

LOW FLOW PROTECTION PLAN GUIDE

Why is a low flow plan necessary?

Irrigation normally occurs during warm, dry months of the year when stream levels are lower than normal and can result in rapid depletion of the stream or river flow. The Environmental Protection Division (EPD) is charged with regulating the state's water resources. Where necessary, EPD maintains in waters of the state a minimum flow equal to the 7Q10 or the natural flow, whichever is less. The 7Q10 is defined as the minimum average flow for 7 consecutive days that occurs on average once every ten years.

EPD requires all applicants to develop the low flow plan to protect the 7Q10 or the natural flow, whichever is less. If prior permitted withdrawals exist downstream, EPD will require the applicant to develop the low flow plan to protect the Non-Depletable Flow (NDF) or the natural streamflow, whichever is less. The NDF is equal to the 7Q10 plus the calculated amount required to protect prior users.

EPD requires storage as a condition of permit issuance for most non-ag Surface Water Withdrawal Permits. Storage increases the reliability of stream/river withdrawals and protects the source from over-pumping. With storage available, the irrigator can pump from the stream or river in higher flow conditions and from storage during low flow events. EPD encourages all farm irrigation facilities to develop storage when possible.

How do you develop a low flow plan?

First, select a method for estimating stream discharge. There are three common methods for measuring flow in a stream below a proposed withdrawal site: 1) Calculation of stream discharge by estimating the area of the cross-section and average velocity of the stream; 2) Weir notch; and 3) Parshall flume. The applicant can determine average stream discharge by use of a commercially available flow meter or by using one of the methods described in the attachment.

The following describes method 1. (Please refer to the attachment starting with Section D-1):

1. Locate an appropriate cross-section (for measuring average cross-sectional area)

Select a site with a straight, uniform cross section (free of big rocks, tree roots, deep holes or anything that would make streamflow determination difficult). The cross section should be upstream of the proposed intake location and of reasonable width (a very wide, turbulent stream or river could make stream flow estimation impossible without the installation of a permanent U.S. Geological Survey stage discharge station).

2. **Determine the average velocity in the stream at the chosen cross-section.**

Select a straight run lengthwise in the stream and determine the average velocity in the stream (See attachment).

3. **Determine the area of the chosen cross-section**

At the cross-section make several depth measurements to determine an average stream depth. Multiply this average depth by the cross-section width to get the area. (See attachment).

4. **Determine stream discharge at the chosen cross-section area**

Multiply the estimated stream cross-section area by the estimated average stream velocity.

5. **Develop a stream stage-discharge relationship**

Upstream of the proposed withdrawal site place a staff of wood, metal or other sturdy material in the most stable part of the stream for use as a stream depth gage. Mark the actual stream depth on the downstream side of the staff gage with a numbered metal tag or similar device. Record this depth in a log along with the corresponding estimated average discharge. Determine and record the depth and average discharge values for different flow conditions.

Plot the staff discharge curve from the recorded data and extrapolate the curve if necessary to get the depth corresponding to the protected low flow. Mark the staff gage at the low flow depth to indicate when pumping must stop.

6. **Check the monitoring system periodically**

Under low flow conditions estimate and record stream discharge at least once a week using the methods above. Repeat the procedure as often as necessary after high flows and during severe droughts to further refine the staff gage-stream discharge curve.

Before each growing season and after every flood or very heavy rain, check both the staff gage for damage/dislocation and the stream cross section for debris buildup and/or scouring. If necessary repair the cross-section or pick a new one, start over and develop a new staff gage-discharge relationship and curve.

The Permittee should read the staff gage and estimate stream flow discharge twice a week during dry periods when irrigating. During normal or slightly below average flows the Permittee should, on a monthly basis, read the staff gage and determine discharge.

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Where can you get help to develop a successful low flow plan?

You can enlist the services of a qualified civil engineer or hydrologist or contact your County Extension Agent or District Conservationist from the Natural Resources Conservation Service (NRCS) for help. Also, please call our office if you have any questions.

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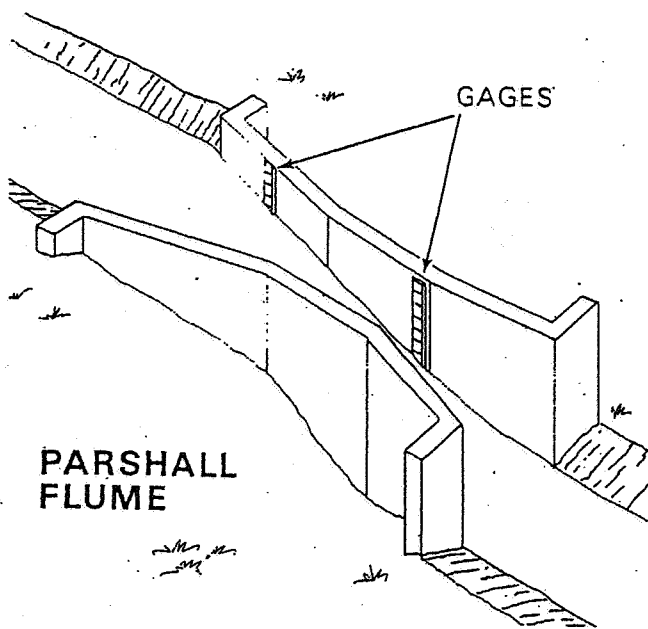


FIGURE 36. When using a Parshall flume, the depth of the water is measured at 2 points in the flume by gages. Then the quantity of water flow is determined from a table of values prepared for that particular flume.

b. and c. Weir Notch and Parshall Flume

If you wish to determine the stream flow more accurately, use the Weir notch method (Figure 35) or the Parshall flume method (Figure 36). See one of your agricultural agencies for procedures and tables.

2. EFFECT OF THE AMOUNT OF WATER IN A LAKE, POND OR RESERVOIR

If your primary source of water is a small lake, pond or reservoir, which is not recharged by a dependable stream, surface-flowing spring or well, you will have to depend on it to meet both your seasonal water demand and peak-use demand rate for your driest season.

To estimate the amount of water available for irrigation from a lake, pond or reservoir, proceed as follows:

1. Determine the surface area.

- (1) Measure a rectangular shape that approximates the size of the lake (Figure 37).

(In these procedures, "lake" represents a lake, pond or reservoir.)

Assume the average width is 183 meters (600 feet) and the average length is 221 meters (726 feet).

- (2) Multiply the average width times the average length of the lake (Figure 37) and convert to hectares (acres).

$$\text{SI: } 183 \text{ m} \times 221 \text{ m} = 4 \text{ ha.}$$

$$10,000 \text{ m}^2/\text{ha}$$

$$\text{Customary: } \frac{600 \text{ ft} \times 726 \text{ ft}}{43,560 \text{ ft}^2/\text{a}} = 10\text{a.}$$

ESTIMATED SURFACE AREA 4 HECTARES (10 ACRES)

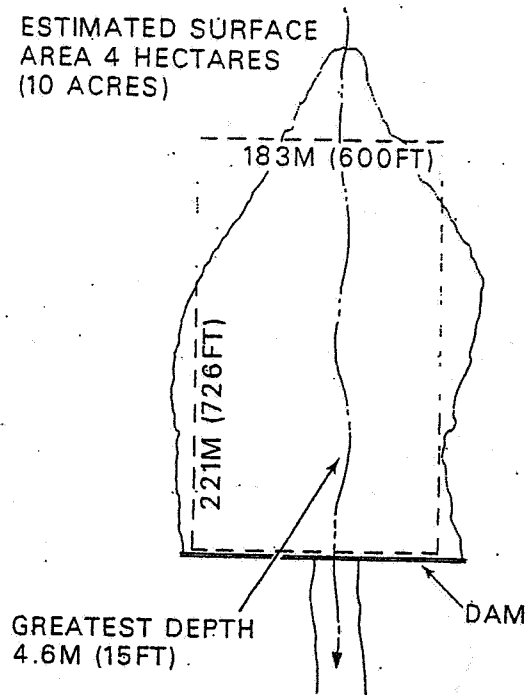


FIGURE 37. How to measure the surface of a small lake for estimating the amount of water stored.

2. Determine the volume of water.

- (1) Measure the depth of water from the surface to the deepest point.

Assume greatest depth is 4.6 m (15 ft).

- (2) Determine the average depth of the lake.

For small lakes, the average depth is approximately .4 times the greatest depth. Therefore, SI: $4.6 \text{ m} \times .4 = 1.8 \text{ m}$ (average depth).

Customary: $15 \text{ ft} \times .4 = 6 \text{ ft}$ (average depth).

- (3) Multiply the surface area times the average depth.

SI: $4 \text{ ha} \times 1.8 \text{ m} = 7.2 \text{ ha} \cdot \text{m}$.

or $7.2 \text{ ha} \cdot \text{m} \times 100 \text{ cm} = 720 \text{ ha} \cdot \text{cm}$.

Customary: $10 \text{ a} \times 6 \text{ ft} = 60 \text{ a} \cdot \text{ft}$, or $60 \text{ a} \cdot \text{ft} \times 12 \text{ in} = 720 \text{ a} \cdot \text{in}$.

3. Determine the volume of water available for irrigation.

Assume the efficiency of your lake is 80 percent of capacity because of seepage, evaporation and sediment (Figure 38). Therefore,

SI: $720 \text{ ha} \cdot \text{cm} \times .8 = 576 \text{ ha} \cdot \text{cm}$.

Customary: $720 \text{ a} \cdot \text{in} \times .8 = 576 \text{ a} \cdot \text{in}$.

If the earth lining in your lake will not hold water and the seepage is too great, you can sometimes correct this by using chemical sealants such as Bentonite. It is mixed with the earth and forms a seal. Membrane lines may also be used.

Some lakes collect soil from the watershed over a period of years. The soil settles out into the bottom of the