CHAPTER 5 WATER DEMAND REQUIREMENTS

A fundamental consideration for the sizing of any water system, or its component parts, is an estimate of the amount of water expected to be used by the customers on the system. This chapter is intended to provide basic, conservative, water demand design criteria which may be used in the absence of any more appropriate information. The preferred criteria for design estimations of water demand requirements is (in order of preference per WAC 246-290-221):

1. Reliable metered water use records;
2. Comparable metered water use data from analogous water systems; and
3. Criteria as presented in this chapter.

5.0 Applicability

The design estimates for water demands presented here are usually associated with specific projects dealing with additions to existing systems, or development of new systems. The design engineer should recognize that the design criteria presented here may contrast with that associated with longer-range demand forecasting methodologies, such as presented in the DOH/Ecology document entitled ***Guidelines and Requirements for Public Water Systems Regarding Water Use Reporting, Demand Forecasting Methodologies and Conservation Programs*** (***Conservation Planning Requirements).*** The intent of this Chapter is to provide criteria or direction for specific projects for which a water use demand (primarily residential) estimate will be needed. This Chapter addresses the design quantity associated with residential demands and selected demands for transitory use facilities. Demands associated with non-residential uses, although discussed, will need to be estimated by other means. (See DOH/Ecology ***Conservation Planning Requirements*** for additional information.)

5.1 Estimating Demands vs. Actual Water Use Data

Design of water systems requires estimates of expected water demands applicable to the sizing of system pumping equipment, transmission and distribution lines, and storage facilities. Estimating water demands (i.e., average day, maximum day, and peak hourly demands) may be complex and involves consideration of a number of factors such as: **climatic influences** (evaporation, evapotranspiration, temperature, precipitation, wind, etc.); socioeconomic **influences** (property values, economic status, residential densities); degree **of recreational or seasonal uses**; **service water pressures**; **extent of metering**; **pricing schedules**; **historic water uses for the development or the area**; **land use and zoning capacity**; **condition of the distribution system** (leakage rates, corrosion problems, etc.); and **conservation practices**.

There is usually insufficient data to account for all the factors that may influence the water demands of any particular water system. Water use records from existing systems *considered to be comparable to the system being designed* may sometimes be used to estimate demands.

However, caution needs to be exercised with this approach. It would be applicable only if the proposed system were to be developed and used in a manner essentially identical to an existing, analogous system. When existing system data is unavailable, or if there is uncertainty regarding existing demand data (the quality of the data may be suspect), then use of generally applicable design criteria, as presented here, would be appropriate.

NOTE: *There is no substitute for reliable and accurate meter records of water usage for estimating future demands. Whenever reliable information can be secured relative to water demand in a given system, the design engineer is expected to use that information for the water system design. All public water systems are required to have totalizing source meters per WAC 246-290-130(4)(g).*

5.2 Residential Water Demand Design Criteria

A 1994 - 95 DOH assessment of residential water demands (commercial and industrial demands were not specifically addressed), was conducted in Washington to provide basic information about water demands that would be useful for water system designs (see Appendix D for details of the assessments and data analysis)**.** From these assessments, two factors emerged which could be correlated to water demands. For single family residential systems, it was observed that average annual water demand appeared to be related to average annual precipitation levels and, to a lesser and more poorly defined degree, lot size.

5.2.1 Calculating Residential Water Demands

The following equations were developed to calculate water demand on a per residential connection or equivalent residential unit (ERU) basis. To calculate total system demand, multiply the “per unit" demand by the total number of ERUs to be served. Chapter 6 of this manual provides guidance for determining ERUs.

5.2.1.1 Average Day Residential Demands

The function that describes the relationship between precipitation levels in an area and the estimate of residential water demand is given by Equation 5-1 below (see Appendix D for development details). This equation is intended to be used in conjunction with any additional information the design engineer may have for the project being considered.

Equation 5-1:

$$ADD = \left(\frac{8000}{AAR}\right) + 200$$

Where: ***ADD*** = *Average Day Demand, (gallons-per-day/ERU)*

AAR = *Average Annual Rainfall, (inches-per-year)*

Equation 5-1 is to be used with rainfall records for the area in which a project is being proposed. When estimating water demands, actual precipitation records for the area should be used. Precipitation records and locations of the numerous rain gauge stations in Washington state are available from the National Oceanic and Atmospheric Administration (NOAA)/ National Climatic Data Center (NCDC), (Climatological Data Annual Summaries and County Extension Offices). The NCDC may be reached at (828) 271-4800. The precipitation data for Washington State is also available on-line via the Internet at:

http://www.ncdc.noaa.gov/

The recommended Internet website for precipitation and temperature data is that of the Western Regional Climate Center (WRCC) at:

http://www.wrcc.dri.edu/summary/climsmwa.html.

This site includes a map of all climatic data stations in Washington, as well as tabular and graphical summaries of historical climatic data available for each station. The WRCC may be reached at (775) 674-7010 or Fax (775) 674-7016.

5.2.1.2 Maximum Day Residential Demand

Water system source, treatment, and storage facilities **must** be designed such that, together, they provide the maximum day demand (MDD) for the system (WAC 246-290-222). Depending upon how the system is designed and operated, however, the source alone may not be able to provide the MDD. DOH **recommends** that the system be designed such that the source alone be able to meet, and preferably exceed, the widely used and accepted standard of MDD. Larger storage tanks, with corresponding greater residence times of stored water, are more susceptible to water quality problems such as stale water, warmer water in the summer, and biological growth. When a system relies on storage to meet MDD, the impact on system users will be significantly greater if the volume of storage constructed is underestimated. It should also be noted that the more a utility relies on storage rather than source to meet MDD, the longer it will take the utility to replenish storage once it is depleted. Fire protection authorities generally recommend the ability to replenish fire suppression storage within a 24-hour period after it is depleted. This may not be possible during periods of high demand if the source cannot provide flow rates equal to or exceeding the MDD.

To determine MDDs from data on ADDs, literature data coupled with documented experience for various water systems in Washington have provided support for ratios of "maximum to average day" demands in the 1.5 to 3.0 range. Selection of a conservative approach for determining ADDs (see Appendix D), as was done for Equation 5-1, would support the use of a peaking factor of 2.0 as a multiplier to the ADD calculated from Equation 5-1. Therefore, Equation 5-2 (below) should be used to calculate the MDD.

Equation 5-2:

MDD = (2)(ADD)   (ADD not to exceed 1000 gpd/ERU)

Where: ***MDD*** *= Maximum Day Demand (gallons/day/ERU)*

ADD *= Average Day Demand (gallons/day/ERU)*

NOTE: ***Although the reported data showing ADD versus Average Annual Rainfall (AAR) in Figure D-1 of Appendix D indicates several values in excess of 1000 gpd/ERU, the majority of the data were below this level in the low rainfall areas. Therefore, the analysis of the relationship between ADD and AAR established an upper boundary value of 1000 gpd/ERU for the ADD. This was considered justifiable on the strength of the data, which was weighted heavily below this upper level, and with the rationale that very few instances would arise where ADD levels for water systems would exceed 1000 gpd/ERU.***

5.2.1.3 Residential Density Considerations (Minimum MDDs in higher rainfall areas)

Although lot size is both intuitively and demonstrably an influential factor in estimating water demands, there is currently insufficient correlative data for development of basic criteria useful for adjustments to the demand values of Equation 5.1. Therefore, no specific criteria are presented which associates residential demand with lot size. However, utility records throughout the state indicate a significant increase in maximum day demands for lot sizes in excess of one acre. It would be appropriate, unless evidence is presented which indicates a better design premise, to use **a maximum day demand (MDD) of 800 gpd/ERU for residential lots in excess of one acre, regardless** of any lower values that may be derived from Equation 5-2. Higher values calculated from Equation 5-2 would still apply. The design engineer should be cognizant of the significant influence that residential density has on water demands and take even higher estimates into serious consideration whenever a development is designed with large lots, and where no limits to irrigation uses will be imposed**.**

Caution: *Some design engineers have experienced situations where use of the historical sizing guidelines of 800 gpd/connection for MDD in western Washington and 1500 gpd/connection for*

MDD in eastern Washington were not adequate for the systems source and storage facilities once installed and in use. In a few isolated cases in western Washington the MDD has been observed to be as high as 2000 gpd/connection. In eastern Washington, the MDD for some systems has been observed to be as high as 8000 gpd/connection. In general, however, the historical sizing guidelines have been found to be adequate for most systems.

5.2.1.4 Analogous Systems

The analogous system approach allows a designer to use metered water use data from an existing water system to establish the water demand design criteria for a separate new system. Analogous water systems are defined as systems with similar characteristics such as similar demographics, housing sizes, income levels, lot sizes, climate, water pricing structure, conservation practices, use restrictions, and soils and landscaping [see WAC 246-290-221(1)(a)]. Demographics are data related to vital statistics of human populations such as size, growth, density, and distribution. Demographics change with the nature of the development. Population densities are different from single family to multi-family residences, from housing provided for families to housing provided for singles or senior citizens/retirees, and from individual lots to mobile home park type developments.

Housing sizes are usually directly linked to the income levels of the residents. Middle income residents typically occupy 1500 to 3000 sq. ft. homes with moderate sized lawns. Higher income residents occupy homes larger than 3000 sq. ft. with usually larger lots. With respect to water use, the greatest impact of income level is probably the extent and nature of, and investment in, the landscaping of the lot. To protect their investment and property values, these residents may use significant amounts of water.

Section 5.2.3 includes a recommendation for increasing water supply to lots greater than 2.5 acres in size (mainly in eastern Washington.) As indicated earlier, the major factor in water use related to larger lot sizes is in the irrigable area, such as lawns, gardens, and other agricultural uses. However, it is possible to have multi-acre tracts in western Washington with xeroscaping (use of native flora, rockery, and pavement) having very little irrigation need.

As shown in Appendix D, climate has a significant impact on water use. The analogous system should not only be evaluated for annual temperature and precipitation comparisons but also for monthly peaks. In areas where freezing temperatures are prevalent in winter, water use should be closely evaluated. Some systems may see higher demands as users allow faucets to run to prevent freezing. Also, a system serving winter use activities, such as a ski resort, would normally expect water demand to increase during this time period.

Water pricing structure relates to the use of ‘inclining block rates’ versus ‘declining block rates, both of which would require the use of individual meters, or ‘flat rates’ where meters may not be needed. If the analogous system has individual service meters, it is expected that the system being designed would also be required to have service meters. In addition, the pricing structure for the analogous system would need to be applied to the system being designed if the water demand estimates were to be truly applicable.

Conservation practices of an analogous system should be applied to the system being designed. These can include, but are not limited to, alternate day watering schedules, installation of low water use fixtures, toilet tank displacement devices, leak detection and other unaccounted water demand reduction programs. Use restrictions relate to voluntary and/or mandatory curtailment measures requested of the consumers. These may be identified in community covenants, bylaws, local ordinances, or on property deeds**. It is very important to determine if the restrictions are enforceable.** *(A legal opinion may be necessary to determine equivalent enforceability.)*

Both the types of soils and landscaping have an impact on irrigation rates. Sands and gravels differ from loams, silts, and clays with respect to moisture retention and evaporation losses. Designers should check with the local county Cooperative Extension office to determine and evaluate any variability that may have an impact on the water demands for the system being designed. It should be recognized that landscaping demands depend largely upon whether natural flora or more water-dependent plants are to be used.

The designer should also consider the analogous system's utility maintenance practices, such as the frequency of, and volume of water used for line flushing, exercising hydrants and valves, and cleaning tanks, etc. as well as the time of year that these activities are typically performed.

When considering water demand data, it is important to realize that water usage patterns are usually unique for a particular system for more reasons than the criteria presented above or in Section 5.1. A water usage pattern may also be unique because of the individuality of consumers on the system, their expectations to be able to use water whenever and however they wish (since they are paying for that privilege), and how well community, cultural, or societal desires influence or impact these individuals. If most consumers in a community subscribe to common goals on water use, water demand limits may be achieved voluntarily. If, however, more consumers on a particular system resist impositions to what they consider to be normal usage and an acceptable standard of living, the limitations on use may depend on the success or ability of the community to enforce applicable local codes or covenants.

It is nearly impossible for the design engineer to predict the mind-set or conservation ethic of new consumers on a water system relative to water use. When designing a system based upon analogy to another system, DOH recommends a conservative factor of safety concerning water demand estimates, even if the proposed new system incorporates all enforceable conservation practices and use restrictions utilized by the identified analogous system. It may be prudent to discuss this design approach with the appropriate DOH engineer early in the design phase of a project.

5.2.1.5 Demand Criteria for Analogous Systems

An examination of Figure D-1 in Appendix D shows that the residential average daily demand (ADD) seldom drops below 200 gpd/ERU, regardless of rainfall levels, and when it does, it does so only marginally. Such a baseline most likely approximates the indoor household uses and would not be subject to the variability that could be expected with external uses that are more relative to rainfall levels. Although a baseline of 200 gpd/ERU may appear to be established for basic average water demands by households throughout the state, it should be recognized and expected that peak water demand days can still occur. For systems with separate irrigation lines, household events associated with entertaining visitors, extended stays of visiting company, increased showering and air conditioning in the summer, and so forth can still create demands that would be in excess of the average. For systems without separate irrigation there may well be peak day demands during dry periods that are comparable regardless of rainfall patterns. Quantification of such peak day demands for internal uses is difficult and not well founded by published reports or empirical (or anecdotal) data.

When designing on the basis of an analogous system, a lower limit for the maximum day demand (MDD) value is established at 350 gallons/day/ERU (WAC 246-290-221). Even though this is somewhat less than what would be calculated using Equation 5-2 (a doubling of the average daily demand), it is consistent with the Department of Ecology's position regarding household water uses when water rights allocations are being decided for developments which restrict outside irrigation uses. Even with the 350-gpd/ERU threshold, the designer must still provide metered water use records from the analogous system that support the water demand design criteria used for the new system.

There may be some projects for which sufficient information (meter records) has been collected and verified to support a maximum day demand of less than 350 gallons/day/ERU. That data may only be used in support of expansion for that specific water system [WAC 246-290-221(2)].

NOTE: *The design engineer should always discuss the design basis with the project proponent to determine if some specific factor of safety (relative to the nature of the project) is needed, and what that factor should be. The designer and the client should also be clear about: 1) the best way to communicate realistic expectations for service to the lot purchasers in the development, and 2) how to convey the message of any constraints regarding water usage of which water users should be apprised, even to the extent of requiring notice on property titles or other appropriate notification to lot owners or system users.*

5.2.2 Calculating Residential Peak Hourly Demand (PHD)

Sizing equalizing storage, transmission and distribution lines, and some pumping facilities requires use of peak hourly demand (PHD) estimates. As explained later in Section 8.1.5, the system must be able to provide PHD at a minimum of 30 psi throughout the distribution system. In the absence of documented information (existing meter records, reported values for an analogous system, etc.), the following generalized equation should be used for determining PHD flows. This equation has been developed to be consistent with the maximum instantaneous demand (MID) values which were presented in previous editions of the state's design guidance manuals ("Red Book of 1978" and "Blue Book of 1984"). The equation has also been structured to accommodate the ranges of peak hourly to MDD ratios reported as a function of system size in the literature and by various water systems in Washington.

The generalized equation for PHD determinations is:

Equation 5-3:

$$PHD = (MDD/1440)[(C)(N) + F] + 18$$

Where:
PHD = *Peak Hourly Demand, (gallons per minute, gpm)*
C = *Coefficient Associated with Ranges of ERUs*
N = *Number of Service Connections, ERUs*
F = *Factor Associated with Ranges of ERUs*
MDD = *Maximum Day Demand, (gpd/ERU)*

Table 5-1 identifies the appropriate coefficients and factors to substitute into Equation 5-3 for the ranges of ERUs:

Table 5-1

Range of N (ERUs)	C	F
15 - 50	3.0	0
51 - 100	2.5	25
101 - 250	2.0	75
251 - 500	1.8	125
> 500	1.6	225

5.2.3 Adjustments of Peak Hourly Demand (PHD) for Lots Greater than 2.5 Acres in Locations Receiving an Average Annual Rainfall of 20, or fewer, inches/year

Additional PHD flows should be determined, in the absence of any other available information, for water systems located in areas receiving 20, or less, inches of rainfall per year (mostly east of the Cascade Mountain Range) which:

1. Do not have a separate irrigation system available for each lot; and
2. Have lot sizes equal to, or greater than, 2.5 acres.

An additional flow of 10 gallons per minute (gpm) should be added to the calculated PHD for each acre to be irrigated in excess of the base value, calculated as the product of 2.5 times the number of connections.

If irrigation is not permitted on more than 2.5 acres per connection, or if additional management controls are instituted, then such information should be noted on restrictive covenants, water user agreements, or some other legally enforceable agreement between the lot owner (or water customer) and the water system. This information is important to present when requesting system approval.

5.2.4 Adjustments Based on Documented Water Use

DOH may adjust the source and standby storage design criteria for water systems that seek additional service connections by taking into account historical water use, system design peaking factors, and other factors outlined in WAC 245-290-200(2). However, there is no established formula or criteria for such adjustments, and any changes to standard source and standby storage design criteria should be justified by an analysis of historical water use as described in Section 5.3 - Documentation of Water Demand.

Any water system requesting an increase in the number of service connections may also be considered an '*expanding'* public water system. If this is the case, a Water System Plan (WSP) would be required in accordance with WAC 245-290-100(2)(d). Both the analyses of historical water use and, if required, the WSP **must** be prepared by a professional engineer and **must** address the elements identified in WAC 245-290-100(4).

5.3 Documentation of Water Demand

Whenever water system meter records are maintained and used for designs of future facility projects, there will be a need to justify the validity of such information to increase the confidence levels for their use.

5.3.1 Basic Elements to Consider with Water Demand Documentation

1. Additional services should be based upon actual water demand and cannot be justified solely by a commitment to implement a conservation program. The results of successful conservation efforts should be demonstrated by corresponding reductions in water use.

2. An analysis of historical water usage should be based upon meter readings covering a minimum of two, but preferably more, non-drought years. The meter readings should include daily use data for the peak usage time period and either weekly or monthly usage during the remainder of the year. The peak usage time period is typically several weeks

during the months of June through September for most community systems. However, a community system may experience peak use in winter when users allow their faucets to run to prevent freezing. Generally, source meter readings should be used to account for system leakage and other water uses associated with such activities as flushing mains, hydrants, or blow-offs, etc., which are not normally quantified**. The MDD figures will be considered validated when consecutive year determinations are within 5% of each other.**

Water demand data should be correlated with the number of full- and part-time residential service connections that were actually in use at the time the data was collected. Industrial, commercial, or other nonresidential water demands should be separated from residential demands in the analysis to allow the proper determination of design criteria in terms of Equivalent Residential Units (ERUs). See Chapter 6 for a detailed discussion of ERUs.

5.3.2 MDD from Limited Meter Records

In lieu of collecting daily demand data during peak usage months, a utility may reasonably have only collected weekly data during peak usage times. If so, the MDD may be determined by applying a reasonable multiplier to the daily average for the peak weeks rather than using Equation 5-2. The multiplier should be based on water use records from an analogous system or from research (documented studies). The weekly data collected should also be correlated to the number of service connections actually in service, as described in Section 5.3.1.

5.3.3 Anticipated Changes in Demand

Water demand computations should address anticipated changes in demand, such as:

1. An analysis should address how future water use patterns may change such as when vacation lots become retirement homes, or are sold as permanent residences in a phased plan for the development. The analysis should consider if commercial or light industrial activities associated with the build-out of the development are intended.

2. Information regarding precipitation levels for the area during the months that water use data was gathered is essential. Such data should be compared with historical records to determine whether the covered period was *above or below average*.

3. Adjustments to design criteria should reflect actual conditions, but should also provide a reasonable margin of safety for increases in demand that may be reasonably anticipated. To provide for uncertainties with some projects, the water system demand and standby storage may actually be greater than initially calculated by the design engineer. This could be the case for systems experiencing higher-than-expected growth rates, or for systems with historical problems with supply reliability, or when it is clear that the

system status (changing economics, demographic influences, etc.) has changed such that a higher demand for service becomes apparent.

5.4 Estimating Nonresidential Water System Demand

Nonresidential water demand is the water use associated with users other than residential (single or multifamily) users, and can include:

- Commercial facilities, including retail/wholesale businesses, restaurants, hotels, office buildings, and car washes;
- Industrial customers that require process water;
- Public facilities, such as schools, public hospitals, governmental offices, parks, landscaped roads, and cemeteries;
- Other large users, such as farms with irrigated crops; and
- Recreational users, including campgrounds, RV parks, seasonal rental units, etc.

This type of customers may fall into the category of "transient noncommunity" (TNC) or "nontransient noncommunity" (NTNC) water systems (see WAC 245-290-020), if they are not associated with a typical "community" public water system serving 15 or more residential connections. Whether associated with a "community" water system, or not, water demands for these customer classes should be determined differently than by applying residential design criteria. PHD, ADD, and MDD determinations may involve use of analogous system nonresidential use records, or meter records directly associated with the nonresidential use.

5.4.1 Procedures for Estimating Non-Residential Demands

The design engineer should calculate ADD and MDD using principles that reflect past experience with facilities or systems of similar size. Table 5-2 presents a summary of average water use as a guide in preparing water demand estimates. For some facilities, the maximum flow rate would be calculated by adding the peak flow rates of <u>all</u> fixtures. (Table 5-3 summarizes rates of flow for certain plumbing fixtures.) Special considerations, such as outdoor watering needs and fire protection requirements, should also be taken into account. Although Tables 5-2 and 5-3 offer reasonable estimates of average water demands for a variety of uses, other sources of information may be of greater value, or more current. The designer should review several sources of information in sequence to ensure local codes are adhered to, or that conservation practices that may be proposed for the development are accounted. The recommended sequence to followed is:

1. Use the Uniform Plumbing Code (UPC) for the area in which the project is to be built. Local jurisdictions may require UPC stipulations and they would thus govern the design.

2. Any specific water demand estimates that the Department of Ecology has prepared should be consulted to see if any of these estimates reflect adjustments for conservation practices that are being proposed.

3. The American Water Works Association (AWWA) should be consulted for any more recent information regarding updated demand estimates that may have been developed. This source would be especially important if current data (based on published reports and research) had been recently applied to estimates which reflected conservation practices, regional demographic changes, or other adjustments to previous tabulations.

4. After seeking information from the foregoing sources, and if appropriate information was not found to be available or accessible, then refer to Tables 5-2 and 5-3.

5. If no information for a project appears to be applicable after reviews of the foregoing, then the designer should contact the local DOH Regional Office to determine appropriate criteria that may apply on a case-by-case basis.

5.4.2 Commercial, Industrial and Public Facility Demand

Commercial, industrial and public facility categories of customers have a wide range of water demands. They can range from less than, to significantly more than, what a single-family residence might use. This is especially the case for large farm irrigation or commercial/industrial process needs. Tables 5-2 and 5-3 (or other reference documents) can be used as a planning guide for water use. These planning guides should be used in conjunction with documented water use records for either existing facilities within the water system, or from comparable uses found in other systems, when estimating water demands.

5.4.3 Farming and Crop Irrigation Demand

Water demands for farming and crop irrigation depend upon the type of farm and/or crop irrigated, as well as weather conditions and geographic location. Water use estimates based upon the type of farm, including the type and number of animals, and/or the crop irrigated should be determined with help from local extension agencies. It may be possible to find and use documented water usage records for various farm practices in the area. Table 5-2 provides some references regarding water use by type and number of livestock. Irrigation needs can be extremely variable and may require additional investigation. The design engineer may find the local County Extension Office useful in this regard.

5.4.4 Recreational Development Water Demand

The term ***recreational development*** is used to designate a variety of temporary locations intended for use by individuals and families away from their normal place of residence for vacations or holidays. They vary from simple campsites suitable for tents or trailers to elaborate communities of rustic housing provided with most, if not all, of the amenities of urban living.

Some recreational developments operate in a manner similar to a state campground, others operate on a membership basis, and others are sold lot-by-lot, as in an ordinary residential plat. Recreational developments may be eligible for reduced water system design criteria. Use of reduced design criteria will be considered if it can be shown that:

1. There are clearly defined sites for each occupant. Sites can be defined by surveyed lot lines, by permanent site markers, or by surveyed site center lines entered on a map which fixes the location of each site. The number of sites or lots is expected to be fixed for the total tract.

2. No permanent residence, no matter how small, how simple, or how rustic, is permitted on a site designated for recreational uses. Reduced criteria will only be applicable for those sites that are intended to be used solely for recreational occupancy. Developments that will be used, either totally or partially in a residential manner should be designed to accommodate appropriate residential demands.

3. It is the acknowledged purpose of the recreational portions of the tract to provide space for short-term or seasonal use only.

4. Satisfactory documentation of claims made with respect to items (2) and (3) above is presented to DOH. This may include a notation of the restrictions on the face of the plat or in covenants filed with the plat or in individual deeds.

Tables 5-2 and 5-3 (or other sources of information such as UPC criteria, Ecology wastewater flow tables, EPA guidance tables, etc.) can be used to estimate water uses for typical recreational facilities. These tables provide information related to typical peak daily water uses for the facilities referenced. However, the MDD requirement for recreational tracts with structures (i.e., cabins, houses, trailers, etc.) that can be used for short-term occupancy, and that may or would have internal plumbing, should be no less than 140 gpd per site or lot. Peak hourly flows are expected to be based upon a level that would provide at least 50 percent of the comparable residential PHD that would be associated with the size of the development. Recreational systems usually experience peak demands during summer holiday weekends, such as Memorial Day, Independence Day, and Labor Day.

Table 5-2:
Guide for Non-Residential Water Demand

Type of Establishment	Water Used (*gpd)*
Airport (per passenger)	3 - 5
Apartment, multiple family (per resident)	50
Bathhouse (per bather)	10
Boardinghouse (per boarder)	50
Additional kitchen requirements for nonresident boarders	10
Camp:	
Construction, semipermanent (per worker)	50
Day, no meals served (per camper)	15
Luxury (per camper)	100 - 150
Resort, day and night, limited plumbing (per camper)	50
Tourist, central bath and toilet facilities (per person)	35
Cottage, seasonal occupancy (per resident)	50
Club:	
Country (per resident member)	100
Country (per nonresident member present)	25
Factory (gallons per person per shift)	15 - 35
Highway rest area (per person)	5
Hotel:	
Private baths (2 persons per room)	50
No private baths (per person)	50
Institution other than hospital (per person)	75 - 125
Hospital (per bed)	250 - 400
Lawn and Garden (per 1000 sq. ft.)	600
Assumes 1-inch per day (typical)	
Laundry, self-serviced (gallons per washing [per customer]	50
Livestock Drinking (per animal):	
Beef, yearlings	20
Brood Sows, nursing	6
Cattle or Steers	12
Dairy	20
Dry Cows or Heifers	15
Goat or Sheep	2
Hogs/Swine	4
Horse or Mules	12
Livestock Facilities	
Dairy Sanitation (milkroom)	500
Floor Flushing (per 100 sq. ft.)	10
Sanitary Hog Wallow	100
Motel:	
Bath, toilet, and kitchen facilities (per bed space)	50
Bed and toilet (per bed space)	40
Park:	
Overnight, flush toilets (per camper)	25
Trailer, individual bath units, no sewer connection (per trailer)	25
Trailer, individual baths, connected to sewer (per person)	50
Picnic:	
Bathhouses, showers, and flush toilets (per picnicker)	20
Toilet facilities only (gallons per picnicker)	10

Type of Establishment	Water Used (*gpd)*
Poultry (per 100 birds):	
Chicken	5 - 10
Ducks	22
Turkeys	10 - 25
Restaurant:	
Toilet facilities (per patron)	7 - 10
No toilet facilities (per patron)	2-1/2 - 3
Bar and cocktail lounge (additional quantity per patron)	2
School:	
Boarding (per pupil)	75 - 100
Day, cafeteria, gymnasiums, and showers (per pupil)	25
Day, cafeteria, no gymnasiums or showers (per pupil)	20
Day, no cafeteria, gymnasiums or showers (per pupil)	15
Service station (per vehicle)	10
Store (per toilet room)	400
Swimming pool (per swimmer)	10
Maintenance (per 100 sq. ft.)	
Theater:	
Drive-in (per car space)	5
Movie (per auditorium seat)	5
Worker:	
Construction (per person per shift)	50
Day (school or offices per person per shift)	15

Source: Adapted from ***Design and Construction of Small Water Systems: A Guide for Managers, American Water Works Association, 1984, and Planning for an Individual Water System. American Association for Vocational Instructional Materials,*** 1982***.***

Table 5-3:
Rates of Flow for Certain Plumbing

Location	Flow Pressure[1] (*psi*)	Flow Rate [2,3] (gpm)
Ordinary basin faucet	8	2.0
Self-closing basin faucet (1)	8	2.5
Sink faucet, 3/8-inch (10-mm)	8	4.5 (2.5)
Sink faucet, 1/2-inch (13-mm)	8	4.5 (2.5)
Bathtub faucet	8	5.0
Laundry tub faucet, 1/2-inch (13-mm)	8	5.0
Shower	8	5.0 (2.5)
Ball-cock for water closet (2)	8	3.0 (1.5 gpf)
Flush valve for water closet (2)	15	15.0 - 40.0 (1.5 gpf)
Flushometer valve for urinal (3)	15	15.0 (1.0 gpf)
Garden hose, 50 ft (15-m) (3/4-inch [20-mm] sill cock)	30	5.0
Garden hose, 50 ft (15 m) (5/8-inch [15-mm] outlet)	15	3.33
Drinking fountain	15	0.75
Fire hose, 1-1/2-inch (40 mm) (1/2-inch [13 mm] nozzle)	30	40.0

Notes:
1. Flow pressure is the pressure in the supply near the faucet or water outlet while the faucet or water outlet is wide open and flowing. Flow pressure is measured in pounds per square inch.
2. Washington State 1993 Plumbing Code Standards shown in parentheses "( )".
   - (1) Lavatory by general public, excluding handicap stations, **must** have spring valve self-closing faucets.
   - (2) Includes Flushometer and Electrochemical hydraulic toilets.
   - (3) Urinals or water closets with continual flushing are not permitted.
3. gpf = gallons per flush

Source: Adapted from ***Design and Construction of Small Water Systems: A Guide for Managers***, American Water Works Association, 1984.

5.5 Water Demand Forecasting

Additional guidance on forecasting water demands is provided in DOH's ***Planning Handbook***, and a joint DOH/Ecology publication, *Conservation* ***Planning Requirements***. These documents, available upon request from DOH (see Table 1-1), are considered the preferred source of basic planning and forecasting methodology for the state.

5.6 Other Regulatory Considerations

The following are other regulatory requirements to consider when analyzing or estimating water demands:

5.6.1 Water Rights

Projected water demands consistent with the level of intended service should be compared against the water rights held by the purveyor. It is acceptable to install pumping equipment capable of producing flows in excess of current water right limits, provided that the discharge from the pump is flow-restricted such that permitted withdrawal rates are not exceeded. For specific project submittal requirements please refer to DOH Policy, *Determination of Water Rights Adequacy in Reviewing Construction Documents and Project Reports (Water Rights Policy).* This policy and the latest Water Right Self-Assessment Form may be obtained from the Regional Planner located in each DOH Drinking Water Regional Office. Also, see other sections of this document pertaining to water rights, including Section 1.7 in Chapter 1 and Section 7.0.2. in Chapter 7.

5.6.2 Water Conservation

The ***Conservation Planning Requirements***, available from Drinking Water Regional Offices, details water conservation requirements. As part of complying with the *Conservation Planning Requirements*, purveyors **must** have an approved conservation program. In cases where Water System Plans (WSPs) are required, the conservation plan is a component of the WSP [WAC 246-290-100(4)(d)(i)]. The conservation plan includes water use data collection, identification of conservation objectives, evaluation of conservation measures, identification of selected conservation measures chosen for implementation, and target water savings projections which are incorporated into the water demand forecast used to justify the need for additional water. Ecology may also have other requirements for obtaining water rights in addition to those listed above.

In cases where WSPs are not required, the conservation plan is a component of the Small Water System Management Program [WAC 246-290-105(4)(h)]. Plan requirements are commensurate with the size and complexity of the public water system.

5.7 General System Reliability

The design engineer **must** address all regulatory requirements associated with insuring system reliability, including sufficient source and storage capacity, pumping capacity, and hydraulic capacity criteria which apply to the water system.

The preface to this manual includes an extensive discussion regarding system reliability. The reader is additionally referred to the Water System Reliability Analysis section in Chapter 4 of the DOH *Water System Planning Handbook* for additional guidance on system reliability. Following is a summary of reliability recommendations made throughout this manual.

5.7.1 System Reliability Recommendations

Recommendations for source and system reliability are expressed throughout the various chapters of this manual. The following presents a brief summary of DOH recommendations that are intended to promote high levels of system reliability for service to customers

Source (reference to Chapters 5 & 7)

(1) Development of two or more sources of supply with a total capacity able to replenish depleted fire suppression storage within a 72-hour period while concurrently supplying the MDD of the system.

(2) Sources capable of providing the MDD for the system with 18 hours of pumping.

(3) With the largest source out of service, remaining source(s) able to provide a minimum of ADD for the system.

(4) Pump stations with power connections to two independent primary public power sources, or either portable or in-place auxiliary power available.

(5) The firm yield of surface water sources is that associated with the lowest flow and/or longest period of extended low precipitation on record.

Booster Pumps (reference to Chapter 10)

(1) Multiple pumps installed with such capacity that the MDD of the service area can be provided when the largest pump is out of service.

(2) Provision of a minimum of 20 psi at the intake of the pumps under PHD or fireflow-plus-MDD-rate conditions.

(3) An automatic shut-off in place for when the intake pressure drops below 10 psi.

(4) Power connections available to two independent primary public power sources or provision of in-place auxiliary power if the pumps provide fireflow, or are pumping from ground-level storage.

Distribution Storage (reference to Chapters 5 & 9)

(1) Construction of more than one gravity storage tank (wherever feasible) with the ability to isolate each tank while continuing to provide service.

(2) Provision of storage sufficient to give SB capacity of at least two times the ADD for all users, and/or to ensure that FSS, will be available at 20 psi at all service connections.

(3) Provision of a minimum SB volume of 200 gpd/ERU, regardless of the number of, and/or excess capacity of, the sources available.

(4) Inclusion of an alarm system that notifies the operator(s) of overflows, or when the storage level drops below the point where the ES volume is depleted. (This should only occur during abnormal operating conditions.)

Distribution System (reference to Chapter 8)

(1) Distribution mains looped wherever feasible.

(2) Pipeline velocities not exceeding 8 feet per second under PHD conditions.

(3) All pipelines capable of being flushed at a flow velocity of at least 2.5 fps.

(4) All mains and distribution lines with appropriate internal and external corrosion protection.

(5) For systems with designed fire flow capability, a hydraulic analysis that shows adequacy of system flows and pressures under “real life” fire fighting scenarios. Analysis to incorporate “achievable” hydrant flows in combination with MDD rate flows and assumption that a residual pressure of 10 psi could occur at the hydrant.