

# WATER METER CALIBRATION, REPAIR, AND REPLACEMENT PROGRAM

**EPD Guidance Document  
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## TABLE OF CONTENTS

<i>Part 1: OVERVIEW OF WATER METERING</i>	3
SUMMARY	3
NECESSITY OF METERS	3
TYPES OF WATER METERS	4
METER USE AND APPLICATION	5
METER CALIBRATION AND REPLACEMENT PROGRAMS	5
<i>Part 2: CRITICAL ELEMENTS OF EPD WATER METERING PROGRAM</i>	6
<i>Part 3: WATER METERING REPORTING AND TRACKING FORM</i>	8

**Georgia Environmental Protection Division  
Watershed Protection Branch**

# Guidance Document

## Meter Calibration, Repair and Replacement Program

Developed by the Georgia Environmental Protection Division (EPD)  
To support the “Coastal Georgia Water and Wastewater Permitting Plan for Managing Saltwater Intrusion”

August 2007

This guidance document is intended for entities in the 24-county area of Georgia’s coast addressed in the “Coastal Georgia Water and Wastewater Permitting Plan for Managing Saltwater Intrusion”, located in Sub-Regions 1, 2 and 3, that are:

- Private Industrial Transient and Non-Transient Non-Community Water Systems (TNCWS and NTNCWS) with an Operating Permit and a Water Withdrawal Permit;
- Private Industrial Transient and Non-Transient Non-Community Water Systems (TNCWS and NTNCWS) with ONLY an Operating Permit;
- Privately Owned or Operated Public Community Drinking Water Systems with ONLY an Operating Permit;
- Public Community Water Systems (CWS) with Water Withdrawal and/or Operating Permits;
- Governmentally Owned or Operated Public Drinking Water Systems with an Operating Permit; or
- Governmentally Owned or Operated Transient Non-Community (TNCWS) or Non-Transient Non-Community Public Water Systems (NTNCWS) with either an Operating Permit and/or a Withdrawal Permit.

It is designed to guide the development and implementation of a meter calibration, repair and replacement program.

**When to use this guidance document:** For most Upper Floridan aquifer groundwater use or withdrawal permittees in the coastal counties of Georgia, a special condition of all new or modified permits will be development and implementation of a water conservation education program. Permittee must adopt a meter calibration, repair, and replacement program and submit a copy of that program to the appropriate EPD District Office (either Savannah or Brunswick) no later than 12 months from the permit issue date. The adopted metering program must include: (1) a schedule for installing meters for all water supply sources and service connections that are not currently metered; and, (2) annual calibration for meters for those users representing at least the top 10% of water users. This program must be updated at intervals determined by EPD.

**How to use this guidance document:** This guide is organized into 3 parts: Part I: Overview of Program – Provides a summary of the program, the applicability of the program, and the criteria to determine the implementation status of the program. Part II: Description of the Program – Provides a detailed discussion of all aspects of the program and related compliance requirements. Part III: Forms – Provides a form for reporting and tracking the implementation of the water-metering program.

**EPD Contact:** If you have any questions, or require additional information, please contact the EPD Drinking Water Program, at 404-656-2750. As the July 2006 Coastal Permitting Plan is implemented, EPD will welcome feedback from permittees regarding this guidance document.

# Part 1: OVERVIEW OF WATER METERING

## SUMMARY

Water use metering is an essential element of efficiency and conservation management, and is necessary in order to conduct a system audit. Metering is a requirement for loss control, accounting and rate making, verification of water and cost savings, and the evaluation of the effectiveness of efficiency and conservation measures. Metering must be provided at all important water production processes and delivery locations including at the supply source, at critical in-plant control points, at wholesale delivery points, and at service connections. An effective metering program allows comparison of measured flows in the system and metered deliveries to customers, which can be used to identify leaks.

Water meters not only help utilities collect the revenue they are due, they also help pinpoint leaks, locate pressure problems along their waterways, and identify and study periods of peak and non-peak use among both residential and business consumers. But meters can only perform these feats if they are accurate. Unfortunately, water meters are not 100 percent accurate and can lose their sensitivity over time and fail to accurately monitor how much water businesses and residences are consuming. Inaccuracy in water use also results when the meters are outdated or in poor repair. This is a serious problem and needs to be addressed, promptly. Inaccurate water meters not only result in lost income for often cash-strapped utilities, they also prevent utilities from realizing the potential for greater savings. Without accurate meters, water and sewer departments cannot completely participate in some of the newest experiments and techniques designed to foster increased water efficiency. Accurate assessment of water usage is vital in keeping utility bills low and conserving water in drought conditions.

In order to assure water is being accounted for accurately, meters need to be selected, installed, operated and maintained using generally accepted industry standards. Meters should be regularly calibrated and tested in accordance with the manufacturer's recommendations or the guidelines recommended by the American Water Works Association (AWWA), *Manual for Water Meters-Selection, Installation, Testing, and Maintenance* (AWWA M6).

## NECESSITY OF METERS

Source and service metering are key components to a successful water use efficiency program. Accounting for use and loss in a water distribution system is critical. Proper accounting will allow facilities to make informed decisions on operations, maintenance, capital investment, and customer service programs. Water metering provides information about how much water is used by whom, where, and in which season. This knowledge can be used to improve management of the water system and to fairly charge customers for the water they actually use. Lack of metering undermines loss control, costing and pricing, and other conservation measures. The following topics should be carefully evaluated when developing a water - metering program:

**Source-water metering.** Knowing the quantity of water supplied to a water distribution system is critical for all water systems. All possible water sources must be metered to account for volume supplied to a water distribution system. Meters must be in convenient locations to allow for regular reading and calibration, and for other maintenance activities. If feasible, the volume of water supplied into the distribution system should be monitored on a continuous basis. This information will lead to a more comprehensive understanding of the water supplied to the system and will give useful information in determining the non-revenue water lost throughout the day. If a facility has two or more completely separate water distribution systems (i.e., no interconnecting water mains between systems), each should be metered and monitored separately.

**Service-connection metering.** Service-connection metering is needed to inform customers about how much water they are using. This allows suppliers to more accurately track water usage and bill customers.

**Public-use water metering.** All water provided free of charge for public use should be metered and read at regular intervals.

**Fixed-interval meter reading.** A program of fixed-interval meter reading is essential to determine the amount of non-revenue-producing water. Source meters and service connection meters should be read at the same relative time in order to facilitate accurate comparisons and analysis. Readings generally should occur at regular intervals, preferably monthly or bimonthly.

**Meter accuracy.** Water meters can be damaged and deteriorate with age, thus producing inaccurate readings. Inaccurate readings will give misleading information regarding water usage, make leak detection difficult, and result in lost revenue for the system. All meters, especially older meters, should be tested for accuracy on a regular basis. The system also should determine that meters are appropriately sized. Meters that are too large for a customer's level of use will tend to under-register water use. Meters should be able to accurately record the full range of expected flow rates.

**Meter testing, calibration, repair, and replacement.** After determining the accuracy of the metering system, the utility should provide a schedule of activities necessary to correct meter deficiencies. Meters should be recalibrated on a regular basis to ensure accurate water accounting and billing. Calibration provides a utility with valuable information on the accuracy of the quantity of water being supplied, leading to appropriate decisions on maintenance or replacement frequency.

## **TYPES OF WATER METERS**

Most commercially available water meters use one of three methods for measuring flow rates: displacement, velocity, and electromagnetic. A water utility needs to know the operating limits of each type of meter being used within the system so that the correct meter can be installed for each application.

**Displacement** metering is typically used for small to medium flow applications, such as measuring water use in residential or small businesses applications. In these meters, flowing water physically moves either an oscillating piston or a nutating (wobbling) disk. They also have built-in strainers that catch debris in the water stream that could damage the meter. Most displacement meters are less than 2 inches in diameter.

**Velocity**-type water meters use jets of water impacting on impellers that turn on their axle while moving a register. Like displacement meters, velocity meters are best suited for relatively small flow measurements associated with residential and small-business water use. Since they are not as accurate at large flow rates, they are usually restricted to water lines 2 inches in diameter or smaller. Velocity meters also have internal strainers to remove debris.

In high-flow situations where standard displacement and velocity meters cannot be used, *turbine* meters are appropriate. Similar to velocity meters, turbine meters measure flow by the rate of spin induced in an in-line turbine. Most often they are used in large industrial processes, firefighting, and entire community water distribution systems. Turbine meters can be installed in water lines as large as 12 inches in diameter.

When water flow rates are highly variable, *compound* meters, which have two measuring components for high flows and low flows can be used. To prevent backflow between the two, the meter is equipped with a check valve. As water flow rates drop, the pressure inside the meter falls and the check valve closes. This diverts the flow to the low-flow rate-measuring component (typically a velocity meter).

**Electromagnetic** flow meters use the electromagnetic properties of water instead of turning mechanisms to measure flow rates. The flow generates voltage as it crosses the force lines of a magnetic field. The strength

of this voltage translates electronically into water flow rates. They have no moving parts, which make them ideal for measuring wastewater flows, slurries, and other liquids with debris or contaminants that could damage a mechanical meter.

## **METER USE AND APPLICATION**

In general, water supply meters are used in the following area of applications.

A **raw water meter** measures the amount of water withdrawn from a water source, normally at the point of withdrawal. For surface water sources, it is normally installed at the high lift raw water pumping station; for groundwater systems at the well house. In systems with lengthy raw water transmission piping, a second raw water meter may be installed directly before the treatment facility to determine system loss in the raw water transmission piping.

A **production water meter** records the total amount of water produced and input into the distribution system. Production metering is best inserted just before water exits the treatment facility into the distribution system. Production metering is an essential operating parameter for treatment facility operation, and for distribution system operation and water accounting. Correct installation of production meters is important to maintain accuracy. Most manufacturers recommend that meters be installed on only straight runs of pipe. A total of at least ten and preferably fifteen pipe diameters of straight pipe should be in front (upstream side) of the meter, and there should be ten diameters on the downstream side of the meter. Meter companies have charts that list accuracy limits for each size and type of meter. For meters with high gallons per minute flows, it is even more critical that they maintain high accuracy.

**Source water meters** act as both a raw water meter for water withdrawal and a production meter for treatment and system operation. Little or no water is used between the water withdrawal point and the production point. Source water meter installation is recommended at the exit of the treatment facility.

**Distribution water meters** are used to measure water movement within the distribution system. Obtaining and analyzing demand profiles in distribution systems can provide valuable information to improve operational factors, such as pumping and storage facility management. System flow profiles, reservoir balancing, and real water loss calculations can be achieved with distribution system metering. Distribution metering should be installed at the following key points within a water system:

- Municipal boundaries — Any boundary between utilities, where water is imported or exported outside the jurisdiction should be metered.
- Distribution facilities — These include pumping stations, pressure reducing facilities, and storage facilities.
- Pressure Management Areas (PMA) — Boundaries between service areas or districts having different water pressure should be metered. This allows the utility to monitor input flows and demands, and identify areas within the entire system that may require more attention with respect to real water losses.

## **METER CALIBRATION AND REPLACEMENT PROGRAMS**

Water meters tend to deteriorate with age, resulting in inaccurate readings. Often meters are often damaged or do not record water use at all. Inaccurate readings result in inaccurate information about water usage which impacts system audits and leak detection efforts. Accounting for all water should be the number one priority for a utility. Implementation of meter replacement programs will not only show a decrease in apparent loss, but an increase in revenue.

A public water supplier should implement a program to test all system meters at regular intervals. The water supplier should also ascertain that meters are appropriately sized, as oversized meters tend to under-record actual water use. To ensure meter accuracy, the utility should establish a meter-testing program, or follow the guidelines recommended in the American Water Works Association (AWWA) standards (C700 Series) as summarized in "Water Meters - Selection, Installation, Testing, and Maintenance" (AWWA M6). In accordance with Manual M6, 95% of the meters scheduled for tests on a periodic basis should actually be tested, and at least 95% of the meters actually tested should register results within the accuracy limits specified for both normal and minimum test-flow rates.

In addition to a meter-testing program, a water supplier should develop a meter replacement program to replace or repair defective meters. Customer meters may need to be replaced at least once every 15 years, if not sooner. In accordance with AWWA Manual M6, a planned meter replacement program can be implemented over a given number of years, e.g., 10 percent of the meters each year over 10 years or 20 percent per year over five years, so that all replaced meters in the system will be the more-efficient, modern design.

Larger meters in the system and wholesale customer meters should be calibrated on a regular basis, as well as tested for accuracy at scheduled intervals. Ranges of meter accuracy should be in general conformance with the latest revisions of the AWWA and/or specific State Plumbing Code requirements. When an AWWA standard for a meter is not available, it should be demonstrated that the meter used is capable of measuring not less than 95% and not more than 105% of the water that passes through the meter. All meter tests should be documented and maintained by the water utility.

## **Part 2: CRITICAL ELEMENTS OF A COMPREHENSIVE WATER METERING PROGRAM**

Water suppliers must set forth a plan by which all water delivered is metered, including public buildings and water sold wholesale to other water suppliers. The utilities need to meter the volume of water entering the distribution system and accumulate historical data related to the volume of water used throughout the year to determine daily peak flows and maximum day peak flows. All metering devices used should meet the requirements of American Water Works association (AWWA) or other applicable standards.

Implementation of the comprehensive program submitted to EPD must consist of at least the following actions:

- 1) As a condition for all new permits, the water system must adopt a water meter calibration, repair and replacement program and submit an implementation schedule to EPD no later than 12 months from the permit issue date. The program prepared by the system must outline an implementation schedule to achieve 100 % metering of all water supply sources and service connections that are not currently metered and establish a program for annual calibration of meters for those representing at least the top 10% of water users.
- 2) All water system connections, including public buildings, must be metered. If a system is not fully metered, the water supplier must develop a meter installation program to achieve 100% metering of all water sources and service connections within 5 years. This implementation schedule must be submitted to the EPD's District Office for review and concurrence.

The prepared schedule should include milestones demonstrating steady and continuous progress toward compliance with the EPD's metering requirements. The *Meter Calibration, Repair and Replacement Program Tracking Form* (below), can be used to annually record and report progress on this effort. The water supplier must be able to report the status of its metering activities, when required by EPD.

Until a system is fully metered, the water supplier should implement activities to minimize water leakage in the distribution system (such as periodic leak detection and repair program to eliminate water losses – See EPD Guidance Documents “Industrial/Commercial Leak Detection and Repair Program” and “Water Loss Control Program”, available at <http://www.gadnr.org/cws/> ).

- 3) All new service connections must be metered when the service connection is activated, as well as all inter-connections used as permanent or seasonal sources.
- 4) New permittees must develop a program to test, calibrate, repair, and replace meters on a regular basis. The meters must be selected, installed, operated, calibrated, and maintained following generally accepted industry and manufacturer standards. At a minimum, the top 10% of water users must be identified and have their meters calibrated annually. Meter evaluation programs should have the following elements:
  - (a) Evaluate and replace older meters as scheduled. The meter replacement program should consider the recalibration or replacement of customer meters consistent with AWWA recommendations.
  - (b) Ensure that meters are appropriately sized. If a meter is too large for a customer, it will typically under-register water use, resulting in lower revenues. A regularly scheduled meter-testing program would ensure meter accuracy for the utility.
  - (c) Install master meters at all water sources (produced or purchased) and test at least once a year and calibrate as necessary to the printed recommendations of the meter manufacturer.
  - (d) Measure the volume of water delivered to water users on all meters installed on all direct service connections. The volume of water may be measured through a single meter for the following clustered entities, as applicable: campgrounds; recreational vehicle parks; buildings with multiple units; complexes with multiple buildings served by a single connection.
  - (e) Implement a program to test all distribution system meters at regular intervals. A protocol based on age of meter can be established for the testing and replacement frequency best suited for the utility. In accordance with the guidelines provided by the American Water Works Association (AWWA) Manual M6, 95 percent of meters scheduled for tests on a periodic basis should be actually tested. In addition, at least 95 percent of the meters actually tested should register results within the accuracy limits established for both normal and minimum test-flow rates.

The AWWA recommends that meters in service be tested, on average, as follows:

Meter sizes 5/8 in. to 1 in = Every 10 years

Meter sizes 1 in. to 4 in. = Every 5 years

Meter sizes 4 in. and larger = Every year

It is advisable to provide for more frequent tests of large meters on the basis that an error in their registration has a greater effect on customer equity, utility credibility and on revenue issues. Older meters and those registering the largest volume should be given priority, since they generally read low. Mechanical drive meters require more frequent maintenance and show increased wear tendency compared to magnetic drive meters.

- f) Read meters on a regular schedule. Regularly scheduled meter reading and prompt billing with rates that reflect amount of water used.
- 5) Based on the percent of sources and service connections metered, water systems should be classified into four different categories: Category A (Sources: 100% metered; Services: 100% metered); Category B (Sources: 100% metered; Services: 99%-95% metered); Category C (Sources: 100%; Services: 94% - 80%); and, Category D (Sources: 100%; Services: less than 80%).

# Part 3: WATER METERING REPORTING AND TRACKING FORM

## I. GENERAL SYSTEM INFORMATION

Reporting Period (Year)	
Water System Permit #	
Water System Name	
Water System Address	
Contact Person Name	
Contact Person Phone #	
Description of Water Use	

## II. SOURCES OF WATER SUPPLY

Please give amounts in gallons per minute (**gpm**), per day (**gpd**) or million gallons per day (**mgd**).

**Source Type:** SW = Surface supply, GW = Ground supply, P = Purchased supply

**Source Status:** R = Regular use, S = Standby use, E = Emergency use

Name of Source	Source Type	Pumping Capacity	Metered? (Check answer)	
			YES	NO
			YES	NO
			YES	NO
			YES	NO
			YES	NO

## III. WATER USAGE AND METERING

Total Number of Service Connections:	
Meter users by Category: Residential _____% Industrial _____% Commercial _____%	
Public _____% Other _____%	
Are all sources of supply (including major interconnections) equipped with master meters? YES _____ NO _____	
What percentage of your system is metered? _____%	How often are they read?
How many meters are recalibrated and/or replaced each year?	
In your regular metering program, check the items regularly performed:	
a. _____ Repairs	d. _____ Calibration
b. _____ Testing	e. _____ Check for tampering
c. _____ Replacement	f. _____ Other
Are your master meters calibrated annually? YES _____ NO _____	
Provide the most recent date each master meter has been calibrated: _____	
How often are large user (2" or larger) meters tested or calibrated? _____ Replaced? _____	
How often residential user meters tested or calibrated? _____ Replaced? _____	
Do you use an automatic meter reading system? YES _____ NO _____	
Do you have funds set aside for regular meter calibration, repair and replacement? YES _____ NO _____	

## IV. CERTIFICATION OF WATER METER CALIBRATION, REPAIR AND REPLACEMENT PROGRAM (To be signed by the owner or official of the water system operating this water system).

I hereby certify that the information provided on this form is true and accurate to the best of my knowledge and belief.

Date: \_\_\_\_\_ Signature: \_\_\_\_\_ Title: \_\_\_\_\_