Chapter 11 -- National Handbook of Recommended Methods for Water Data Acquisition

11.C. PUBLIC WATER SUPPLY

11.C.1. Description

Public water supply refers to water withdrawn by public and private water suppliers and delivered to users. Public water suppliers provide water to domestic, commercial, and industrial users, to facilities generating thermoelectric power, for public use, and occasionally for mining and irrigation. The Standard Industrial Classification (SIC) code for this category is 4941. A public water supply is a public or private water system that provides water to at least 25 people or has a minimum of 15 service connections. Examples of public water-supply systems include those that serve cities and towns, military bases, apartment complexes, and large mobile home parks.

The water-use activities in the public water-supply category include water withdrawal from ground and surface water; instream conveyance to and from reservoirs and canals; consumptive use, as evaporation during open storage or conveyance; raw and finished water storage; purchases from other public water suppliers; treatment; and distribution to other public water suppliers and to various users (figure 3).

Small public water-supply systems have water from a few wells pumped to an elevated tank from which water flows by gravity through a distribution system to users. As the population served by the public water-supply system increases, or as local ground-water supplies prove inadequate to meet the needs of the population served, surface water is used, either in place of or in addition to, the wells. Treatment plants are used much more frequently when surface water is a source of supply. Increasing average daily demand (ADD) on the public water supply system necessitates the development of larger sources, storage facilities, and distribution systems until the system depicted in figure 3 begins to emerge. Large public water-supply systems can be complex and incorporate many reservoirs from which withdrawals are made from one reservoir (or from several independent reservoir systems), from wells, well fields, or even springs.

Consumptive use occurs primarily through evaporation from open reservoirs and canals as water flows through the system and is very significant in arid areas or areas with large open water bodies. Water treatment can range from a simple system of no treatment, simple chlorination, addition of corrosion control chemicals, to a more complex system that adds coagulation, flocculation, sedimentation, and filtration. Water used in backwashing filters or other sanitary operations is either released into wastewater-collection systems or returned to the hydrologic system. After treatment, water usually is sent to finished water storage or directly into the distribution system.

Distribution includes deliveries to (1) other water suppliers (wholesale); (2) domestic, commercial, industrial, thermoelectric, mining, and agricultural users (retail); (3) public use, such as in municipal buildings and parks or for street washing, fire fighting, and hydrant and system flushing. Unaccounted for water in the distribution system is the result of leaks, unauthorized use, or inaccurate meters.

Figure 3. Diagram of public water supply.

Seasonal variation in public water supply can be as important a factor as the total volume used over a year. When the climate has little variation over a year, seasonal variations in use generally are minimal. But in areas of strong climatic seasonal variation, the volume of use during the summer months can be an order of magnitude or more higher than the volume of use during the winter months. There are two factors that influence seasonal use: (1) the summer increase of outdoor use, such as lawn and garden watering, pools, and car washing; and (2) the influx of vacationers on the beaches or mountains during the summer and on the ski slopes during the winter.

Many cities are currently (1995) mandating the use of water-saving devices, raising water rates, and implementing restrictions on water use because of extended droughts or the need to keep demand within the safe yield of the system. The Greater Boston Metropolitan Area dramatically increased the reliability of their water system through conservation. The area served by the Massachusetts Water Authority experienced nearly a 20 percent decline in water use from 1988 to 1992, as a result of leak detection programs, domestic conservation programs featuring public education and retrofit low-flow fixtures, conservation consulting services provided to industrial and commercial users, and rate increases for water supply and wastewater treatment. A detailed water-demand analysis of future water use in the City of Boston shows that a combination of changes caused by new regulations will further result in substantive reduction in water demand over the next 25 years or so despite increased population.

Measured or estimated public water-supply data are the rate of (1) withdrawal by source; (2) release into distribution system; (3) deliveries to other water suppliers, and to domestic, commercial, industrial, irrigation, and thermoelectric users; and (4) estimated unaccounted for use. Other relevant data include the population served and the number of service connections.

11.C.2. Sources of public water-supply information

Sources of public water-supply information are (1) the State agency responsible for water-use data collection in support of an allocation or resource-management program; (2) the State agency responsible for compliance of the USEPA's Safe Drinking-Water Program, (3) the State Health Department, and (4) Rural Water Associations. Data collected by these agencies may include detailed field inventories of all public water suppliers and monthly flow and treatment sheets for surface-water sources. Public water-supply data also may be obtained from those States that have river basin commissions or agencies that oversee the development of water conservation or emergency plans.

The USEPA maintains the Public Drinking-Water Supply File in the Federal Reporting Data System (FRDS), which contains information about population served and water sources for facilities that serve at least 25 people or have a minimum of 15 service connections. Community supplies are those that supply drinking water to other users. Non-community supplies that are non-transient include prisons, county homes, boarding schools, nursing homes, and colleges and universities with dormitories. Non-community supplies that are transient include self-supplied commercial or industrial business that provides drinking water during business hours.

Information on some of the largest public water suppliers may be available through the American Water Works Association. Occasionally, public water-supply information may be available from reports by consulting firms or USGS studies. The Public Utilities Commission frequently collects data on a number of public water suppliers that are subject to their authority (which varies from State to State). Data on reservoir evaporation usually are estimated based on evaporation rate and reservoir area.

Information on public water supply deliveries can be obtained from individual public water suppliers or derived from data available from the U.S. Bureau of the Census. Information about the volume of water delivered to users can be obtained from the water supplier as well as information about water-supply withdrawals. Water suppliers may include in their billing systems the number of connections and volume of water delivered to domestic, commercial, and industrial users. Many public water suppliers divide customers into large and small users on the basis of criteria that are specific to the utility. Large users commonly are classified as "industrial" because of meter size rather than by the amount of water used. It is important to maintain consistency when identifying the types of users in each category whenever data are combined from different water suppliers.

11.C.3. Measurement, estimation, and data-collection methods for public water supply

The first step in water-use data collection is to determine required data elements, level of accuracy, and available resources to complete the work. Although this section will provide guidelines in obtaining all the data listed at the end of the "Description" section, individual projects may require only a subset of the data. Information on withdrawal by source and release into the distribution systems generally are available, but deliveries to users and unaccounted for use are difficult to obtain and are frequently estimated. Data also may be collected on release of treatment wastes either into the wastewater-collection system or as return flow.

The task of identifying public water suppliers is fairly easy--lists can be obtained from the State agency responsible for the program that supports the Safe Drinking Water Act. Some of the geographic and hydrologic data are stored in USEPA's Public Drinking-Water Supply File in the Federal Reporting Data System (FRDS). Most large public water suppliers meter their withdrawals and the volume of water sold to customers, especially to other water suppliers, and are likely to be automated. Metered data will be less available as the public water supplier decrease in size. In addition, detailed data available from State agencies on public water suppliers will decrease as the size of the public water supplier decreases--State agency resources will be used toward the largest public water suppliers that have the greatest impact on the water resources. However, the availability of data, even automated data, does not necessarily mean that the data are immediately usable. The State data must be analyzed to ensure that the data are consistent with project requirements. For example, determining if the water suppliers definitions of domestic, industrial, and commercial users are consistent with the project definition.

The first step in working on public water-supply data is to acquire data from State or Federal agencies and evaluate it. Then determine which data are still required and the best method for obtaining them.

11.C.3.a. Primary data acquisition

Most large public water suppliers are metered so measurement by project staff is unnecessary. If time and resources permit, field verify some of the large users and measure some of the small users to obtain coefficients for other small users.

11.C.3.b. Secondary data acquisition

Public water-supply data usually are reported to one or more State agencies, including agencies responsible for the allocation program (if any), compliance to the Safe Drinking Water Program (most States); State public health, water conservation, or emergency planning (drought or disasters). The USEPA maintains the Public Drinking-Water Supply File in the FRDS which contains information about population served and water sources for facilities that serve at least 25 people or have a minimum of 15 service connections. The Public Utilities Commission frequently collects data on a number of public water suppliers that are subject to their authority (which varies from State to State). Public water-supply information can be obtained from public water suppliers by cooperator surveys. Estimates of withdrawal and per capita use data, by county and hydrologic unit, are available from USGS District offices.

In general, data obtained from any of the above sources should provide a fairly comprehensive list of automated identification, geographic, and hydrologic information for public water suppliers, and in some cases, data on the rate or volume of withdrawal from each source. The data need to be checked for consistency and completeness. Data also may be available on the amount of water released into the distribution system, deliveries to groups of users, and unaccounted-for water use. Frequently, these data are not developed from uniform criteria and will need to be analyzed carefully before being incorporated into the project data base. Requesting a list of the public water-supplier's largest users (customers) to accompany the breakdown of deliveries may help resolve any inconsistencies.

Careful analysis of metered water-use data is critical; the data may be unreliable because of inconsistent record-keeping or because there is no meter-replacement or meter-calibration program to ensure meter reliability. Many public water suppliers divide customers into large and small users, frequently on the basis of criteria that are specific to the utility and may reflect past, current, or anticipated volumes delivered to users. Although large users are commonly classified by the utility as "industrial" because of the meter size, the actual use of the water may be for industrial, commercial, or domestic purposes. Check with the utility on how they subdivided deliveries and determined unaccounted-for water. Water sold to other water suppliers or released into the distribution system usually are based on readings from master or main meters and generally are reliable.

11.C.3.c. Derived data

Although public water-supply water-use data generally are abundant, the following data may need to be estimated: (1) withdrawal for small public water suppliers; (2) deliveries to domestic, industrial, commercial, and other users, including thermoelectric power companies, mining operations, and irrigators; (3) public use; and (4) unaccounted-for use. Previous research has been done to estimate current and future public water-supply demands (Davis and others, 1991, and Franklin and Maidment, 1986). Coefficients found in water-use literature also can be used to estimate withdrawals. These coefficients include gallons per connection, rates of per capita use, population per household, and employment, housing, and income trends. Deliveries and withdrawals can be estimated using coefficients based on population data or from deliveries and withdrawal of a public water supplier with similar population and types of water users.

References that document water-demand-forecasting models (Davis and others, 1991) contain tables of water-use coefficients that can be helpful when estimating water use in the absence of actual historic water-use data. The limitations of water-use-forecasting models as discussed by Dziegielewski and Boland (1989, 1990) and Wilson and Luke (1990) should be well understood before they are used.

Public use and unaccounted-for use combined are frequently estimated as the difference between water released into the distribution system and deliveries to billed customers. When this occurs, the two groups can't be separated and are referred to as public use and losses. Public use and losses by State ranged from 3 to 41 percent, and averaged 14 percent of public water supply withdrawals in the United States in 1990 (Solley and others, 1993).

11.C.3.d. Quality assurance

Quality assurance of public water-supply water use commonly involves comparing (1) public water-supply withdrawal values with population-served values; (2) population served values reported by public water suppliers with those included in U.S. Bureau of the Census publications; (3) deliveries to domestic, commercial, industrial users, and public use and loss estimates with those of other public water suppliers, and determining the mean, mode, interquartile range, and standard deviation, and identifying and resolving outliers; and (4) public water-supply data with public wastewater-collection and return flow data.

11.C.4. Public water-supply selected references

These references are supplemental to the ones in the General reference Section.

American Association for Vocational Instructional Materials, 1982, Planning for an individual water system: Athens, Ga., 160 p.

Baumann, D.D., Boland, J.J., and Sims, J.H., 1981, The evaluation of water conservation for municipal and industrial water supply--illustrative examples: Fort Belvoir, Va., U.S. Army Corps of Engineers, Institute for Water Resources, contract report 82-C1, 356 p.

California State University, 1989, Water distribution system operation and maintenance, a field study training program, 2nd ed.: Sacramento, Calif., California State University, School of Engineers, 497 p.

-----1990a, Small water system operation and maintenance, a field study training program, 2nd ed.: Sacramento, Calif., California State University, School of Engineers, 530 p.

-----1990a, Water treatment plant operation, a field study training program, 2nd ed.: Sacramento, Calif., California State University, School of Engineers, v. 1, 659 p., v. 2, 673 p.

Clark, R.M., 1976, Cost and pricing relationships in water supply: American Society of Civil Engineers, Journal of the Environmental Engineering Division, v. 102, no. EE2, Proceedings, p. 361-373.

Clark, R.M., and Goddard, H.G., 1977, Cost and quality of water supply: American Water Works Association Journal, v. 69, no. 1, p. 13-15.

Dziegielewski, Benedykt, and Boland, J.J., 1989, Forecasting urban water use: The IWR-MAIN Model: Water Resources Bulletin, v. 25, no. 1, p. 102-109.

-----1990, Reply to discussion by Lee Wilson and Ron Luke of Forecasting Urban Water Use: The IWR-MAIN Model: Water Resources Bulletin, v. 26, no. 4, p. 699-707.

Franklin, S.L., and Maidment, D.R., 1986, An evaluation of weekly and monthly time series forecasts of municipal water use: Water Resources Bulletin, v. 22, no. 4, p 611-621.

Gallagher, D.R., and Robinson, R.W., 1977, Influence of metering, pricing policies and incentives on water use efficiency: Canberra, Australia, Australian Water Resources Council Technical Paper 19, Research project 72/42, 138 p.

Gibney, R.D., III, 1983, An analysis of urban water demand for southeast Florida: Gainesville, University of Florida, Water Resources Research Center, Publication 81, 212 p.

Holtz, D., and Sebastian, S., 1978, Municipal water systems--The challenge for urban resource management: Bloomington and London, Indiana University Press, 307 p.

Hutson, S.S., Morris, A.J., 1992, Public water-supply systems and water use in Tennessee: U.S. Geological Survey Water-Resources Investigations Report 91-4195, 74 p.

Jones, C.V., Boland, J.J., Crews, J.E., DeKay, C.F., and Morris, J.R., 1984, Municipal water demand--statistical and management issues: Boulder, Co., and London, Westview Press, 170 p.

Joseph, E.S., 1982, Municipal and industrial water demands of western United States: Journal of the Water Resources Planning and Management Division, v. 108, no. WR2, p. 204-216.

Lewis, K.C., Carriker, Roy, and Marella, R.L., 1981, Analysis of residential demand for water in the St. Johns River Water Management District: St. Johns River Water Management District Technical Report SJ 81-2, 107 p.

Litke, D.W., and Kauffman, L.F., 1993, Analysis of residential use of water in the Denver Metropolitan area, Colorado, 1980-87: U.S. Geological Survey Water-Resources Investigations Report 92-4030, 69 p.

Lofting, E.M., Davis, H.C., 1977, Methods for estimating and projecting water demands for water-resources planning. Climate, climatic change, and water supply: Studies in Geophysics, National Academy of Sciences, 49 p.

Maidment, D.R., and others, 1985, Analysis of daily water use in nine cities: Austin, University of Texas, Center for Research in Water Resources, Bureau of Engineering Research, Technical Report 201, 64 p.

Marella, R.l., 1992, Factors that affect public-supply water use in Florida, with a section on projected water use to the year 2020: U.S. Geological Survey Water-Resources Investigations Report 91-4123, 35 p.

Seidel, H.F., 1985, Water utility operating data--an analysis: American Water Works Association Journal, v. 77, no. 5, p. 34-41.

Wallace, L.P., 1987, Water and revenue losses--unaccounted for water: Denver, Co., American Water Works Association, 182 p.

Wilson, Lee, and Luke, Ron, 1990, Discussion on forecasting urban water use: The IWR-MAIN model by Benedykt Dziegielewski and J.J. Boland: Water resources Bulletin, v. 26, no. 3, p. 527-533.

PREVIOUS CONTENTS NEXT