL is designed for side-looking operation from underwater structures such as channel walls. The Argonaut acoustic sensors, receiver electronics, temperature sensor, pressure sensor and processor are configured in a pressure housing (see Figure 1).



Figure 1. SonTek Argonaut™ SL Doppler Flow Meter

The location and sampling size where the velocity measurements are collected (cell length) are adjustable based on user-selected parameters up to a range of 70 feet. The measurement area can be extended away from the instrument to avoid signal contamination due to boundaries or mounting structures.

Sutter-Mutual Water Company

The ITRC has been working in cooperation with the Sutter-Mutual Water Company (SMWC) on a modernization program to improve water delivery flexibility, reduce energy costs and conserve water supplies. As part of this effort, a SonTek Argonaut™ Side-Looking (SL) Doppler Flow Meter was installed in the Tisdale Main Canal during a 4-month time period in 2001.

The Argonaut SL was utilized to measure the daily flow volume from the Tisdale Pumping Plant. The pumping plant supplies water from the Sacramento River to the Tisdale Main Canal (see Figure 2). The average flow rate is 525 cfs.



Figure 2. Tisdale Pumping Plant

The Argonaut SL was programmed to take continuous readings of water level and mean velocity measured in 10-minute intervals.

The Argonaut SL was installed in the Tisdale Main Canal approximately 60 ft upstream of the Tisdale Bridge in a section of the canal approximately 50 ft wide (see Figures 3 and 4).

Flow discharge was the product of the mean velocity and cross-sectional area (computed from the water level and cross section profile). The flow rate in the canal was computed in post-processing analysis.



Figure 3. Tisdale Main Canal

The daily flow volume in acre-feet was determined and checked against the flow records provided by SMWC.

The percent difference in the measured volume of delivered water using the Argonaut SL ranged from -1.4 to +2.6% per month while the percent difference in total delivered volumes during the four months was -0.9%.

The daily flow volume at Tisdale Bridge measured by the Argonaut SL and the SMWC diversions from the Sacramento River at the Tisdale Pumping Plant are shown in Figure 5.

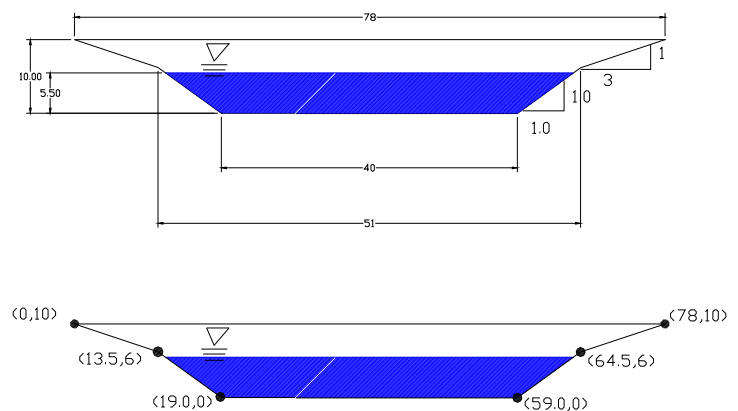


Figure 4. Tisdale Main Canal Cross Section

**Sutter-Mutual Water Company, Tisdale Bridge
SonTek Argonaut SL and Sacramento River Diversions
April 18 to June 30, 2001**

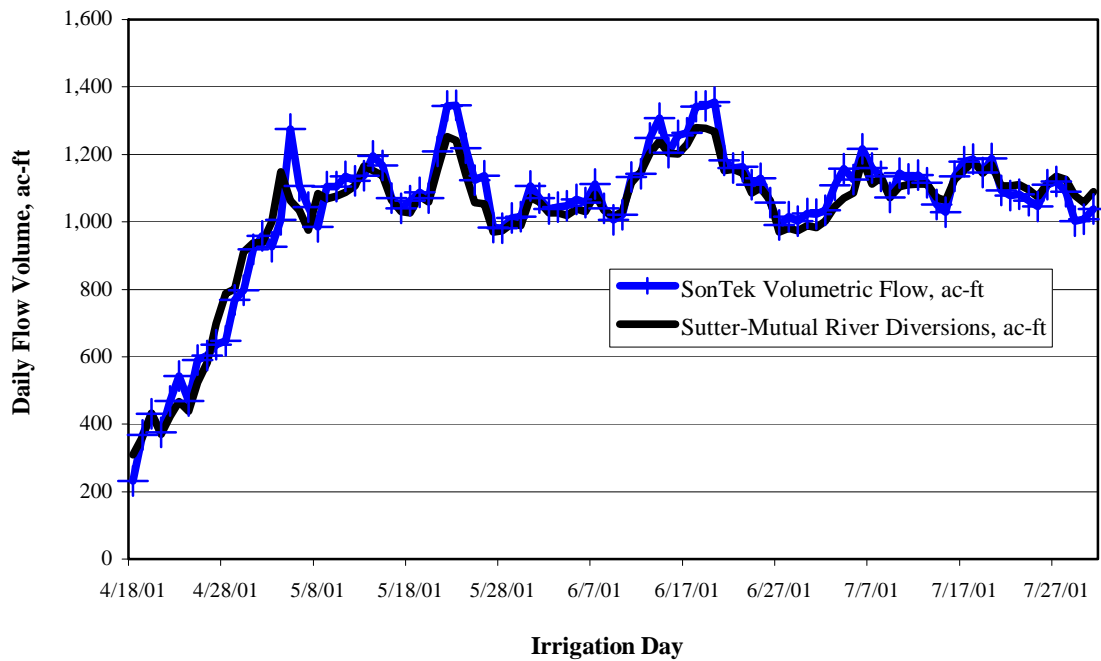


Figure 5. Daily Flow Volume in the Tisdale Main Canal (Tisdale Bridge) measured by the SonTek Argonaut™ SL compared to the calibrated flows of the Tisdale Pumping Plant.

Internal Flow Computations

The Argonaut SL has the ability to perform internal flow (discharge) computations as the product of mean velocity and cross-sectional area. The mean velocity is computed from an empirical (index velocity) of mean velocity.

The user selects the velocity equation used for computing flow and loads the channel geometry with up to 20 cross-sectional points (x-y pairs). The index coefficients for establishing the empirical velocity relationship in the channel are determined through regression analysis. For guidelines refer to *Canal Velocity Indexing at Colorado River Indian Tribes (CRIT) Irrigation Project in Parker, Arizona using the SonTek Argonaut SL* (Irrigation Association 2003).



Figure 6. Mounting hardware for Argonaut SL at Truckee-Carson Irrigation District

Benefits

Researchers and irrigation districts have used the SonTek Argonaut™ SL in a variety of applications. The Argonaut SL provides:

- Variable range (cell length) to avoid the effects of mounting structures and boundary conditions
- No head loss required
- Not affected by biological growth
- Small and lightweight
- Operates under unsteady velocity distributions
- Can be mounted on a riverbank, bridge abutment, or other vertical structure.
- Programmable cell range extending up to 22 meters (72.2 ft) away
- With an added interface, meter can be integrated with a Supervisory Control And Data Acquisition System (SCADA)

Cost

Base cost for the Argonaut SL is approximately \$6,800. Adding a vertical beam for water level and firmware upgrade to compute flow adds about another \$2,000. Components to connect the unit to a SCADA system will cost an additional \$4,000.

Use

Projects where the Argonaut SL has been utilized (02/15/02):

- Sutter-Mutual Water Company
- Truckee-Carson Irrigation District
- Anderson-Cottonwood Irrigation District

For Further Information

Dr. Stuart Styles, P.E.
Director
Irrigation Training and Research Center
California Polytechnic State University
San Luis Obispo, California 93407
(805) 756-2429
sstyles@calpoly.edu
www.itrc.org

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Sacramento, California

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Mid-Pacific Region
Sacramento, California

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