

**STATE OF IDAHO
DEPARTMENT OF WATER RESOURCES (IDWR)**

**MINIMUM ACCEPTABLE STANDARDS FOR
MEASUREMENT AND REPORTING OF
SURFACE AND GROUND WATER DIVERSIONS**

The source and means of diversion of water, whether surface or ground water, generally determines the measurement and reporting process. Surface water sources such as streams, springs and waste channels are normally diverted into open channels (ditches or canals), but closed conduits (pipes or culverts) are also used. Ground water is usually diverted into pipes (which may also discharge into open channels).

Measuring devices are required at or near the point of diversion from the public water source.

SURFACE WATER DIVERSIONS

I. Flow Measurement

The following discussion is applicable only to diversions from surface water sources. Measurement of a ground water diversion with an open channel measuring device must be preapproved by the Department.

A. Standard Open Channel Measuring Devices

All open channel flow diversions should be measured using one of the following standard open channel flow measuring devices commonly used in Idaho:

- contracted rectangular weir
- suppressed rectangular weir
- Cipolletti weir
- 90 degree V-notch weir
- ramped broad crested weir (or ramped flume)
- Parshall flume
- trapezoidal flume
- submerged rectangular orifice
- constant head orifice

Construction and installation of these devices should follow published guidelines. References are available upon request.

B. Non-standard open channel devices: Rated Structures or Rated Sections

IDWR may authorize the use of non-standard devices and rated sections provided the device or section is rated or calibrated against a set of flow measurements using an acceptable open channel current meter or a standard portable measuring device. Further restrictions and requirements are available from the Department upon request.

C. Closed conduit measuring devices

Refer to the Ground Water measuring section for installation, accuracy, and calibration standards of closed conduit measuring devices.

II. Reporting

All surface water measuring devices, rated structures and rated sections should be read and readings recorded at least once per week, and more frequently if necessary. IDWR will accept the assumption of constant flow rates between readings if flow rates are continuous and reasonable constant. Forms will be provided for recording dates, stage (or water levels) and flow rates.

Users with diversions located within water districts may report their diversions individually to IDWR or provide for the water district watermaster to report their diversions in acceptable annual water distribution reports. Ground water diversions are not normally included in a water district, and must be reported individually.

GROUND WATER DIVERSIONS

Ground water diverters have the option of installing a flowmeter, or using power records to estimate water withdrawals. Information regarding the use of power records will follow this discussion of flowmeters.

I. Flow Measurement

There are many flowmeters on the market, with costs ranging from several hundred dollars to several thousand dollars. In general, the higher priced meters are more accurate and require less maintenance. Most meters on the market have an acceptable accuracy rating for IDWR's guidelines. However, some types and designs are much more prone to maintenance problems. Moving parts tend to wear when sand or silt is present, and moss often plugs small orifices and slows moving parts. No single flowmeter is best for every situation. We recommend that you visit with qualified dealers and discuss your needs with them.

A. Minimum Standards

The following are minimum standards for closed conduit flowmeters:

- Minimum manufacturers' design accuracy of +/- 2 percent of reading
- Installed accuracy of at least +/- 10 percent of reading
- Meter must be calibrated with an independent, secondary measuring device when installed, and at least once every four years thereafter
- Must read instantaneous flow or be capable of flow rate calculation
- Must record total volume
- Non-volatile memory (power outage does not zero volume reading)
- Sufficient digits to assure "roll-over" to zero does not occur within 2 years
- Volume reading cannot be "reset" to zero
- Installed to manufacturers' specifications

Meter manufacturers typically specify that a meter must be located in a section of straight pipe at least 10 pipe diameters downstream and 5 pipe diameters upstream of any valves, bends, contractions, or other interferences which will distort the flow pattern. However, some types of meters will produce acceptable results when installed in shorter sections of straight pipe. For example, at least one electromagnetic flowmeter provides excellent measurement accuracy with only 5 lengths of straight pipe upstream from the meter.

Each manufacturer should provide the installation specifications for its meters. These **specifications must be adhered to** in order to achieve the accuracy required for the water measurement program. Again, we stress the importance of visiting with a qualified dealer and discussing your specific needs with them.

B. Types of Measuring Devices

| Types | Pipe Sizes | Maintenance Required | Relative Purchase Price |
|---|--|--|-------------------------|
| Differential Head <ul style="list-style-type: none"> ● Orifice ● Venturi ● Annubar | small to large | Low to high. Sand wears on sharp edges, and particles can plug small orifices and tubes. | low to medium |
| Force Velocity <ul style="list-style-type: none"> ● Turbine ● Propeller ● Impeller | small to large | Typically moderate to high. Often problematic when exposed to sand or moss. Some cannot measure low velocities | low to medium |
| Ultrasonic | small to large | Low. Typically non-invasive with no moving parts to wear | high |
| Vortex | small to medium (about 12 to 14 inch maximum pipe diameter) | Low. Few or no moving parts to wear. | high |
| Electro-Magnetic | small to medium (about 12 to 14 inch maximum pipe diameter) | Low. No moving parts. Can provide good results with shorter lengths of straight pipe. | high |

II. Power Records

An alternative to installing flowmeters is the use of power records and other information to estimate the annual diversion from a pump. This method, which we call the Power Consumption Coefficient (PCC) method, utilizes information obtained from the pumping plant while running at or near full capacity. Two parameters are measured while the pump is operating: flow rate and input power. With this information, one can calculate the number of kilowatt-hours required to pump one acre foot of water. This number is unique to each well and pumping plant due to the physical attributes of the system.

To determine the rate of flow, a portable measuring device, such as an ultrasonic non-invasive meter or a differential head device, can be used. Simultaneous with the flow measurement, power is measured using the utility's kilowatt-hour meter. A qualified individual with the necessary equipment will be required to perform these measurements. If your system is operating when the Department examines it after proof of beneficial use is filed, the Department will derive this relationship. Otherwise, you may have to hire a private consultant to make the measurements in subsequent years.

With the power consumption coefficient, an annual volume of water pumped can be calculated from the total annual kilowatt-hours of energy consumed by the pumping plant. The total power usage for each pumping plant will be supplied to the Department by electric utilities.

Some complex systems cannot use this method due to the potential for large errors. See the discussion on page 5 to see if this method can be used.

Because systems wear and water levels change, it is necessary to occasionally verify the flow to power ratio. Therefore, the power consumption coefficient must be re-calibrated at least once every four years.

III. Water Level Measurements

All ground water pumpers will be required to make certain water level measurements. These measurements will be used by the Department and other groups to study and define aquifer characteristics. They include:

- measure and record the depth to water in the well (pump off) prior to the first diversion of the irrigation season
- measure and record the depth to water in the well with the pump operating and the system stabilized. This measurement should be made early in the season, preferably within days of turning on for the first time.

IV. Reporting

For irrigation, all ground water measuring devices should be read and readings recorded prior to the first diversion of the season (around April 1), at least once per month during the irrigation season, and at the end of the irrigation season. Non-irrigation users should begin measuring within 56 days of receiving measurement information.

When power records are used to estimate the diversion, it may be necessary to keep a daily record of pump operation. This will usually only be necessary when the pump's flow rate changes significantly due to operational or other changes. For example, operation of multiple pivots, using fewer lines, booster pumps, throttling, etc. will usually cause dramatic changes in the flow.

All records of measurements and readings shall be submitted to the Department after the last diversion of the irrigation season, and no later than January 15th of the following year.

Can power records be used to estimate my diversion?

Only irrigation water users may use power records to estimate their diversion because the utilities will only provide consumption information for irrigation uses. If you are not an irrigation user, but want to use power records, you must propose a method of reporting your power consumption data.

Owners of **surface water diversions** must have a flow measuring device in most cases. The alternate method of estimating water withdrawals with power records cannot be used unless you pump from a public water source and can show the Department that it will yield reliable results (case by case determination).

Owners of **ground water diversions** can either install a totalizing flowmeter or ask the Department to use power records to estimate withdrawals. If the pump discharges to an open channel, an open channel measuring device can be employed to measure the water diverted if the device and a method of tracking hours of operation are pre-approved by the Department. Flow meters which register only instantaneous flow rate are not acceptable unless the water user can demonstrate a reliable method of tracking the number of hours the pump operates through the season (the flow measuring device must then be read and flow rate recorded at least once per week).

Estimating total water diversion from power records requires the derivation of a relationship between power demand and flow. Flow rate and power demand must be measured simultaneously to determine the number of kilowatt hours needed to pump an acre foot of water. This relationship, called a power consumption coefficient, is applied to the year end power records to determine the total acre feet diverted.

The total water diverted can be accurately estimated if the system configuration or operation is not complex. Unfortunately, power records will not always yield acceptable results, and it will be necessary to install a flowmeter. **Flowmeters must be installed** if any of the following conditions exist:

- The well flows (artesian) so that water can be diverted when the pump is off.
- The energy consumption meter that records power used by the pump also records power used by other devices not integral to the irrigation system. For example, if the meter also records power used by a home, shop, cellar, etc., a flowmeter must be installed because power used by the pump cannot be isolated from the other devices. However, if the meter also records power used by center pivots, booster pumps, or other devices which operate when the main pump operates, the alternate method may be acceptable.
- The energy consumption meter records the power used by more than one well pump. If a deep well pump which discharges to an open pond or ditch and a relief pump are both connected to the same electrical meter, the discharge from the well pump can be measured, and a time clock can be installed to record the total number of hours of pump operation which can be multiplied by the flow rate to determine the total volume of water diverted.
- The energy supplied to the pump cannot be accurately and reliably measured. For example, most diesel and propane driven pumps do not have provisions to measure the fuel used by the engine. These will be reviewed one case-by-case basis.
- The flow rate from the pump varies significantly due to changes in demand or operation. For example, pumps that discharge into a pressurized system some times and then open discharge at other times, or pumps that supply multiple pivots, would likely have flow rates that changed drastically. These changes would alter the flow to power ratio, causing inaccurate estimates of diversions. The alternate method of estimating water withdrawals with power records may only be used if the water user can propose an acceptable method of tracking these changes in operation.
- Changing water levels cause the flow to vary more than 25% (or pressures to vary more than 15%) over the irrigation season.

Should I use a flowmeter or power records?

If, after determining that you may use the alternate method of estimating your annual diversion with power records, but you are not sure which method would be best for you, the following may help you decide:

If you choose to **INSTALL or use an existing FLOWMETER**, you will need to:

- Install a flow meter prior to the first diversion of the irrigation season. Estimated cost for a new meter is from \$800 to \$5,000 or more, depending on the size and type of meter, the complexity of the piping system, and the availability of straight, exposed pipe.
- All flowmeters must be calibrated before use, and at least once every four years thereafter. This may be a service provided by private consultants, utilities, irrigation districts, or other entities which can verify the accuracy of your flowmeter.
- Record the total flow reading indicated on the flowmeter several times throughout the season. Estimated time involved is about 1 to 3 hours per diversion per year.

If you choose to **USE POWER RECORDS** to estimate your diversion, you will need to:

- Submit maps and a schematic drawing of the wellhead and associated piping to the Department, which will be evaluated to determine whether power records can be used. If acceptable, you must sign an agreement with the Department.
- Have an approved consultant establish the relationship between flow and power for each diversion at least once every four years. The Department will do this work at the time your use is examined for proof of beneficial use if your system is running.
- Record the utility meter identification number (the identification number on the face of the utility's meter which records the quantity of energy supplied to the pump) prior to and after diverting for the season (around April 1 and November 1). This is necessary because utilities regularly change meters, and this change may affect the power to flow ratio.
- Keep a daily record of pump operation. This will usually only be necessary when the pump's flow rate changes significantly due to operational or other changes. The amount of time necessary to keep these records will be proportional to the number of changes made to the system.
- Measure and record the pressure in the piping system, near the pump's discharge once a month during the irrigation season