California Department of Pesticide Regulation
Environmental Monitoring Branch
1001 I Street, Sacramento CA 95814-2828
P.O. Box 4015, Sacramento CA 95812-4015

STANDARD OPERATING PROCEDURE
Procedure for Determining Wadable Stream Discharge with Price Current Meters

KEY WORDS

Discharge, Stream, Stream flow

APPROVALS

APPROVED BY: _____ DATE: 12/14/04
Kean S. Goh, Ph.D.
Environmental Monitoring Branch Management

APPROVED BY: _____ DATE: 12/14/04
Frank Spurlock, Ph.D.
Environmental Monitoring Branch Senior Scientist

APPROVED BY: Carissa Ganapathy DATE: 1/6/05
Carissa Ganapathy
Environmental Monitoring Branch Quality Assurance Officer

PREPARED BY: Adriana Moncada DATE: 13 Dec 2004
Adriana Moncada
Environmental Monitoring Branch Scientific Aide

Environmental Monitoring Branch organization and personnel, such as management, senior scientist, quality assurance officer, project leader, etc., are defined and discussed in SOP ADMN002.

PREVIOUS AUTHORS: C. Garretson and A. Fecko

1.0 INTRODUCTION

1.1 Purpose

This Standard Operation Procedure (SOP) is the approved method for estimating stream flow (discharge) using the Price Type AA and Pygmy current meters in conjunction with the CMD 9000 Digimeter Current Meter Digitizer.

1.2 Definitions

1.2.1 Discharge - the volume of water per unit time passing a given point. Discharge (length^3/time) is calculated as the product of water velocity (length/time) and cross-sectional area (length^2) of the stream or ditch. The most common units are feet^3/sec (cfs). Typically a stream or ditch is divided into increments, and the total discharge calculated as the sum of measured discharge from each increment.

1.2.2 Price Type AA - a current meter that is generally used in deeper (greater than 1-foot depths) and swifter waters than the pygmy meter. A "AA" meter features a Bucket Wheel 5" in diameter and is designed to be used either by direct wading measurement or suspended by a cable from an overhead structure or boat.

1.2.3 Pygmy Meter - a current meter intended for shallower (less than 1-foot depths), slower moving waters and feature a Bucket Wheel 2" in diameter. It is designed for wading measurements only.

1.2.4 Top Setting Wading Rod - has a main rod marked with 0.10-foot increments to measure the water depth of a wadable stream. “Top setting” refers to the fact that the second rod (sliding rod) can be slid up and down, and the vernier allows the current meter to be set at 0.6, 0.2, or 0.8 of the water depth.

1.2.5 Vernier - is a small scale calibrated to indicate factional divisions of the observation depth (figure 2) when the sliding rod is moved into position (see section 5.2 and 5.3).

2.0 MATERIALS

2.1 Current Meters – Model #1210 (AA) and Model #1205 (Pygmy) including for each:

- 2.1.1 Cup assembly
- 2.1.2 Tail fin assembly
- 2.1.3 Carrying case
- 2.1.4 Spare parts kit containing:
  - Pivot assembly
  - Binding post assembly
  - Pivot set screw
  - Thumb screw
  - Hanger screw
- 2.1.5 Rating charts
- 2.1.6 Instrument oil
- 2.1.7 Screwdriver

2.2 Top set wading rod (USGS Style) Model # 1287
2.3 Tape measure or tagline (long enough to traverse the stream bed)
2.4 Stakes (to anchor tape to shore)
2.5 Mallet (to drive in stakes)
2.6 CMD 9000 Current Meter Digitizer
2.7 Water Quality Field Data sheets and clipboard
2.8 Waders

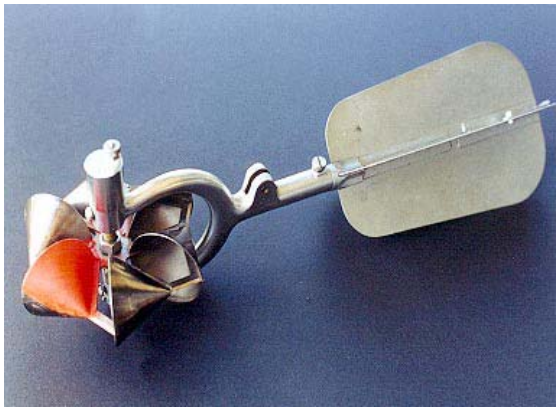

Figure 1. Price Type AA Meter

3.0 EQUIPMENT SET-UP

3.1 Choose the appropriate meter to measure the stream flow.

3.1.1 If the depth is one foot or less the Pygmy meter should be used.

3.1.2 If the depth is greater than one foot either meter may be used as long as the flow velocity does not exceed 3 feet per second.

3.1.3 If the velocity is greater than 3 feet per second and less than 8 feet per second then the AA meter should be used.

3.1.4 Minimum velocity for either meter is 0.8 ft/sec (0.25 m/sec).

3.2 Assemble the current meter, wading rod and digitizer according to the instruction manual.

3.3 Once assembled, test the meter operation by performing a spin test. When assembled properly, spin the cup assembly briskly counterclockwise as viewed from above (NEVER SPIN THE CUP ASSEMBLY IN THE WRONG DIRECTION! This can damage the contact wires and cause inaccurate readings). The cups should spin freely for a minimum of 60 seconds for the Pygmy meter and 3.5 minutes for the AA meter. Record results on the field data sheets. See section 7.1.6 if either meter fails spin test.

3.4 Set-up the digitizer.

3.4.1 Choose either the AA or the Pygmy meter by pressing the **Meter Type** key.

3.4.2 Choose “single” head type, by pressing the **Head Type** key.

3.4.3 Choose English units by pressing the **Eng/Met** key.

3.4.4 Using the **Mode** key, choose Mode 1.

3.4.5 Use the **Review** key to confirm the proper parameters are set.

4.0 SITE SET UP USING PROCEDURES FROM CARTER AND DAVIDIAN (1969)

4.1 Determine the transect location. A site where the stream is most consistent in depth and flow rate across its width is easier to sample and provides more accurate results. Measurements are best made along a straight reach of stream. Avoid reaches with ox-bows, dry riverbeds, piles of debris, tributaries, and islands. If avoiding these areas is not possible, refer to Rantz 1983, Chapter 5, page 79.

4.2 Place a stake on the left and right side of the bank of the designated transect. Pull the measuring tape across the chosen transect, keeping it perpendicular to the flow of water. Secure the measuring tape to the stakes on both banks keeping the tape out of the water.

4.3 Left edge of water (LEW) and Right edge of water (REW) should be identified along the designated transect. LEW is the left edge of water when facing downstream. Left edge of water (LEW) should be identified as the point where the flow of the water begins on the transect. The right edge of water (REW) is where the flow of the water ends on the transect. Annotate the starting width and the ending width of the stream and record on a field data sheet (see attachment 1) to reflect change in flow while taking discharge reading.

Figure 2. Stream divided into 30 increments

4.4 Determine the spacing of the stream in terms of increments. A rule of thumb is to use 20 to 30 increments.

4.4.1 Use smaller number of increments for streams that are narrow and a larger number of increments for extremely wide streams. The spacing of the increments should be consistent in depth and flow Ideally each increment should have no more than 5% of total flow.

4.4.2 If large inconsistencies in flow rate or streambed topography are found, then the number and size of sampling increments can be adjusted to accommodate the differences.

4.4.3 If the flow adjacent to the bank is found to be extremely slow or absent, isolate the low flow area to its own increment.

5.0 TAKING VELOCITY AND DEPTH READINGS

5.1 Place the wading rod with attached current meter at the first increment. Hold it upright and measure water depth by reading the scale on the top-setting wading rod (the lower portion of the rod that does not slide). Indentations are at every inch. The two and three indentation marks are every half-foot and 1 foot, respectively.

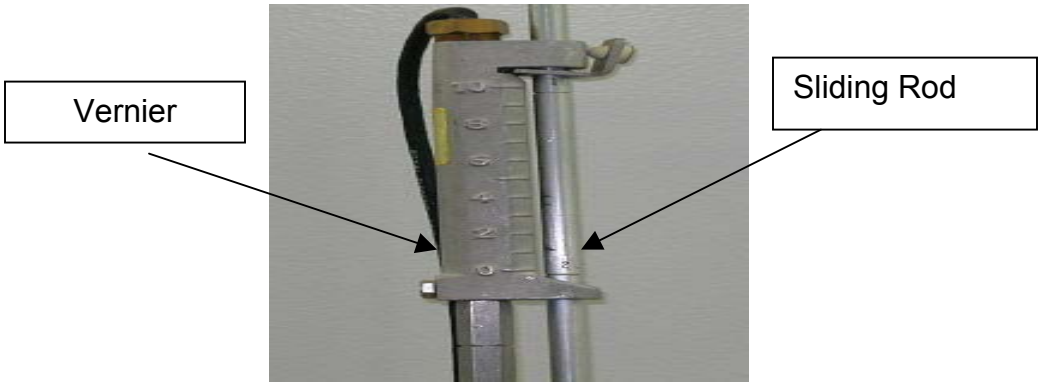

Figure 3. Top-Setting Wading Rod

5.2 Observation depth for current meter measurements is dependant on water depth. If the depth is less than 2.5 feet, then the one point method should be used. In this method the current meter measurement is taken at a depth on the vertical that is equal to 60% of the total depth when measured from the surface of the water. To set the 0.6-point, move the sliding rod so that the foot measurement on it lines up with the tenth of a

foot measure on the vernier. For example, if the first increment is 1.3 feet deep, take the sliding rod and line the number one on the sliding rod to the three on the vernier. The average velocity of the first increment would be found 0.8 feet (60%) down from the surface of the water.

5.3 If the depth is greater than 2.5 feet than the two-point method should be used. In this method the current meter measurement is taken at a depth on the vertical that is equal to 20% and 80% of the total depth when measured from the surface of the water. To set the 0.2-point, multiply the depth of the water by 2 and then move the sliding rod so that the foot measurement on it lines up with the tenth of a foot measure on the vernier. For example, if the first increment is 2.6 feet deep, multiply this number by 2, which give you 5.2 feet. Then, take the sliding rod and line the number five on the sliding rod to the two on the vernier. To set the 0.8-point, divide the water depth by 2 and then move the sliding rod so that the foot measurement on it lines up with the tenth of a foot measure on the vernier. For example, to calculate the 0.8-point, use the same depth from the 0.2-point measurement of 2.6 feet and divide by 2, which gives you 1.3 feet. Then, take the sliding rod and line the number one on the sliding rod to the three on the vernier.

5.4 Once the depth for the current meter measurement(s) has been established, press the **Start/Stop** key on the digitizer. The digitizer will initialize for a few moments and then begin reading revolutions and time elapsed simultaneously. After approximately 40 seconds the digitizer will stop reading and display the final number of revolutions and the total elapsed time followed by the velocity in feet per second.

5.5 At each measurement record the following information on the field data sheet, (see attachment 1):

- 5.5.1.1 Depth of water at each increment
- 5.5.1.2 Distance from left edge of water
- 5.5.1.3 Observation depth (0.6 for the one-point method or 0.2 and 0.8 for the two-point method)
- 5.5.1.4 Revolutions of the current meter (at each depth)

6.0 CALCULATIONS

6.1 To calculate total discharge, see reference text, Rantz, 1983, page 80.

7.0 MAINTENANCE

7.1 Maintenance should be performed after each use and if the current meter fails the spin test.

7.1.1 Wash the current meter in DI water after each use and dry carefully.

7.1.2 Oil the points on the meter indicated in Figure 4 with the oil supplied with the meter. The points are (1) Pentagear, (2) Shaft, (3) Bearing (which are all in the contact chamber) and the (4) Pivot bearing.

7.1.3 Always remove the Contact Chamber cap and allow the internal parts to dry after each use.

7.1.4 After each use, turn the Knurled Raising Nut counterclockwise as far as it will travel to lock the Bucket Wheel in place.

7.1.5 If meters fail to spin after normal maintenance, refer to Instruction and Care Manual for the meter under Pivot Bearing Adjustment.

7.1.6 Factory service is recommended on a periodic basis.

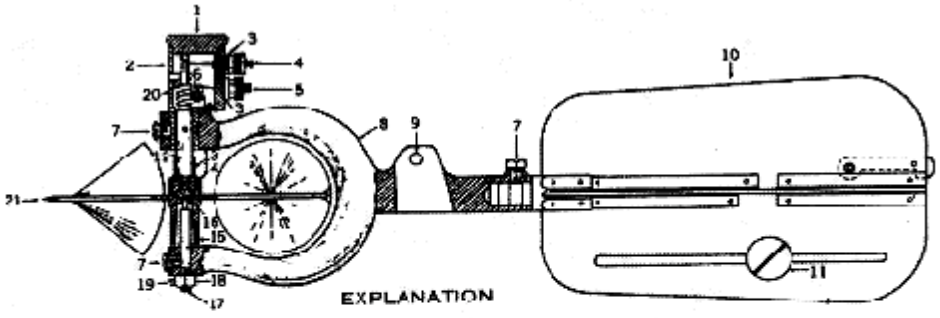

Figure 1.--Assembly drawing of Price type AA current meter.

Figure 4. Assembly drawing of Price Type AA current meter

8.0 REFERENCES

Carter, R.W., and Davidian, J., General Procedure for Gaging Streams: Techniques of Water Resources Investigations of the U.S. Geological Survey, Book 3, Chapter A6, p. 7, 1969.

Instruction and Care Manual, Part No. 1205-66 and 1210-66, Scientific Instruments, Inc., 518 West Cherry Street, Milwaukee, WI.

Rantz, S.E., Measurement and Computation of Stream flow: Volume 1. Measurement of Stage and Discharge. USGS. Chapter 5, p. 79, 1983.

Attachment 1.

Follow procedure as described in SOP FSWA009.01 for determining increments cross channel width				
LEW (ft):		REW(ft):		
Increment Number	Distance from Left Edge of Water	Depth (feet) at each increment	Method 0.6 or 0.2/0.8	Velocity at each Increment (Feet per second)