Water Conservation and Quantification of Water Demands in Subdivisions

A Guidance Manual for Public Officials and Developers

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1. PURPOSE
To facilitate the review and approval process of new subdivisions, and to prevent the establishment of subdivisions with inadequate: water supply and fire suppression systems; liquid and solid waste disposal; gas, electric, and telecommunication services; and roads; and to mitigate risks to the public health and welfare and the pollution of water resources, it is imperative that development guidelines which can be consistently applied in every county and locale throughout the state be made available to county planners, county commissions, developers, and state agencies.

The purpose of this document is to provide guidelines for the preparation and review of subdivision water supply proposals and associated water right applications. Criteria upon which an evaluation of such proposals may be made by the reviewing authority are presented for Water Conservation Measures, Water Demand Analysis, Design Requirements for Community Water Distribution Systems, and Water Right Requirements and Limitations.

2. THE NEW MEXICO SUBDIVISION ACT NMSA 1978, AS AMENDED IN 1995

2.1. Classification of Subdivisions

Type One: 500 or more parcels, any one of which is less than 10 acres.
Type Two: 25-499 parcels, any one of which is less than 10 acres.
Type Three: 24 or less parcels, any one of which is less than 10 acres.
Type Four: 25 or more parcels, each of which is greater than 10 acres.
Type Five: 24 or less parcels, each of which is greater than 10 acres.

2.2. Statutory Responsibilities of County Commissions

Section 47-6-9(A) requires that County Commissions adopt regulations setting forth the County's requirements for: (1) water conservation measures; (2) quantifying the maximum annual water requirements of subdivisions, including water for indoor and outdoor uses; (3) assessing water availability to meet the maximum water requirements of subdivisions; and (4) water of an acceptable quality for human consumption and for protecting the water supply from contamination.

Section 47-6-9(C) requires that Bernalillo, Dona Ana and Santa Fe counties adopt regulations pursuant to Section 47-6-9(A) on or before July 1, 1996; and **Section 47-6-9(D**) requires that all other counties adopt regulations by July 1, 1997.

Section 47-6-9(E) states that nothing in the New Mexico Subdivision Act shall be construed to limit the authority of counties to adopt subdivision regulations with requirements that are more stringent than the requirements set forth in the Subdivision Act, provided the County has adopted a comprehensive plan in accordance with Section 3-21-5 NMSA 1978 and those regulations are consistent with such plan.

Section 47-6-11(C) requires the County Commission to: (1) determine whether the subdivider can fulfill the proposals in his disclosure statement required by Section 47-6-17; and (2) determine whether the subdivision will conform with the New Mexico Subdivision Act and the County's subdivision regulations.

2.3. Statutory Responsibilities of the State Engineer Office

Section 47-6-10(A) requires that prior to adopting, amending or repealing any regulation, the County Commission shall consult with representatives of the State Engineer Office to give consideration to the conditions peculiar to the county and submit written guidelines to the County Commission for its consideration in formulating regulations governing subdivision water supply requirements.

Section 47-6-11(F)(1) requires that for preliminary plat approval of Type-One, Type-Two, Type-Three (except for those with 5 or less parcels--these are subject to summary review procedures), and Type-Four subdivisions, County Commissions request an opinion from the State Engineer to determine: (a) whether the subdivider can furnish water sufficient in quantity to fulfill the maximum annual water requirements of the subdivision, including water for indoor and outdoor domestic uses; and (b) whether the subdivider can fulfill the proposals in his disclosure statement concerning water, excepting water quality.

Prior to final plat approval of Type-Three subdivisions with 5 or less parcels, and Type-Five subdivisions, County Commissions may request an opinion from the State Engineer, however, this is not specifically required by the Subdivision Act.

Section 47-6-20(A) states that any public agency receiving a request from the County Commission for an opinion pursuant to Section 47-6-11 shall provide the Commission with the requested opinion within the time period set forth in Section 47-6-22(A). The County Commission shall provide the appropriate public agency with all relevant information that the Commission has received from the subdivider on the subject for which the Commission is seeking an opinion. If the public agency does not have sufficient information upon which to base an opinion, the public agency shall notify the Commission.

Section 47-6-20(B) states that all opinion requests mailed by the County Commissions shall be by certified mail "return receipt requested." County Commissions delivering opinion requests shall obtain receipts showing the day the opinion request was received by the particular public agency.

Section 47-6-11(H) states that if in the opinion of the appropriate public agency, a subdivider cannot fulfill the requirements of Section 47-6-11(F), or if the agency does not have sufficient information upon which to base an opinion: (1) the County Commission shall give the subdivider a copy of the opinion; (2) the subdivider shall be given 30 days from the date of notification, to submit additional information to the public agency through the County Commission; and (3) the public agency shall have 30 days from the date the subdivider submits additional information to change its opinion, or issue an opinion if none was previously offered due to insufficient information. Where the public agency has rendered an adverse opinion, the subdivider has the burden of showing that the adverse opinion is incorrect either as to factual or legal matters.

2.4. Time Limit on Administrative Action

Section 47-6-22(A) states that all opinions required of public agencies shall be submitted to the County Commissions within 30 days after the public agencies receive the written request and accompanying information from the County Commission. If the County Commission does not receive an opinion with the 30 day period, the Commission shall proceed in accordance with its own best judgement concerning the subject of the opinion request. The failure of a public agency to provide an opinion when requested by a County Commission does not indicate that the subdivider's provisions concerning the subject of the opinion request were acceptable or unacceptable or adequate or inadequate.

2.5. Contents of Disclosure Statement

Section 47-6-17(B) requires that the disclosure statement for subdivisions with not fewer than 5 and not more than 100 parcels include: (1) a statement describing the maximum annual water requirements of the subdivision, including water for indoor and outdoor domestic uses, and describing the availability of water to meet the maximum annual water requirements; (2) a statement describing the quality of water in the subdivision available for human consumption; (3) a description of the means of water delivery within the subdivision; and (4) the average depth of water within the subdivision if water is available only from subterranean sources.

Section 47-6-17(C) requires that the disclosure statement for subdivisions with 100 or more parcels shall contain all of the information required in Section 47-6-17(B)

3. PROTOCOL FOR SUBMISSION OF PROPOSALS AND COMMENTS FROM PUBLIC AGENCIES

Subdivision proposals prepared by developers and their consultants are normally submitted to the office of the County Commission where they are date stamped. The Commission then prepares a cover letter and sends proposal packets to the appropriate public agencies for review and comment by certified mail with return receipt requested.

The Subdivision Act specifically requires proposals to be routed through the County Commission to ensure that they have an opportunity to review and comment on all correspondence pertaining to the subdivider's proposal, and to ensure that all correspondence is entered into the public record so that it may be examined by members of the public.

In instances where time is critical, the State Engineer Office may provide its opinion directly to a subdivider if the County Commission is contacted by the State Engineer Office, and the Commission agrees that such action is prudent under the circumstances.

4. REQUIRED CONTENTS OF SUBDIVISION PROPOSALS

Except for those subdivisions which are subject to summary review procedures (See Section 2.3), a subdivision proposal should generally include the following documents:

(1) Executive Summary, including:
   - (a) location by township, range, and sections, or land grant, and proximity to existing communities and transportation routes
   - (b) number of lots; minimum, maximum, and average lot size; total acreage in each phase of development; projected time frame for project completion
   - (c) type of dwellings to be constructed, e.g. single family detached, or multi-family including apartments, condominiums, and townhouses
   - (d) overview of community facilities that will be provided
   - (e) a paragraph summary for each of Items (3)-(11) which follow

(2) Disclosure Statement

(3) Land and Water Use Covenants and Restrictions, including water conservation measures

(4) Water Supply Plan, including, if appropriate:

(a) water demand analysis
(b) preliminary engineering plans
(c) letter from water purveyor
(d) proof of an existing water right

(5) Water Availability Assessment, including, if appropriate:
(a) well records, including drilling logs
(b) history of observed water levels and well yields
(c) aquifer pump test data, including drawdown and recovery tables
(d) description and results of computer models

(6) Water Quality Analysis, including results from laboratory analysis of primary and secondary contaminants

(7) Fire Protection Plan, including, if appropriate, letter from the local fire authority having jurisdiction

(8) Liquid Waste Disposal Plan, including, if appropriate, letter from wastewater utility

(9) Solid Waste Disposal Plan, including if appropriate, letter from sanitation utility

(10) Terrain Management Plan, including:
(a) soil survey and land use limitations
(b) grading plan
(c) flood plain management plan
(d) drainage plan
(e) erosion control plan
(f) landscaping and revegetation plan

(11) Transportation Plan, including, if appropriate:
(a) traffic impact analysis
(b) specifications for road construction
(c) specifications for lighting, signage, speed limits, and traffic control signals
(d) letters from appropriate transportation authorities

(12) Vicinity map showing location and boundaries of the subdivision relative to existing communities, transportation routes, and natural features

(13) Site plan (plat) showing lot envelopes and location of wells if a community water system is proposed

The State Engineer Office is responsible for reviewing Items (1)-(5) and (7). Items (6), (8) and (9) are reviewed by the New Mexico Environment Department. Item (10) is reviewed by the local Soil and Water Conservation District Office; and Item (11) is reviewed by the New Mexico Highway Department.

5. PROTOCOL FOR REVIEW OF PROPOSALS

County Commissions should examine proposal packages received to determine if all required documents have been included before copies are distributed to public agencies for review and comment. This can prevent unnecessary delays in the review process. Upon receiving a proposal from a County Commission, the State Engineer Office date stamps the proposal packet and then examines it to determine if all of the documents required by the county subdivision regulations for the type of subdivision proposed have been included. If there are omissions, the County Commission is contacted to obtain the missing documents. Complete proposals are then routed to the appropriate section in the agency for evaluation.

The first document examined in the proposal package is generally the disclosure statement. The disclosure statement should be comprised of concise factual responses, carefully tailored to provide prospective lot purchasers with information required to make an informed decision. The proposed means of providing water to the subdivision will determine what additional information should be included in the disclosure statement to conform with the state and county subdivision regulations. Omissions or inadequate responses are carefully noted.

To determine if the information presented in the disclosure statement is accurate and reliable, the next documents to be examined are the land and water use covenants and restrictions. Any restrictions that will affect water use will be important in evaluating the water demand analysis, and should also be reflected in the disclosure statement. Contradictions or omissions are carefully noted.

Having gained an overview of the proposed restrictions which may affect water use, the water demand analysis is reviewed to determine if it is technically correct and reasonable. Sources of data and all assumptions should be documented. Deficiencies in documentation, erroneous assumptions, omissions, and all computational errors are noted. In addition, if a letter is required from a water purveyor indicating they are ready, willing, and able to provide water to a proposed subdivision, and if a letter is required from the County Fire Marshall or local fire fighting unit, these documents are examined and any conditional requirements that the subdivider will have to qualify for the service applied for are noted. It is important that the water demand analysis be complete and accurate, because the estimate of the maximum annual water requirement is important in determining the amount of the water right required, where applicable, and, because it will be an essential element in the water availability assessment. Flow rates computed in the water demand analysis for average day, maximum day, and maximum day plus fire flow are important in sizing pumps, pipelines, and storage tanks.

The proposal is then examined for proof of an existing water right sufficient to meet the maximum annual water requirement. The State Engineer may question water right claims to determine if they have been exercised in accordance with state law and court decisions, and this may require the evaluation of a water right to determine if it is still valid after successive years of non-use. If the subdivider does not have a water right, or his water rights are inadequate, this is noted. If change of ownership of a water right, or an application to change the point of diversion, or place or purpose of use is required, this is investigated to determine if the subdivider has filed an application with the Water Rights Division of the State Engineer Office to do so, and whether or not such application has been approved.

After reviewing the water demand analysis, the water availability assessment is evaluated, to determine if it is complete, accurate, technically sound, and the conclusions reasonable. The primary purpose of this evaluation is to determine whether or not the subdivider can demonstrate that sufficient water is available to meet the demand for the proposed subdivision in the long-term. Where water is extremely scarce, it is of the utmost importance to determine how much water can be practically recovered, and whether or not the yield, which may diminish over time, will be sufficient to meet the projected demand. Data in the water availability assessment is compared with data in the water demand analysis and disclosure statement to make sure they are consistent.

Water quality data is reviewed to determine whether drinking water standards established by the U.S. Environmental Protection Agency (USEPA) are met. If acceptable contaminant levels are exceeded, the water supply may not be suitable for drinking water. Secondary water quality parameters such as iron, sodium, sulfate, hardness (calcium and magnesium), pH, total dissolved solids, and odor, which are not regulated by USEPA, may also need to be analyzed to determine if there is a potential problem and whether or not the more stringent water quality standards adopted by some counties are met. While the New Mexico Environment Department (NMED) is responsible for the water quality review, State Engineer Office staff also review the water quality data to determine if there is a need for water softening or other treatment that may effect the water demand, and to note any details that may be important in the water availability assessment.

Upon completing the review of the proposal, all notes are compiled into a memorandum in which the State Engineer offers an opinion as to whether or not the subdivider can provide water sufficient in quantity to fulfill the maximum annual water requirements of the subdivision and whether the subdivider can fulfill the water supply proposal in his disclosure statement. A cover letter is then prepared, and the completed memorandum is transmitted to the appropriate county officials by certified mail.

Time permitting, State Engineer Office staff may attend County Commission meetings where subdividers present their proposals, to present the State Engineer's opinions on proposals, field questions from the Commission and the public, and to note any specific concerns expressed by those present which may require further investigation by State Engineer Office staff.

6. WATER CONSERVATION MEASURES

Water conservation may be defined as any beneficial reduction in water use or water losses (American Public Works Association, 1981; Prasifka, 1988). Water waste may be defined as the indiscriminate, unreasonable, or excessive running or dissipation of potable water; and non-essential water use may be defined as the indiscriminate, or excessive dissipation of potable water which is unproductive, or does not reasonably sustain economic benefits or life forms, where there is a shortage of potable water (Monterey Peninsula Water Management District, 1988).

Drought is not the only circumstance under which water shortages occur. Population growth or migration can also cause shortages by overburdening water supplies that were once abundant. Thus, water conservation is an important consideration in water supply planning for any new subdivision. Reducing the water demand in subdivisions may add years to the life of aquifers that are being mined, reduce the cost of wastewater treatment, save energy, postpone or eliminate the expansion of water treatment and distribution systems, and decrease the volume of wastewater discharged into rivers and streams.

Indoor water use can be reduced without household members having to make any changes in their daily habits by installing water-saving plumbing fixtures and appliances in new construction. Outdoor water use can be kept to a minimum by installing low-water use landscaping and by careful consideration of any use of hot tubs, swimming pools and water gardens. Controlling excessive water pressure, metering and rate structures (water pricing), and the establishment of a good accounting and auditing system, may be integrated into the design and operation of water systems to reduce water waste.

The purpose of this section is to describe practical water conservation criteria for the design of subdivisions. These criteria can be applied to single-family homes, apartments, condominiums, townhouses, and mobile home parks.

6.1. Indoor Plumbing Fixtures

6.1.1. Toilets. In the United States, most toilets used 7.0 to 8.0 gallons per flush (gpf) until the 1950s, when the 5.5 gpf toilet entered the market; by the early 1980s, the 3.5 gpf toilet became the standard (Vickers, 1989, 1990.). These figures do not include toilet leakage, which is estimated to be as high as 20%. **The National Energy Policy Act of 1992 (NEPA) now requires that toilets manufactured after January 1, 1994 for dwelling units, use no more than 1.6 gpf.** It may be of interest to note that the average family of four flushes 16 to 28 times per day; and 6 flushes per capita per day is a reasonable assumption for estimating water use (Brown and Caldwell, 1984; Karpiscak, 1990).

6.1.2. Showerheads. The maximum flow rate of pre-1980 showerheads in the United States is 5.0 to 8.0 gallons per minute (gpm). However, studies indicate (Brown and Caldwell, 1984), that the average measured flow rate of pre-1980 showerheads is more often about 3.4 gpm because people run these showers at about two-thirds of maximum capacity. In the 1980s, 3.0 gpm showerheads became the industry standard. **NEPA now requires that the maximum flow rate of showerheads shall not exceed 2.5 gpm.**

6.1.3. Faucets. Conventional kitchen and bathroom faucets have a maximum flow rate of 3.0 to 7.0 gpm. **NEPA now requires that the maximum flow rate of kitchen and bathroom faucets shall not exceed 2.5 gpm, and 2.0 gpm faucets are recommended for bathroom sinks.** But, no matter how thrifty a faucet's flow rate, leaving the tap running constantly is really the most wasteful practice. There are faucets available however, which shut-off automatically, including some that use infrared sensors to detect any object that enters the beams' range.

6.1.4. Insulated Hot Water Pipes. Insulation reduces loss of heat from hot water pipes and reduces water wasted while users wait for the flow of hot water at the tap. A 1-4% reduction in water use and energy savings can result (Whipple, 1994, p. 57)

6.2. Appliances

6.2.1. Air Conditioners. An evaporative cooler (swamp cooler) installed in a 1,700 square foot single-family dwelling may consumptively use (evaporate) 10,758 gallons of water during a 1,130 hour cooling season in Albuquerque; and 16,355 gallons in a 1,718 hour cooling season in Las Cruces. (See Appendix B). Bleed-off water that is used to reduce mineral build-up on the pads inside the cooler may increase the total water use by 67% (Watt, 1986, pp. 105, 110) in coolers without pumped bleed-off recirculation. **To conserve water, evaporative coolers that recirculate bleed-off water, or refrigerated air conditioning systems, which require no water, can be installed in new construction; and bleed-off water from evaporative coolers without recirculation can be used for landscape irrigation.**

6.2.2. Dishwashers. To meet U.S. energy-efficiency standards, dishwashers manufactured since mid-1994 save energy by eliminating a hot water wash and rinse cycle, which reduces the total water use. Many of these models use about half the water that dishwashers used 20 years ago. Dishwashers manufactured in the U.S. use 7.5 to 12.5 gallons per wash in the normal cycle; European models which are typically more frugal with water, use 5.5 to 8.5 gallons (Consumer Reports, 1993, 1995a, 1995b). Note that a study conducted by Ohio State University showed that 16 gallons of water are typically used to hand wash 8 place settings and serving pieces (Buzzelli, 1991, p. 57). **To conserve water, low-water use dishwashers which require no more than 13 gallons in the regular cycle, and have a cycle adjustment which reduces the water used for small loads, can be installed in new construction.**

6.2.3. Hot Water Heaters. There are no noteworthy ways to save water in the selection or use of a typical hot water heater. However, installing a point-of-use water heater which produces hot water instantaneously, can reduce water waste (Buzzelli, 1991, p. 39). This can be especially important in homes or apartments where the hot water tank is a long way from the bathroom, and occupants have to run the water a long time before it gets hot enough for a bath or shower.

6.2.4. Washing Machines. To meet U.S. energy-efficiency standards, washing machines manufactured since mid-1994 save energy by eliminating hot water rinses, which reduces the total water use. In the regular cycle, top-loaders use 40 to 45 gallons per load; the front loaders 25 to 30 gallons. In the permanent-press cycle, water use increases by 5 to 10 gallons for top loaders, but is about the same for the front loaders (Consumer Reports, 1995a, 1995c). Some washers use as much as 68 gallons in the heavy duty cycle. Suds-saver washing machines which spew wash water into a tub or sink next to the machine, and then suck it up again to be reused for one or more additional wash-water fills can save laundry detergent and up to 17 gallons of water for each reuse (Consumer Reports, 1993). **To conserve water, low-water use washing machines which require no more than 43 gallons in the regular cycle and 53 gallons in the permanent-press cycle, and have a cycle or water-level adjustment which reduces the water used for small loads, can be installed**

in new construction.

6.2.5. Water Softeners. A softener is designed to remove hardness, i.e., calcium and magnesium, the minerals that lead to soap-curd deposits in the bathtub and sinks, dull-looking laundry, spots on dishes, scaly deposits on faucets and showerheads, and scale inside the water heater and pipes. A softener is not intended to make water any safer to drink. Water requirements for regeneration vary from 15 to 120 gallons per 1,000 gallons of water softened (Consumer Reports, 1990). The Environmental Protection Agency (1980) has reported that water softener regeneration typically occurs once or twice a week, discharging 30 to 88 gallons per regeneration; and that water requirements for this purpose range from 2.3 to 15.7 gallons per capita per day (gpcd), but average about 5 gallons per capita per day (gpcd). A softener controlled only by a timer regenerates at regular intervals and may use more salt and water than necessary because they regenerate whether or not the resin needs it. On the other hand, demand-control softeners monitor water flow or changes in hardness to adjust regeneration more precisely to the actual demand for water. There are also softeners which have electronic controls, that can calculate the average number of gallons of water used in the previous 7 days or track abnormal variations in average water use, and call for regeneration accordingly. **To conserve water, product specifications can be compared and a softener selected that regenerates automatically with a low regeneration water requirement per 1,000 gallons of water softened.**

6.3. Landscaping

6.3.1. Xeriscape. In 1980, the Denver Water Department coined the term **xeriscape** as a systematic approach to landscaping to conserve water (Knox, 1989). Xeriscape, from the Greek word "xeri" for dry, is a style of landscaping based on seven common-sense steps to create a beautiful, yet low-water use landscape. A well-designed xeriscape minimizes the area in irrigated turf; only trees, shrubs, flowers and groundcovers with low water requirements are planted; and plants are zoned in the landscape according to their different water needs so they can be irrigated separately, and efficiently. The goal in developing a water wise landscape is to reduce the need for irrigation, irregardless of whether it is in turf or ornamental areas of the landscape. As the irrigated area is reduced, water savings increase. Xeriscape can reduce outdoor water use by 50% or more without sacrificing the quality and beauty of a home environment. It is environmentally sound, requiring less fertilizer and chemicals, and it is low-maintenance. The seven steps to xeriscaping are:

> **Step 1: Planning and Design.** A landscape design is developed to suit homeowner's needs, life style, and climate. A well-planned xeriscape can increase the value of property and reduce water use. Prepare a site plan drawn to scale showing the location of the house, its orientation to the sun, other structures, utilities, and existing vegetation. Delineate those areas that will be developed for specific uses. Limit the disturbance of native vegetation on slopes and the perimeter of lots to eliminate the need for planting vegetation that must be watered. Divide the landscape into water use zones. High water-use zones are small, highly-visible areas, that receive the most care and require frequent watering. The high water-use zone is normally the area nearest to the house and is typically where most family activity

occurs; plants in this zone are functional, i.e., attractive and durable, such as turfgrass. The moderate water-use zone blends verdant areas with the more arid parts of the landscape; plants in this zone are watered only occasionally. The low water-use zone requires the least care; plants are only irrigated during establishment (typically 12-18 months); and thereafter, they survive on rainfall only. It is important to avoid abrupt changes from low to high water-use zones because this results in overwatering along the edge of the low water-use zone.

Step 2: Soil Analysis. Evaluate the soil, including its structure, texture, water-holding capacity and drainage. The physical and chemical characteristics of the existing soil will determine the type of soil improvement needed. When most homes are built, the soil around them is usually altered. The area against the foundation of the house is especially likely to be filled with poor soil and debris and may be far from ideal for growing turf, perennials and other plants.

Step 3: Appropriate Plant Selection. Select plants that are well-suited to the site and local environment. Soil type and exposure to direct sunlight are important considerations. Match the water use zones with the condition of the planting site. Place high water-use plants in areas of the landscape that stay moist, and low water-use plants in areas that stay drier naturally. In order to avoid waste, plants with similar light and water requirements should be grouped together. The irrigation system should then be designed to deliver the amount of water that each grouping needs to be healthy.

Step 4: Practical Turf Areas. Use turf for a specific function or aesthetic benefit. A small "oasis" of turf near the entrance to the home or a playing surface of durable turf in recreational areas, are all examples of practical turf areas. Avoid planting a steep slope with turf because it will be difficult to water and maintain sufficient soil moisture to keep the turf green (Christopher, 1994, p. 63). Design turf areas in practical shapes that can be efficiently irrigated and maintained. Avoid sharp angles and long narrow strips that are difficult to mow and water (Christopher, 1994, p. 63; University of Georgia, 1992, p. 10). Minimize the area of irrigated turf where possible; restrict turfgrass to low-water use varieties that are well adapted to the climate, soil, exposure, intended use, and expected level of care they will receive. Acclimation to sunny or shady exposures, heat, frost and drought tolerance, resiliency under wear, aesthetic appeal, and maintenance requirements--cutting, watering, fertilizing, and weeding, are all important considerations in selecting a turfgrass.

Step 5: Efficient Irrigation. A water-wise landscape requires a minimal amount of irrigation water, and water should be applied efficiently and effectively to make every drop count. Just as plants are zoned in the landscape according to their different water needs, zone the irrigation system so that plants with different water needs are irrigated separately. Water turfgrass, for instance, separately from shrubs and flowers. Using irrigation water efficiently also requires the selection of an appropriate type of irrigation system for the plants and for each area of the landscape. Trees and shrubs in the low water-use zone would need supplemental water only during establishment, while plants in moderate water-use zones require water only during periods of limited rainfall. For these plants, a temporary system such as a soaker hose or hand watering may be all that is required. On the other hand, high water-use zones require frequent watering and may warrant a permanent system with automatic controls. Whenever possible, use highly efficient watering techniques, such as drip irrigation. Soil moisture sensors such as gypsum blocks and tensiometers may be used to determine when to irrigate. Irrigation controllers may be used to water plants on time and in sequence, day by week by month, but they must be properly programmed to reflect seasonal changes in plant water requirements, otherwise water may be wasted. Bermadon valves are generally preferable to clock-type controllers; the Bermadon valve must be turned on manually but it turns itself off after a set amount of water passes through it (Christopher, 1994, p. 38). Sensors which automatically turn the irrigation system off if rain falls or if the soil is too wet to need watering, can improve irrigation efficiency and reduce waste. Considerable water savings can be realized by studying the water needs of plants, breaking bad watering habits, and learning how to water, when to water, and the most efficient ways to water. Use the following guidelines for lawn watering: (1) Water only when the grass really needs it; (2) deep-soak the roots and water less frequently--daily sprinkling may result in a shallow root system and weakens the grass, making it more susceptible to disease and more fragile in dry conditions and during winter; (3) water during the cool, early morning hours to minimize evaporation; (4) avoid watering on windy days to minimize wind drift and evaporation; (5) aim sprinklers--don't waste water on open dirt, sidewalks or driveways; (6) adjust sprinklers to throw a low pattern of water to minimize evaporation; and (7) monitor the amount of water applied (Buzzelli, 1991, p. 89).

Research conducted by the Rodale Institute indicates that for uniformity, efficiency, and range (distance) of coverage, the impulse- or impact-type sprinklers are the best (Ellefson, 1992, p. 107). Inexpensive revolving sprinklers (with revolving arms that move by water pressure), as well as fixed sprinklers that shoot water through a pattern of holes in their tops, give the least uniform coverage, often leaking and/or distributing most of the water near the sprinkler. Oscillating sprinklers cover a square area, but often deposit too much water at the ends of their oscillations, where they pause to reverse direction. In addition, though oscillating sprinklers may be great for children to play in, throwing water high in the air increases evaporation and wind drift losses. Traveling sprinklers (the ones that look like little tractors) have revolving arms and move across the lawn for better distribution and efficiency.

Step 6: Use of Mulches. Mulching is a very beneficial landscape practice. Mulches conserve moisture by preventing evaporative water loss from the soil surface and reducing the need for irrigation during periods of limited rainfall. By maintaining an even moisture supply in the soil, mulches prevent fluctuations in soil moisture that can damage roots. Mulches also prevent crusting of the soil surface and allow water to penetrate readily to plant roots. They insulate the roots of plants from summer heat and winter cold and help control weeds that compete with plants for moisture. By serving as a barrier between the plant and soil, mulches help discourage soil-borne diseases that stress plants and cause them to use more water. A 3-4 inch depth of mulch is normally optimum. Depending on the mulch and growing conditions, a depth greater than 5 inches will discourage plants from growing and retard the percolation of water down to the soil. Use fine-textured, organic non-matting mulches when possible. Fall leaves, pine straw pine bark nuggets, and shredded hardwood bark are excellent choices. Mulch as large an area as possible under trees and shrubs. Islands of unplanted mulch require no water and little routine maintenance.

Step 7: Appropriate Maintenance. Keep plants healthy, but do not encourage water-demanding new growth. Once plants are established, reduce the amount of nitrogen applied as well as the application rate and frequency of application. Avoid plant stress by mowing properly, by thinning shrubs instead of shearing, and by controlling weeds and pests before they affect plant health.

6.3.2. Landscape Design Requirements

In the text which follows, a procedure to implement a program for landscape requirements in new developments is presented. Model landscape ordinances which have been effectively implemented by water utilities and districts in the U.S. are included in Appendix A.

Procedure for Enacting an Ordinance
Governing Landscape Design Guidelines
(Center for the Study of Law and Politics, 1990, p. 61)

Step 1: Prepare an ordinance for adoption and use it as a part of city or county building permit approval process. The ordinance may include:

(1) Limits on turf area size by percentage of landscapable area (typically 20-50%). The landscapable area is the total lot or project area less the footprint of all buildings, driveways, non-irrigated portions of parking lots, hardscape such as decks, patios, walkways, and other non-porous paved areas, and utility easements. Water features are included in the calculation of landscapable area, but areas dedicated to the production of food crops such as vegetable gardens and orchards are not (California Department of Water Resources, 1992, p. 8).

(2) The prohibition of turf and high water-using plants in areas next to buildings, along narrow pathways or median islands, in the drip line area of native trees, or in sloping locations.

Step 2: Prepare landscaping design guidelines, which are a detailed explanation of how landscapers can comply with the ordinance. Include:

(1) A list of plants with low water requirements

(2) Descriptions of the recommended types of irrigation control systems, methods of irrigation, soil preparation methods, lower water-use varieties of turf, a maintenance and watering schedule, and proper placement of plants in the landscape. Remember that plants with similar light and water needs should be grouped together.

Step 3: Present the ordinance and guidelines to city and county governments for review and comment. Solicit comments from landscape architects, planners, developers, and water purveyors and incorporate comments received into the proposed ordinance and guidelines.

Step 4: Adopt the ordinance and guidelines. Incorporate them into the building permit approval process and apply them to all new construction.

Step 5: Enforce the ordinance and guidelines. Landscape design requirements are most effective when accompanied by a design review service offered through the city or county planning office, or local water utility. Such services can help subdividers and homeowners develop landscaping plans that are consistent with community water conservation goals. Some communities designate review boards, usually consisting of landscape architects or planners, to evaluate and approve landscape designs for certain types of new development. For example, a city or county may use a review board to ensure that new landscaping and irrigation systems comply with its xeriscape requirements. After the landscape project has been completed, the site is visited and a certificate of compliance is issued if all landscape design requirements are met. To provide an incentive for low water use landscaping, a credit or rebate may be offered toward the connection fee if homeowners comply with landscaping guidelines.

A prototype for landscaping guidelines which must be met to qualify for a rebate is presented in the text which follows.

Prototype for Landscape Rebate Program Requirements
(Center for the Study of Law and Politics, 1990, p. 69)

(1) There is 20% less turf area than traditional landscapes and not more than:
   - 800 square feet of irrigated turf per single-family detached dwelling
   - 500 square feet of irrigated turf per condominium or townhouse
   - 300 square feet of irrigated area per apartment or mobile home dwelling

(2) Not more than 40% of the total irrigated landscaped area is turf.

(3) In planned unit developments, turf areas are consolidated into large, relatively flat areas creating "oases of green" surrounded by dwelling unit clusters, thereby producing the greatest visual impact and optimizing irrigation efficiency. Turf is not used adjacent to building foundations, along narrow paths or median strips, or within the drip line of native trees.

(4) Low water-use shrubs and ground covers are used in landscaped areas where turf is not used.

(5) Water-loving plants generally are confined to drainage areas and patios or other intensively used or highly lighted areas.

(6) Rock plants and other colorful low water-use plants are used to add seasonal color highlight, visual interest, and balance.

(7) Prior to landscaping, soil tests are conducted, and the ground is carefully prepared. At a minimum, ground beneath planting is scarified and covered with a mixture of not less than 4-6 inches of topsoil amended with at least 4 cubic yards of organic material per 1,000 square feet and other soil amendments in a quantity and type approved by a landscape architect.

(8) Well-designed underground sprinkler systems are installed in landscaped areas. Turf heads

are on a system that is separately controlled from shrub and other nonturf areas. Design of the turf-area system provides uniform application. Low-discharge heads are used in nonturf areas or where slopes present a runoff problem. Automatic water timers and rain sensing shut-offs are used at all stations.

(9) In nonturf areas, a 3-inch surface layer of organic mulch is installed around all plants except for low ground covers.

6.3.3. Training Landscape Maintenance Personnel. A training program for landscape maintenance personnel will make them much more effective water conservers. A training program should include:

Irrigation scheduling. This should include an overview of the water requirements of different species of plants, signs of plant stress, use of soil probes and soil cores to check soil moisture, installation and use of soil moisture sensors such as gypsum blocks and tensiometers, determination of how much water to apply, best time of day to irrigate, duration of irrigation, and use of automatic controllers to turn water on and off.

Irrigation system maintenance. How to spot problems in irrigation equipment and make, contract for, or recommend to site managers the needed repairs.

Landscape maintenance practices that reduce the need for irrigation water. These practices include:

(1) Proper height for turf mowing
(2) Proper frequency of turf aeration and thatching to increase water retention
(3) Proper fertilization schedule to maintain plant health and drought tolerance
(4) Soil preparation and mulching practices to increase water retention

6.3.4. Irrigation with Reclaimed Wastewater

A complete evaluation of all the factors involved in the reuse of reclaimed wastewater must be performed to determine if it is feasible to use such waters for landscape irrigation in a proposed subdivision, and the results of the feasibility study should be thoroughly documented in the subdivision proposal. A general overview of this subject is provided in the text which follows. More detailed information may be obtained from federal guidelines, state regulations, municipal ordinances, engineering texts, and journal articles.

Regulation. There are no federal standards governing water reuse in the U.S., however, the U.S. Environmental Protection Agency has published guidelines for water reuse (USEPA, 1992) that address all important aspects of water reuse, including recommended wastewater treatment processes, treatment reliability provisions, reclaimed water quality limits, monitoring frequencies, setback distances, and other controls for various water reuse applications. Regulations that do exist have been developed at the state level, and these normally include acceptable levels of constituents of reclaimed water and prescribe means for assurance of reliability in the production of reclaimed water to ensure that the use of reclaimed water for the specified purposes does not impose undue risks to health (Crook, 1994, p. 67). Higher treatment standards are usually specified for the irrigation of food crops, golf courses, parks, and playgrounds, than for forage produced for non-milk-producing cattle, and roadway landscaping. Where the risk of human exposure is high, regulations may specify treatment and water quality requirements that will produce an effluent that is essentially free of measurable levels of pathogens, including viruses. General guidelines for the reuse of domestic wastewater in New Mexico have been prepared by the New Mexico Environment Department, and these may be obtained by contacting that agency.

Water Quality. The presence of toxic chemicals and pathogenic microorganisms in untreated wastewater creates the potential for adverse health effects where there is contact, inhalation, or ingestion of chemical or microbiological constituents of health concern. Thus, acceptability of reclaimed water for landscape irrigation depends on its physical, chemical and microbiological quality. The quality of reclaimed water depends on the source water quality, wastewater treatment processes and treatment effectiveness, treatment reliability, and distribution system design and operation. Factors that affect the source water quality include use of water softeners (increases sodium) and detergents (increases boron) in dwelling units, presence of industrial waste, infiltration into the sewage collection system, and seasonal variations in flows caused by stormwater.

Treatment Reliability. The need for reclamation facilities to reliably and consistently produce and distribute reclaimed water of adequate quality and quantity is essential and dictates that careful attention be given to reliability features during the design, construction, and operation of the facilities. Reliability requirements include standby power supplies; alarm systems; multiple or standby treatment process units and equipment to prevent treatment upsets during power and equipment failures, flooding, peak loads, and maintenance shutdowns; emergency storage or disposal of inadequately treated wastewater; elimination of treatment process bypassing; design flexibility of piping and pumping to permit rerouting of flows under emergency conditions; monitoring devices and automatic controllers; and provisions for uninterrupted chlorine feed. Non-design reliability features include provisions for qualified personnel, an effective monitoring program, a quality assurance program, and an effective maintenance and process control program (Crook, 1994, pp. 60-61, 70). An industrial pretreatment program and enforcement of sewer use ordinances to prevent illicit dumping of hazardous materials into the collection system, are generally required to ensure treatment reliability.

Conveyance and Distribution Facilities. The distribution network includes pipelines and appurtenances, pumping stations, and storage facilities. The major concern which guides design, construction, and operation of a reclaimed water distribution system is the prevention of cross-connections. A cross-connection is a physical connection between a potable water system and any source containing nonpotable water through which potable water could be contaminated. Another major concern of regulatory agencies is improper use or inadvertent use of reclaimed water. Typical regulatory controls to prevent cross-connections and intentional or unintentional misuse of reclaimed water include the following: color-coding of pipes and appurtenances (pumps, outlets, and valve boxes); horizontal and vertical separation of potable and reclaimed water lines; prevention of ability to tie into reclaimed water lines; backflow protection devices on potable water lines; and pipeline design and construction criteria (Crook, 1994, p. 61-62). The color purple is generally used to identify reclaimed water lines and appurtenances. Other design, operation, and safety requirements include: certified operator on duty at reclamation plant 24-hours per day; adequate storage or rerouting of excess flows during rainy periods and winter months; lining of detention ponds; key operated valves and outlets; use area controls including groundwater monitoring, surface runoff control, and prohibition of irrigation when the ground is saturated or frozen; fencing; signs; setback distances (from dwellings, public roads, wells, and reservoirs); control of windblown spray; and provisions for worker protection (Crook, 1994, p. 70-71). It is important to emphasize that in locales where groundwater is the source of potable water for residents, the installation of groundwater monitoring wells will be necessary to determine the impact, if any, of the application of reclaimed water on water quality and water levels.

Water Rights to Reclaimed Water. It is important to establish who has the legal right to the water--the supplier of the water entering the wastewater treatment plant, the treatment plant owner, or the public. The reuse of wastewater is subject to the administrative requirements which normally apply to changes in freshwater diversions, and the impact on return flow and downstream users must be taken into consideration. Depending upon the situation, it may be necessary to file an application with the State Engineer Office for a new appropriation of water, or to change the place and purpose of use.

Feasibility Studies. Before a plan for the reuse of reclaimed water is adopted as a part of a new subdivision development, a feasibility study should be prepared that would include an evaluation of environmental regulations; ownership, appropriation of water rights, and impact on return flow; legal liability; quality of water required for the proposed use; contractual provisions which set forth the responsibilities and liabilities of the provider and users; public acceptance; past reuse experience; environmental conditions (climate, soil, topography, groundwater levels and quality) at the point of use; economics; and technical feasibility. Conditions that must be met before reclaimed water is a viable option generally require that the reclaimed water is of adequate quality for the use, considering all relevant factors; that it is provided at a reasonable cost to the user, which is comparable to, or less than the cost of potable domestic water; that the use will not be detrimental to public health; and that the use will not adversely affect downstream water rights, will not degrade water quality, and is determined not to be injurious to plantlife, fish and wildlife (Thomas, 1994, p. 94-95).

6.3.5. Water Harvesting

Downspout Collection. A 1,000 square foot roof will yield 150 gallons of water during a 0.25-inch rain. By extending downspouts from gutters into the ground and adding on a section of solid pipe followed by a perforated pipe, water can be directed into planting beds.

Grading. Design paved surfaces to slope into turfgrass areas, planting beds, holding ponds, or cisterns; on steeply sloping sites, use terraces to slow down and collect the runoff; create small depressions or swales at the bottom of slopes to catch runoff (Ellefson, 1992, p. 104).

Collection Basins, Ponds, and Cisterns: These may be used to store runoff and should be lined with either hard-packed clay, concrete, or nonporous vinyl liners to prevent the water from percolating into the soil. A pump with a filtration system or gravity flow siphons can be used to withdraw water for landscape irrigation. Small cisterns, adequately elevated, work well with drip irrigated planting beds. Ponds and cisterns may also be a source of water for fire fighting provided that sufficient storage can be maintained. However, in regions that experience cold winters, ice cover may preclude the use of ponds and cisterns for this purpose.

Swales. These are long, level excavations, which can vary greatly in width and form from small ridges in gardens, rock piles placed across slope, or deliberately excavated hollows at the base of slopes or in flatlands (Mollison, 1992, p. 167). The purpose of a swale is to intercept overland flow, to hold it for a few hours or days, so that it can be absorbed by the soil and recharge the ground water. Swales are built on contour or on dead level survey lines, and it is important to emphasize that they are not designed to be a watercourse. The base is ripped, graveled, sanded, loosened, or dressed with gypsum to increase infiltration. Runoff from slopes, roofs, roads, and other paved areas, and flows in diversion drains, may be directed into the swale. The interswale may be left bare, however, it is generally seeded with cereal grasses and covered with a mulch to increase infiltration, reduce evaporation, and prevent soil erosion. Trees are normally planted on the outer banks, and will shed about 25% of their root system each year, and this, together with leaf litter and soil micro-organisms, becomes organic matter (humus), which increases water retention in the soil (Morrow, 1993, p. 42).

6.4. Recreational Water Facilities and other Water Features

It is recommended that the water use estimate for hot tubs, swimming pools, ponds, and water gardens be consistent with the procedure in Step 4 on page 23 of this manual, and be carefully considered in the water conservation measures for new subdivisions. From the perspective of water conservation, such facilities may be more appropriate where they will serve an aesthetic or recreational purpose which benefits all inhabitants of a community. Fountains or other types of decorative water bodies where water is sprayed into the air are discouraged.

6.5. Design and Operation of Water System

6.5.1. Pressure Reduction. Over-pressurized water systems can result in inefficient water use. Pressure-reducing valves (PRV) should be installed when static pressures exceed 100 pounds per square inch (psi) in the transmission lines and distribution mains, and where pressure exceeds 80 psi at customer meters. (Center for the Study of Law and Politics, 1990, p. 43; Great Lakes Upper Mississippi Board, 1987, p. 108; Rocky Mountain Institute, 1991, p. 26). The static pressure at a residential service connection where a PRV is installed will generally be maintained at 45-55 psi. Note that in some areas particularly where dwellings are built on slopes, differences in elevation and friction losses in the piping system may require working pressures at the street of up to 80 psi to ensure that automatic indoor fire sprinkler systems and landscape irrigation sprinklers function properly (American Water Works Association, 1989, p. 41). Pressure reduction at a service connection can reduce water use by 5% or more (Whipple, 1994, p. 57)

6.5.2. Metering. Metering is an essential element of any residential water-conservation initiative. Without water meters, individual users cannot tell how much water they are using or how much they are saving. By installing water meters and basing billings on water use, local utilities create a strong incentive for consumers to use less water. Metering is a more equitable means of billing for water use, and water-conserving customers will benefit directly. The cost of installing a water meter in new construction is generally much less than retrofitting a service connection with a meter later. Labor costs are the biggest factor in meter retrofit programs, and account for the cost variation. The cost of installing meters will generally be recovered in savings in the water purveyor's supply and delivery costs in 3 to 4 years.

6.5.3. Rate Structures (Water Pricing). It is important that water is priced to reflect the true cost of producing it. Water rates should be designed to recover all costs including construction of water supply facilities, heavy equipment, management, training, operation and maintenance, water quality laboratory tests, depreciation, interest on debt or capital, and taxes; and must provide for the establishment of a reserve fund for future improvements, extensions, and enlargements, and the replacement of system components that wearout with age. **The ability to recover all costs is extremely important in determining the viability of proposed new systems, or of old systems needing assistance (Whipple, 1995, p. 77) .** The rate structure should generate revenues sufficient to allow the utility to operate on a self-sustaining basis; provide assurance that there will be a stable and predictable stream of revenue over time and as circumstances change; and provide incentives for conservation (Mitchell, 1994, p. 13-14). Water subsidies and other price breaks lead to profligate water use. Flat rate billing systems do not promote water conservation, and metering without a use-based water rate will not reduce demand. To conserve water, customers should be billed on the basis of a fixed monthly charge plus a charge per unit of water used. An increasing block-rate structure may be effective in preventing waste. Water and sewer rates should not be lumped together so that water use can be monitored.

6.5.4. Recordkeeping and Water Audits. It is imperative that a recordkeeping system be established to monitor operation and maintenance costs, revenues, and the use of water. A water audit is a detailed examination of where and how much water enters the system, and where and how much leaves it. Water system audits facilitate the assessment of current water uses and provide data needed to reduce water losses, revenue losses, and forecast future demand. With this information, the water utility is better equipped to target conservation efforts and system improvements where they are most needed. Estimating and reducing unaccounted-for water is a major objective of a water system audit. Unaccounted-for water includes distribution-system losses through leaks, unmetered water delivered through fire hydrants, water taken illegally from the distribution system, inoperative system controls (for example, blowoff valves and altitude-control valves), and water used in flushing water mains or sewers (Center for the Study of Law and Politics, 1990, p. 35). Unauthorized use of hydrants includes theft by chemical lawn service companies, building contractors, and water haulers who have the tools needed to open hydrants without permission.

7. WATER DEMAND ANALYSIS

7.1. Classification of Water Systems

7.1.1. Individual Domestic Well. Groundwater is diverted from one Section 72-12-1 NMSA 1978 domestic well to serve one residential connection, which may be a single-family dwelling, or a multi-family dwelling. Each lot purchaser is usually responsible for drilling their own well, installing a pump, pressure tank, and water line, and maintaining the system. The annual diversion from the well is limited to 3 acre-feet in any year.

7.1.2. Shared Well. Groundwater is diverted from one Section 72-12-1 NMSA 1978 domestic well to serve at least 2 residential connections. The subdivider may drill the well that will serve each cluster of homes, install the pump and pressure tank, and water distribution line to the perimeter of each lot. Lot purchasers are generally responsible for installing a water service line from the distribution line to the home they build. Land and water use covenants and restrictions prepared by the subdivider will stipulate that lot purchasers in each cluster of homes will be entitled to use an equitable portion of the permitted water right associated with each well; and lot purchasers will be responsible for the assessment and collection of fees, and the operation and maintenance of the water system. A water meter is required at the wellhead, and the annual diversion from each well is limited to 3 acre-feet or less in any year.

7.1.3. Community Water System. Includes any existing or proposed water supply system which relies upon surface and/or groundwater diversions other than wells permitted by the State Engineer Office under Section 72-12-1 NMSA 1978, and which consists of common storage and/or distribution facilities operated for the delivery of water to multiple service connections. All diversions must be metered at the source, and it is recommended that each service connection be metered. The annual diversion must not exceed the water right.

7.2. Community Water System

To evaluate the ability of a subdivider to provide water sufficient in quantity to satisfy all water uses in a subdivision from a community water system, it is first necessary to quantify the maximum annual water requirements for indoor domestic uses including water for evaporative cooling and water softening, landscape irrigation, fire fighting, and other uses including distribution system losses. For subdivisions that will be developed in phases, it is important that the water production and delivery capacity be adequate to meet the water demand at full development. Inadequate design capacity may result in shortages in water deliveries. The maximum annual water requirement for the subdivision is computed using the following procedure.

Step 1: Determine a reasonable occupancy rate for the proposed dwelling units. Review housing and population data published by the U.S. Department of Commerce, Bureau of the Census, for the county and locale under study; also contact local water utilities to obtain data for similar residential customers. Data obtained from these sources may be used as general guide. The occupancy rate used for the design of a new subdivision should reflect a margin of safety to avoid underestimating the water demand. U.S. Census Bureau data indicate that the average occupancy rate per dwelling unit is 2.7 capita (Vickers, 1990). For design purposes, a minimum occupancy rate of 3.0 capita may be assumed; however, a higher rate (3.1-5.0), may be more appropriate for some residential developments. A lower occupancy rate may be appropriate for developments such as retirement communities provided that there is a reasonable assurance that the lower occupancy rate will continue in the future.

Step 2: Compute total indoor water requirements for each dwelling unit. For dwelling units with water conserving plumbing fixtures and appliances, assume a water requirement of 60 gallons per capita per day (gpcd) for normal household purposes such as drinking, food preparation, bathing, flushing toilets, washing clothes and dishes, and cleaning (See Table 1 which follows for a breakdown of this figure). Water requirements for evaporative cooling may be computed using the procedure presented in Appendix B which takes into consideration the volume of indoor living space, air flow requirements, design dry and wet bulb temperatures, and the annual number of cooling hours. In lieu of using this procedure, water requirements for evaporative cooling in New Mexico may be estimated at 20 gpcd. Water requirements for water softener backwash and regeneration will depend on the total hardness of the water, daily water use, and the frequency of regenerations, but may be estimated at 5 gpcd (See Section 6.2.5). **On the basis of this criteria, the total indoor water use for a dwelling unit equipped with an evaporative cooler and water softener would be 85 gpcd.** The total indoor water requirement (W_1), expressed in gallons per year for each dwelling unit, is computed using Equation (1).

$$W_1 = (CPU)(GPCD)(365 \text{ days/yr}) \qquad \text{(Eq. 1)}$$

CPU is the number of capita per dwelling unit; and GPCD is gallons per capita per day.

Table 1. Indoor water use in single and multi-family dwelling units with water conserving plumbing fixtures and appliances, in gallons per capita per day (gpcd). The prototype for this table is based on data published in a report prepared by Brown and Caldwell (1984) for the U.S. Department of Housing and Urban Development, Washington, DC.

Item and Assumptions	GPCD
Toilets (1.6 gal/flush x 6 flush/capita day)	9.6
Toilet leakage (0.17 x 24 gal/capita day)	4.1
Showers (2.5 gpm x 4.8 minute)	12.0
Baths (50 gal/bath x .14 bath/capita day)	7.0
Faucets (Estimated)	9.0
Dishwasher (13 gal/load x .17 load/capita day)	2.2
Washing machine (50 gal/load x .30 load/capita day	15.0
Subtotal	58.9
Evaporative cooling	20.0
Water softening	5.0
Total	83.9

Step 3: Compute landscape irrigation water requirements for each dwelling unit. The maximum irrigated area on each lot and restrictions on the type of turfgrass should be stipulated in the land and water use covenants and restrictions. Irrigation water requirements expressed in gallons per square foot per year for Kentucky bluegrass, Bermuda grass, Buffalo grass, ornamental trees and shrubs, and herb and vegetable gardens for selected locations in New Mexico counties are provided in Appendix C. Consumptive irrigation water requirements were computed by staff in the New Mexico State Engineer Office using the Original Blaney-Criddle Method and 30-year temperature and precipitation normals for the 1951-80 period of record. Dividing the consumptive irrigation requirements by an application efficiency of 50% for flood and sprinkler irrigation, and 85% for drip, yielded the water requirements shown in the table in Appendix C. The sprinkler irrigation efficiency reflects a worst-case condition where the application rate, frequency of irrigation, and overthrow of sprinkler spray onto sidewalks, driveways, other paved surfaces, and structures,

is poorly controlled.

The total irrigation water requirement (W_2), in gallons per year, for each dwelling unit, is computed using Equation (2).

$$W_2=A_1I_1+A_2I_2+A_3I_3+A_4I_4+A_5I_5 \qquad \text{(Eq. 2)}$$

where A_1, A_2, and A_3, are the areas in square feet of (1) turfgrass, (2) trees and shrubs, and (3) herb and vegetable gardens, that are irrigated by flood or sprinklers on one lot; and I_1, I_2, and I_3 are the corresponding flood or sprinkler application requirements in gallons per square foot per year which are obtained from the table in Appendix C; A_4 and A_5 are the areas in square feet of (4) trees and shrubs, and (5) herb and vegetable gardens, that are irrigated by drip; and I_4 and I_5 are the corresponding drip application requirements in gallons per square foot per year.

Step 4: Compute water requirements for ornamental ponds, water gardens, and swimming pools, for each dwelling unit. The calculation of these water requirements includes: volume of pool, number of times pool is completely drained and refilled in one calendar year, surface area, net evaporation rate, and makeup water for evaporation losses. Each dwelling unit will not necessarily have any recreational water facilities; and in regions that experience cold winters, small water bodies may be iced over for several months. These factors should be taken into consideration in the calculation. The total water requirement for these recreational water facilities (W_3), in gallons per year, for each dwelling unit, is computed using Equation (3).

$$W_3=(NPU)/(NDU)[(NR)(V)+(SA)(ENR)(7.48\ \text{gal/ft}^3)] \qquad \text{(Eq. 3)}$$

where NPU is the number of pool units; NDU is the number of dwelling units; SA is the average surface area of the pool in square feet; ENR is the net evaporation rate in feet per year; NR is the number of complete refills in one calendar year; and V is the volume of the pool in gallons.

If pan evaporation data is available for the area under study, the gross evaporation for a small water body may be computed by multiplying the pan evaporation by a coefficient of 0.85. The annual gross evaporation may also be estimated by reading values from isopleths drawn on maps prepared by the U.S. Natural Resources Conservation Service (formerly the U.S. Soil Conservation Service) and other agencies. The isopleths normally represent annual evaporation from a large water body such as a lake or reservoir. Since small water bodies have a higher evaporation rate, the value taken from the isopleth should be divided by 0.70 to yield the pan evaporation; multiplying the pan evaporation by 0.85 will yield the gross evaporation for a small water body. The normal annual rainfall may be obtained from long-term weather data (e.g. 30-year normals) published by the National Oceanic and Atmospheric Administration or by reading values from isopleths on precipitation maps. Subtracting the rainfall (R) from the gross evaporation rate (EGR) yields the net evaporation rate (ENR=EGR-R).

Step 5: Compute the total maximum allowable water use for each dwelling unit.

$$W_4 = (W_1+W_2+W_3) \qquad \text{(Eq. 4)}$$

Step 6: Compute the total maximum allowable water use for all dwelling units.

$$W_5 = (NDU)(W_4) \qquad \text{(Eq. 5).}$$

Step 7: Compute fire fighting water requirements. Water requirements for fire suppression have a significant impact on sizing the distribution system components, including water lines, appurtenances, and storage facilities. The ideal way to develop a fire suppression system is to construct a distribution system that will serve the short and long-range development of the service area so that fire protection will be adequate at full development. Needed fire flow (NFF) is defined as the rate of water flow at a residual pressure of 20 pounds per square inch (psi) and for a specified duration, that is necessary to control a major fire in a specific structure (American Water Works Association, 1989, pp. 1-2). Assuming one structural fire in the subdivision per year, the total water requirement for fire suppression (W_6), in gallons per year, is computed using Equation (6):

$$W_6=(NFF)(T) \qquad \text{(Eq. 6)}$$

where NFF is the needed fire flow in gpm; and T is the duration in minutes.

Needed fire flows can be easily calculated using the Insurance Services Office (ISO) methodology which is widely accepted throughout the United States. The ISO is a nonprofit association of insurance companies which provides statistical, actuarial, and survey information for numerous affiliated insurance companies; it compiles data that are used to establish rates for fire protection policies for both residential and commercial properties; and it sets standards for public fire protection systems to minimize the loss of life and property. For one- and two-family dwellings not exceeding two stories in height, the NFF shown in Table 2 should be used assuming a minimum duration of two hours (120 minutes). For other habitable buildings such as apartments, condominiums, and townhouses, the procedure in Appendix D should be used.

Table 2. Needed fire flow (NFF) for one- and two-family dwellings based on Insurance Services Office standards.

Distance Between Buildings (ft)	Needed Fire Flow (gpm)
Over 100	500
31-100	750
11-30	1000
Less than 11	1500

Step 8. Compute the maximum annual water requirement for the subdivision. Distribution system losses in small water systems typically range from 5-10% of the total withdrawal (American Water Works Association, 1993, p. 2-4; Prasifka, 1988, p. 50). For design purposes, 5% losses may be assumed for subdivisions with less than 50 homes; and 10% losses for subdivisions with more than 50 homes. Distribution system losses do not apply to water requirements for fire fighting because of the short duration (typically 2 hours) of this water demand. The maximum annual water requirement (W_7) in gallons per year, for all purposes in a subdivision, is computed using Equation (7).

$$W_7=[(W_5)/E_c]+W_6 \qquad \text{(Eq. 7)}$$

where E_c is the conveyance efficiency of the distribution system expressed as a decimal. For subdivisions with less than 50 homes, E_c is 0.95; and for more than 50 homes E_c is 0.90.

Water requirements for other uses such as guest houses, day care centers, dormitories, cafeterias, health spas, parks, greenbelts, playing fields, golf courses, and other community facilities; and livestock watering, should be estimated separately using the same concepts presented in the procedure in this section. These water requirements are subject to the application of the conveyance efficiency factor, E_c, and should be included in the estimate of the maximum annual water requirement, (W_7).

7.2.1. Example Calculation of Maximum Allowable Subdivision Water Use

The application of the method to estimate water demands and maximum allowable subdivision water use is illustrated for hypothetical subdivisions in Taos and Las Cruces as follows:

(1) Indoor water use, normal household purposes
- (a) Taos (3 occupants, no evaporative cooler or water softener)
  60 gpcd
  65,700 gallons per year
  (0.20 acre-feet per year)
- (b) Las Cruces (3 occupants, with evaporative cooler and water softener)
  85 gpcd
  93,075 gallons per year
  (0.29 acre-feet per year)

(2) Landscape water use, per dwelling unit. Landscape water use for 1,600 square feet of sprinkler irrigated Kentucky bluegrass (Appendix C) will vary from:
- (a) Taos 48,200 gallons per year (0.15 acre-feet per year)
- (b) Las Cruces 89,400 gallons per year (0.27 acre-feet per year)

(3) Other outdoor water use, per dwelling unit None

(4) Total maximum water use per dwelling unit, exclusive of fire flow requirements.
- (a) Taos 113,900 gallons per year (0.35 acre-feet per year)
- (b) Las Cruces 182,475 gallons per year (0.56 acre-feet per year)

(5) Total maximum allowable water use for all dwelling units, assuming 20 homes.
- (a) Taos 2,278,000 gallons per year (6.99 acre-feet per year)
- (b) Las Cruces 3,649,500 gallons per year (11.20 acre-feet per year)

(6) Water demands for other water uses, such as guest houses, day care centers, dormitories, cafeterias, health spas; parks, greenbelts, playing fields and golf courses; and livestock watering, shall be estimated separately. For this example, these are assumed to equal 0 gallons

(7) Water demands for fire fighting, assuming NFF is 500 gallons per minute for 120 minutes 60,000 gallons

(8) Total maximum allowable subdivision water use for the 20 dwelling units assumed in this example is the sum of Items (5) and (6) divided by an assumed conveyance efficiency of 0.95 plus Item (7).

- (a) Taos 2,397,895 gallons per year (7.36 acre-feet per year)
- (b) Las Cruces 3,841,579 gallons per year (11.79 acre-feet per year)

7.3. Shared Well

Water requirements for small clusters of homes (generally 6 or less) which are served by a shared well may be computed using the same procedure outlined for Community Water Systems. For small subdivisions, water requirements for fire suppression may not be necessary if a fire department located within close proximity will provide emergency service and can do so in a timely manner. In addition, distribution system losses may be considered negligible for design purposes. Because the total diversion from a Section 72-12-1 domestic well that serves a cluster of homes cannot exceed 3 acre-feet in any calendar year, the question which may need to be answered is how much water will be available to each lot owner for landscape irrigation and other outdoor water uses. To make this determination, the following procedure is used.

Step 1: Determine a reasonable occupancy rate for the proposed dwelling units.

Step 2: Compute total indoor water requirements (W_8), in gallons per year, for the dwelling units using Equation (8).

$$W_8=(NDU)(CPU)(GPCD)(365\ days/yr) \qquad (Eq.\ 8)$$

Step 3: Compute the amount of water (W_9), in gallons per year, that could be used for landscape irrigation on each lot using Equation (9). The diversion from each well which serves a cluster of homes cannot exceed 3 acre-feet per year, or 977,553 gallons per year.

$$W_9=(977{,}553\ gal/yr-W_8)/(NDU) \qquad (Eq.\ 9)$$

Step 4: Compute the maximum area, in square feet, that can be used by a lot owner for landscape irrigation using Equation (10).

$$A_s=(W_9/I) \qquad (Eq.\ 10)$$

where A_s is the area in square feet that is irrigated by flood or sprinklers on one lot; and (I) is the flood or sprinkler application requirement in gallons per square foot per year for a specific type of vegetation and locale shown in the table in Appendix C. The higher the value of (I), the smaller the area which can be irrigated; and conversely, the lower the value of (I), the greater the area which can be irrigated. Using the (I) for Kentucky bluegrass, which has the highest water requirement, will result in the smallest area that can be irrigated with the amount of water available.

Step 5: Compute the maximum area, in square feet, that can be used for landscape irrigation using the procedures presented earlier computing limitations on maximum allowable subdivision water use.

Step 6: The maximum allowable area, in square feet, that can be used for landscape irrigation is the lesser of the areas computed using Steps 4 or 5 above.

7.4. Methods for Limiting Maximum Allowable Subdivision Water Use

Water use in the proposed subdivision should be limited to the maximum allowable subdivision water use, either by regulating metered water deliveries or by limiting outdoor water use. Enforcement would be by county regulation, if applicable, or by land and water use covenants. In cases where subdivision water supplies will be provided from new appropriations of groundwater or individual domestic wells within declared underground water basins, and provided that statutory criteria are met, the water right permit may be issued by the State Engineer in an amount not to exceed the maximum allowable subdivision water use approved for the subdivision. SEO recommended guidelines permit the subdivider and County to specify methods of ensuring compliance with the maximum allowable subdivision water use. There are three options for limiting the maximum annual water use of a subdivision which may be considered by the County and the subdivider.

Method A: Water supplies to the subdivision and to each dwelling unit limited only by metered water deliveries. Under Method A, the total amount of water provided to each lot in the subdivision in any year would be limited to the total maximum water use, as computed in Section 7.2.1. Each lot purchaser would be allowed to use water for whatever purpose he chooses within the permitted amount, including any distribution of outdoor landscaping and, possibly, pools or ornamental water bodies. Other than the limitation on water use, covenants would not be required.

Method B: Water supplies to the subdivision and to each dwelling unit limited by the adoption of a standard water conservative landscape covenant for the subdivision, or as may be adopted by the County. The maximum irrigated area on each lot (e.g., 1,600 square feet for single family detached dwellings) and restrictions on the type of turfgrass and other types of vegetation must be included in the water demand analysis, and stipulated in the disclosure statement and in the land and water use covenants and restrictions. Examples of such criteria and ordinances are included in Appendix A.

Method C: Recommended allowable subdivision water use based on an allocation meeting water conservation criteria with detailed design provisions regarding landscape water use and detailed restrictive covenants. Under Method C, the subdivider would submit a detailed landscape plan (generally from a landscape architect) including area designations for plant groups with similar light and water requirements, layout of irrigation system, and calculation of irrigation water requirements. Components of such use would be calculated by the subdivider based on the SEO tables of irrigation water requirements. The maximum irrigated area on each lot and restrictions on the type of turfgrass and other types of vegetation must be included in the water demand analysis, and stipulated in the disclosure statement and in the land and water use covenants and restrictions. Such designs may result in a lower demand for water than the SEO recommended maximum allowable, and are generally intended to make the maximum possible beneficial use of a limited supply.

8. DESIGN REQUIREMENTS FOR COMMUNITY WATER DISTRIBUTION SYSTEMS

The water distribution system internal to the development shall be sized to meet both the initial and future demands for the proposed development. Oversizing for future extensions may be required. In constructing the internal water distribution system, the following design provisions are recommended.

8.1. Design Flow

A water utility must continue to serve its customers during a fire. The Insurance Services Office recommends that the fire suppression system be able to operate with the remainder of the potable water system operating at the maximum daily rate (Lindeburg, 1986, p. 7-16). Therefore, the distribution system shall be sized for maximum daily demand plus the fire flow requirement, or, maximum hourly demand, whichever is greater (American Water Works Association, 1989, p. 16).

8.1.1. Average Day Demand. The average of the total amount of water used each day during a 1-year period. The average daily demand (Q_{AD}) in gallons per day (gpd) and in gallons per minute (gpm) is computed using Equation (11a) and Equation (11b) respectively.

Q_{AD} in gpd=(W_5)/(365 days/yr) (Eq. 11a)

Q_{AD} in gpm=(W_5)/(525,600 min/yr) (Eq. 11b)

8.1.2. Maximum Day Demand. The maximum total amount of water used during any 24 hour period in a 3-year period. Maximum daily demand (Q_{MD}) is typically 1.5-2.0 times average daily demand (Lindeburg, 1986, p. 7-17); and for design purposes, shall not be less than 1.5 times the average daily demand. It is important that the multiplier used is justified by the registered professional engineer designing the water supply system. The maximum daily demand (Q_{MD}) in gpd and gpm is computed using Equation (12a) and Equation (12b) respectively.

Q_{MD} in gpd=(F_{MD})(Q_{AD} in gpd) (Eq. 12a)

Q_{MD} in gpm=(F_{MD})(Q_{AD} in gpm) (Eq. 12b)

where F_{MD} is the demand multiplier for the maximum daily demand.

8.1.3. Maximum Hour Demand. The maximum amount of water used in any single hour, of any day, in a 3-year period. Maximum hourly demand (Q_{MH}) is typically 2.0-6.0 times average daily demand; and for design purposes, shall not be less than 2.0 times the average daily demand. It is important that the multiplier used is justified by the registered professional engineer designing the water supply system. The maximum hourly demand (Q_{MH}) in gpm is computed using Equation (13).

$$Q_{MH} \text{ in gpm}=(F_{MH})(Q_{AD} \text{ in gpm}) \qquad \text{(Eq. 13)}$$

where F_{MH} is the demand multiplier for the maximum hourly demand.

8.1.4. Maximum Day Plus Fire Flow. The aggregated demand for maximum daily demand plus fire flow (Q_{MDF}) in gpm is computed using Equation (14).

$$Q_{MDF} \text{ in gpm}=Q_{MD}+NFF \qquad \text{(Eq. 14)}$$

8.2. Pipe Flow Velocity

Velocities in water distribution lines typically range from 5-10 feet per second (fps) at the design flow rate (Gagliardi, 1992, p. C.21; Tullis, 1989, p. 22). Pipe flow velocities are limited by design to avoid a number of potential operating problems. If the velocity is less than 3.0 fps, problems may occur due to suspended solids settling out or trapped air that cannot be removed. However, velocities in pump suction lines must be kept low enough to maintain the pump's required net positive suction head (NPSH). On the other hand, high velocities may cause cavitation and erosion of the pipe wall or liner, water hammer which may damage pumps and valves, and increase pumping costs. **Design criteria published by the Crane Company (1988, p. 3-6) suggest that pipe flow velocities of up to 7 fps are reasonable for municipal water distribution lines.** The pipe flow velocity in the service line from the distribution water main to the customer water meter should not exceed 15 fps (American Water Works Association, 1975, p. 48)

8.3. Pressure

The pressure in the distribution system is affected by the water demand in the area; size of mains and design of the distribution grid system; elevation of the main and the customer's piping; distance from the utility's pumps; and pressure zones (American Water Works Association, 1975, p. 38). The system should be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. If future connection to a different supply system is anticipated, critical pressure in that system may be used as initial design pressure. See also Section 6.5.1 on **Pressure Reduction** for more on this subject.

8.4. Sizing Pipelines

The purpose of the design flow analysis is to determine the minimum acceptable inside diameter of each segment of the piping system that will accommodate the design flow rate while maintaining the pressure drop and flow velocity within reasonable limits (Casiglia, 1992, p. B.63). Except for short cul-de-sacs, the minimum size of water mains that must provide required fire flows at fire hydrants, is 6 inches in diameter (American Water Works Association, 1989, p. 19; Great Lakes Upper Mississippi River Board, 1987, p. 111). Where the external supply or pressure is not adequate to meet requirements, larger pipe diameter, parallel or looping lines, or additional storage or pumping shall be provided to meet requirements (Boulder County Land Use Department, 1995, p. 7-4.). If friction head losses are ignored, an initial estimate of the required inside pipe diameter (D) in inches, is computed using Equation (15).

$$D=(0.6393)(Q/V)^{0.5} \qquad \text{(Eq. 15)}$$

where Q is the maximum daily demand plus the fire flow requirement in gpm, or, the maximum hourly demand in gpm, whichever is greater; and V is the flow velocity in the pipe in feet per second.

8.5. Hydrant Flow Rate and Location

The minimum flow rate for each fire hydrant shall be 500 gpm. A higher flow rate may be required to suppress fires at multiple-family dwellings such as apartments and condominiums. The maximum distance between hydrants, as measured along the roadway, should not exceed 300 ft in high density residential areas and 600 ft in areas of moderate density (American Water Works Association, 1989, p. 20). In low density areas where homes are built on large lots spacing criteria adopted by the authority having jurisdiction may permit up to 1,000 ft between hydrants along the roadway. However, no lot should be more than 500 ft from the nearest hydrant, in any area. Hydrants should be installed at each street intersection; in the middle of long blocks, particularly when required flow exceeds 1,300 gpm; and near the end of long dead-end streets. The planning of hydrant locations should be a cooperative effort between the water utility and the fire department.

8.6. Storage

New water systems should be designed with sufficient treatment and storage capacity to meet the maximum daily demand plus the required fire flow for the specified duration. Distribution storage equalizes demands on supply sources, production works, and transmission and distribution mains. As a result, the sizes or capacities of these components need not be so large. In addition, system flow and pressures are improved and stabilized to better serve customers throughout the service area; and reserve supplies are provided in the distribution system for emergencies, such as fire fighting and power outages. In normal system operations, some water from storage should be used each day not only to maintain uniformity in production and pumping, but also to ensure circulation of the stored water (American Water Works Association, 1989, p. 24). Storage in the distribution system is normally brought to full capacity each night and is increased during low-demand periods of the day. By pumping at night, water utilities can take advantage of reduced electrical rates for off-peak power.

8.7. Adequacy and Reliability of System

A water supply system is considered to be fully adequate if it can deliver the required fire flows to all points in the distribution system with usage at the maximum daily rate. When the delivery is also possible with the most critical limiting component out of service for a specified length of time, depending on the type of component, the system is considered to be reliable (American Water Works Association, 1989, p. 32).

Distribution system components are often taken out of service for maintenance. In addition, system components fail on occasion. For this reason, utilities should construct their distribution systems with loops, backup pumps, backup power supplies, and storage tanks so that if any component fails or is out of service the effect on the availability of water is minimized.

9. WATER RIGHT REQUIREMENTS AND LIMITATIONS

9.1. Doctrine of Prior Appropriation

In New Mexico, water resources are administered under the Doctrine of Prior Appropriation. A person who takes water and applies it to beneficial use is an appropriator; and the taking of the water constitutes the appropriation, which includes a priority date. This priority entitles the appropriator to receive a full appropriation before those with junior, or more recent water rights receive their appropriations.

9.2. Owning a Water Right

All natural waters in streams and watercourses, or underground, belong to the public and are subject to appropriation. An appropriation water right, like equipment or furniture, is considered property and can be separated from the land and transferred to another location subject to statutory requirements. The appropriator "owns" only the right to use the water and not the "corpus," or body of water itself. Beneficial use is the basis, the measure and the limit of the right and priority in time gives the better right. All beneficial uses are considered equal regardless of the value resulting from the use. Municipalities, county governments, and certain other political subdivisions of the state may condemn water rights for public purposes provided that this action is approved by the court and original owners are reasonably compensated.

9.3. Obtaining a Water Right

To obtain a right, an application must be filed with the State Engineer for a permit to appropriate water. The applicant must specify the source of water, purpose and place of use, point of diversion, and amount of water to be used. After the application is filed, the applicant presents all essential facts in a legal notice which is published in a newspaper circulated in the area where the water will be appropriated, once a week for 3 consecutive weeks. Protests to the application must be filed with the State Engineer within 10 days of the last date of the published notice. If a protest is filed, a hearing may be required before the State Engineer before the application is acted upon. An application will be denied if unappropriated water is not available, if the new use will impair existing water rights, or would be contrary to the conservation of water in the state, or detrimental to the public welfare of the state. If the State Engineer concludes that unappropriated water is available and that other criteria are met, the application is approved and it becomes a permit to appropriate water. The permit states when construction should be completed and when the water will be applied to beneficial use. The completion deadline depends on the size and complexity of the project; and an additional period of time may be allowed for the application of water to beneficial use. When construction is completed, or at the construction deadline, the site is inspected, and a certificate of completion is issued provided that all requirements are met.

This procedure applies to all surface waters, but only to ground water in declared underground basins. When the State Engineer finds that the water of an underground source has reasonably ascertainable boundaries, he can assume jurisdiction over the appropriation and use of such water by declaring the basin. Within a declared underground water basin, no well may be drilled without a permit and drilling may be done only by a well driller licensed by the State Engineer Office. The State Engineer declares and extends basins to protect prior appropriations, to guarantee the water's beneficial use and to ensure the orderly development of the resource. A basin may be declared without prior notice, however, after declaring the basin, a public hearing is required on the declaration within a specified time. The State Engineer has no jurisdiction outside declared underground basins, except to prevent waste. Declaring a basin has no effect on water rights initiated before the declaration date. After that date, however, those wanting a water right or wanting to drill additional wells to fulfill an existing right must apply to the State Engineer for a permit. If the water in a basin has been fully appropriated, no new water rights can be issued. The important effect of declaring an underground basin is that applicants bear the burden of proof to show that unappropriated water is available and that the appropriation will not impair existing surface or groundwater rights, would not be contrary to the conservation of water in the state, or detrimental to the public welfare of the state. Water right owners outside the underground basin boundaries are protected by the appropriation doctrine. If they believe their water right may be impaired, they have recourse to the courts, not the State Engineer.

Applications to appropriate small amounts of underground water for individual domestic use, livestock watering, public works projects such as the construction of highways, and mineral exploration, are exempt from normal administrative procedures which require the advertisement of the application and public hearings, except where there are judicial constraints imposed by state or federal courts. The diversion from a well permitted for any of these purposes is limited to a maximum of 3 acre-feet in any year.

9.4. Quantifying a Water Right

The amount allocated to a new right depends on reasonable need and water availability. For community water systems that will be supplied by groundwater, consideration should be given to economic constraints, maintenance requirements, and limitations of aquifer performance, that may effect the feasibility of pumping a well continuously for extended periods of time. It may also be prudent to provide a margin of safety in the determination of the sustainable yield which allows for some diminishment in well yield over time. Therefore, as a matter of practicality, the diversion right for some community water systems may be taken as a percentage of the production capacity of the existing well, provided that this value does not exceed the amount of water specified in the water right application.

9.5. Changing Ownership

If the seller of a parcel of land has water rights that the buyer expects to obtain with the property, the buyer should require that the water right be conveyed in the property deed and that all documents related to the water right be conveyed to the buyer. Under a 1996 state law, the buyer must file a change of ownership form in the State Engineer Office and then at the county clerk's office in the county where the water right is located. Those who inherit or purchase water rights must also complete and file a change of ownership form.

9.6. Separating a Right from the Land

Although the right to water is conveyed with the sale of irrigated land, unless reserved in the deed, a water right can be sold separately from the land and applied to a new use in another area provided that the transfer will not impair other rights in the move-to location, would not be contrary to the conservation of water in the state, or detrimental to the public welfare of the state.

9.7. Changing the Place or Purpose of Use

A water right transfer does not always mean a new owner. A transfer can mean that the owner wants to change the use of the water, the amount of the allocation, or the location of a well under a recognized right. Changes in place and purpose of use or changing the location of a well require filing an application with the State Engineer and proof that the change will not impair existing rights, would not be contrary to the conservation of water in the state, or detrimental to the public welfare of the state.

9.8. Specification of Water Right and Water Use Limitations in Disclosure Statements

County subdivision regulations usually require that the subdivider's disclosure statement include any limitation, physical or legal, anticipated for each water use. The content of these statements will depend upon the classification of the proposed water supply system.

9.8.1. Individual Domestic Well. For subdivisions where each lot purchaser will be responsible for drilling their own well the following text should be included in the disclosure statement: *The State Engineer will grant a domestic permit under Section 72-12-1 NMSA 1978 only to the person, who in good faith, intends to use the well for household or other domestic purpose. The permit is limited to the maximum allowable water use stated herein. If the total withdrawal is to exceed 3 acre-feet per annum from any well or group of wells that supply a common system, it will be necessary for the subdivider or users to obtain water rights.*

9.8.2. Shared Well. For subdivisions where the subdivider or homeowners will drill one or more wells each which will serve a cluster of homes (generally 2-6), it is important that all parties understand that the State Engineer does not grant domestic well permits to supply clusters of lots in any subdivision in the name of the subdivider or developer. The following text should be included in the disclosure statement: *A "conditional Section 72-12-1 NMSA 1978 well" may be drilled in the name of the developer (Article 1-15.5, Groundwater Rules and Regulations) after State Engineer approval of an application. This will allow the well to be drilled and tested but no water may be diverted for any use. Upon the sale of the lot on which the well is located, the owner may file application under Section 72-12-1 (Article 1-15.5, Groundwater Rules and Regulations), specifying the lots to be served from the well. The State Engineer will grant the application previously described, with a requirement that the well be metered and reports of use will be required to be submitted to the State Engineer on at least a quarterly if not monthly basis. The diversion from the well will be limited to a maximum of 3 acre-feet in any year.*

To ensure that the total amount of water diverted in any calendar year from a well which provides water to more than one lot does not exceed 3 acre-feet, the subdivider's disclosure statement should also include a restriction on the total area, expressed in square feet, that a lot owner can plant in lawn grasses, ornamental shrubbery and trees, and gardens, which would require irrigation; and prohibit hot tubs, swimming pools, and ponds or water gardens, where the area irrigated (square feet) is the maximum permitted under the criteria adopted. And finally, the total amount of water each lot owner will be entitled to should be specified. The entitlement is determined by dividing the domestic water right by the number of residential connections served by each individual well. However, in counties where more stringent restrictions have been placed on the amount of water each lot owner can use in any calendar year, if the entitlement allowed by the county is less than the result of the previous calculation, the lower figure should be specified in the disclosure statement.

9.8.3. Community Water System. For subdivisions where groundwater will be diverted from one or more wells exclusive of those permitted under Section 72-12-1 NMSA 1978, or where surface water will be diverted to supply the subdivision, proof of an existing water right sufficient in quantity to meet the water demand in the subdivision shall be provided in the development plan and the maximum annual water requirement and limitation of the right shall be included in the disclosure statement. This statement may be written as follows: *Proof that (name of subdivider) is owner of (number of acre-feet) of water rights that will meet the requirements of the proposed subdivision is included in (identify section) of the development plan.*

9.8.4. Extended Community Water System. For subdivisions where water is diverted from the distribution mains of an established water purveyor, a letter of intention indicating that the water purveyor is ready, willing, and able to provide water, and proof of a valid water right sufficient in quantity to meet the water demand of its current customers as well as the new subdivision shall be provided in the development plan; and the highest annual water use recorded by the water purveyor during the most recent 3 years, the maximum annual water requirement for the new subdivision, and the limitation of the right, shall be included in the disclosure statement. This statement may be written as follows: *Data provided by (name of water purveyor) indicate that the maximum annual water requirement for current customers is (number of acre-feet) per year and the maximum annual water requirement for (name of new subdivision) is estimated at (number of acre-feet) per year, which brings the total demand to (acre-feet) per year. Proof that (name of water purveyor) is owner of (number of acre-feet) of water rights that will meet both existing commitments and the requirements of the proposed subdivision is included (identify section) of the development plan.*

9.8.5. Metering Requirements. The following text should also be included in the disclosure statement where applicable. *In declared underground water basins, for any well which serves two or more connections, a totalizing meter must be installed before the first branch of the discharge line from the well and the installation shall be acceptable to the State Engineer. A written document shall be submitted to the State Engineer with the name of the manufacturer, model, serial number, date of installation, and initial reading of the meter prior to appropriation of water; and records of the amount of water diverted shall be submitted quarterly to the State Engineer Office on or before the 10th of January, April, July and October of each year.*

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