WATER QUALITY PROGRAMS DIVISION

Standard Operating Procedure for the Use of Floats to Determine Stream Discharge

Adopted November 2004

Draft Copy

OKLAHOMA WATER RESOURCES BOARD
WATER QUALITY PROGRAMS DIVISION
3800 NORTH CLASSEN
OKLAHOMA CITY, OK 73118

STANDARD OPERATING PROCEDURE FOR USE OF FLOATS TO DETERMINE STREAM DISCAHRGE
ADOPTED NOVEMBER 2004

1.0 Introduction

A float can be used where the velocity is too low and the depth is insufficient to obtain reliable measurements with a Pygmy current meter. They are also used where flood measurements are needed and the measuring structure has been destroyed or it is impossible to use a meter.

2.0 Definitions/ Terms

Floats- any object that will float unrestricted along a stream reach.
LEW- Left edge of water, determined by looking downstream, with left side being the LEW.
Reach- A section of stream that displays uniform properties and is representative of that particular stream.

3.0 Safety

Upon reaching the sampling location, site safety determinations should be made before proceeding. These will be different for wadeable and bridge sites. Please refer to the OWRB safety manual for instructions on how to sample both kinds of sites. When regulating the flow of traffic is necessary, please refer to the portion of the safety manual outlining "Traffic Safety Protocols".

4.0 Quality of the Measurement

When sampling for all programs, Quality Assurance/Quality Control (QA/QC) samples will be routinely collected to assure that environmental samples meet the Data Quality Objectives (DQO's) that are outlined in the controlling Quality Assurance Project Plan (QAPP). QA/QC sampling is designed to control each step of the sampling process. Blanks are collected to ensure that field personnel are properly cleaning the plastics and glassware used in field sampling. Duplicate samples are collected to ensure that composite samples are properly processed. Replicate samples may be collected to ensure that the sampling methodology employed is collecting a representative sample. Spike or known samples may be submitted to test the efficacy of the analytical laboratory.

For float measurements quality assurance will be measured in three ways. The primary measure of QA is the adherence to the SOP. A second measure is internal duplication of measurements. This involves releasing the float at the same point on the upstream tagline at several locations and comparing measurements. A third measure is site replication. Staff members should periodically replicate a float measurement by both side by side measurements with another staff member and replication of a particular site. Float measurements can be made with accuracy fewer than 10 percent but only under good conditions and when a certain amount of care is exercised. If a poor reach is selected and not enough float runs are made, the results can be as much as 25 percent in error.

5.0 Personnel and Equipment

5.1 Personnel

Principle investigators for the OWRB are required to have degrees and/or experience with biological or other applicable sciences. Principle investigators are defined as crew leaders, and this designation may be made upon the leader of a multi- or a one person crew. Training is required for all SOPs dealing with water quality and quantity collections and measurements as well as habitat assessments and biological collections. In-house training will be conducted for the use of all meters and digital titrators used for water quality or quantity measurements. Investigators must be familiar with OWRB SOP document and all training will follow the methods outlined in that document. Extra training will be provided when new SOPs are developed. Training of field crews will be done through dry run exercises in the laboratory to familiarize field crews with sample collection, sample preservation, instrument operation, calibration, and maintenance. In addition, when new personnel are hired or new methods developed, qualified staff will train on sample collection, measurement, and field analysis methods through side-by-side field trips. These trips will familiarize staff with SOP requirements. When training is considered adequate, a qualified staff member will check field staff for adherence to SOPs.

In most instances, the float measurements should be done by two staff members—one upstream and one downstream. However, more one person may only be available. In these instances attempt to not disturb the water when moving between taglines.

5.2 Measurement Equipment

There are two main types of floats that are used, a surface float and a rod float. Surface floats may be almost anything that floats, such as wooden disks, partially filled bottles, or orange peels. Floating debris or ice cakes may also serve as natural floats. A surface float should have sufficient weight to prevent wind currents from moving the float. Rod floats are wooden rods weighted on one end so they will float upright in the stream. (Fig 1) Rod floats must not touch the streambed because this will interrupt the progression of the float.

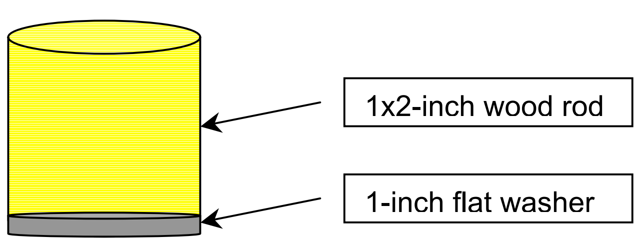

Figure 1. Rod Float

6.0 Discharge Measurements

6.1 General Procedure

The procedure for a float measurement is to distribute a float at a specific interval across the stream width. Two cross sections are selected along a reach of straight channel for a float measurement. The cross sections should be far enough apart so that the time the float takes to pass from one cross section to the other can be measured accurately. The distance between the two cross sections should be at least 10 feet, with 20 feet or longer preferable. The reach should have uniform features and be free of pools, debris piles and overhanging vegetation. (Fig 2) At the lower cross section, a tagline should be used to divide the stream width into 20-30 segments. At each segment, release the float upstream of the first cross section, allowing the float to settle and reach a consistent velocity. As the float passes the first cross section, start the stopwatch. When the float passes the second cross section, note the time and distance from LEW. Where the float crosses the 2nd cross section, a depth measurement is made. A travel time of at least 20 seconds is recommended, but a shorter time can be used on small streams with high velocities, where it is impossible to select an adequate length of straight channel. Care must be taken when measuring low velocities, so that the floats are not being affected by wind.

Fig 2

Figure 2. General setup for measuring discharge using floats

6.2 Determining Stream Velocity Using Floats

The velocity of the float is equal to the distance between the cross sections divided by the time of travel. The mean velocity of flow in the vertical is equal to the float velocity multiplied by a coefficient, which is based on the shape of the vertical-velocity profile and relative depth of immersion of the float. A coefficient of about 0.85 is commonly used to convert surface velocity to mean velocity. The coefficient for rod floats varies from 0.85 to 1 .00 depending on the shape of the cross section and the velocity distribution. The discharge in each partial section is computed by multiplying the average area of the partial section by the mean velocity in the vertical for that partial section. The total discharge is the sum of the discharges for all the partial sections.

7.0 Forms

Forms are Discharge Measurement Notes

8.0 Data Storage

All paper copies of Discharge Measurement Notes should be maintained with the station data set. The data from the notes should be quality assured and entered into the Water Quality Database.

9.0 References

Discharge measurements at gaging stations, by T.J. Buchanan and W.P. Somers: USGS—TWRI Book 3, Chapter A8. 1969.

Measurement and computation of streamflow Volume 1. Measurement of stage and discharge Volume 2. Computation of discharge, By S. E. Rantz, et al.: USGS—Water Supply Paper 2175.