BRIAN SANDOVAL
GOVERNOR

State Of Nevada Water Conservation Planning Guide

Draft

Department of Conservation and Natural Resources
Bradley Crowell, Director

Division of Water Resources
Jason King, P.E., State Engineer

[This page intentionally left blank.]

Introduction

The previous version of this guide was published by the Division of Water Planning in 1991, which coincided with the revision to the Nevada Revised Statutes (NRS) requiring that suppliers of water develop water conservation plans. Many changes have occurred since the guide was first published. The Division of Water Planning was absorbed by the Water Planning Section as part of the Nevada Division of Water Resources (NDWR or State Engineer's Office). Additionally, the NRS's governing the contents of a water conservation plan were revised which also includes a continual five year update requirement.

Purpose and Goals

Many advances in water conservation have occurred in the last two decades, warranting an update of the strategies and available resources. Websites have become a vital source of information and means of information distribution that was unavailable at the time the previous guide was written.

The goal of this revised water conservation planning guide is to provide public and private entities, from the individual and the small water supplier up to the large governmental and quasi-governmental water purveyors, with basic guidelines for drafting or revising a water conservation plan that will comply with industry standards and meet NRS and Nevada Administrative Code (NAC) regulations. An effective Water Conservation Plan is a functional and dynamic tool for implementing water conservation measures specific to a water delivery system that will help ensure a reasonable supply of water specific to a water purveyor and in a broader sense our state as a whole. The general guidelines are presented in the main body of the text but helpful side bars will provide additional information or tie the text with the NRS Chapter 540 requirements for a Water Conservation Plan.

There is a difference between Water Conservation Planning and a Water Conservation Plan. Water Conservation Planning is an on-going iterative *process* that produces a *product* in the form of a Water Conservation Plan. The plan itself should never remain a static document. Instead, the plan should be a living document to guide the water system manager/operator in current conservation practices. As the plan is implemented, the planning process should include a review of the plan to see which components work and which don't work. The plan should be revised with new industry standards in mind or as changes occur to the water system on a routine basis.

Water conservation is not a goal unto itself but a means to an end. Water Conservation Planning and Drought Planning should be implemented not in times of drought or emergency but before these times of drought in order to protect the water system owner and public from shortfalls in supply and proper controls on demand. Water Conservation Planning is about adding another tool on the water supplier's tool belt to handle increasing demand, decreasing supply or a mixture of both. This guide is about helping the water purveyor create and refine this

tool. Since every water system is inherently different the plan should be customized to the water system.

Table of Contents

1.0 Reasons for Water Conservation

While many natural resources are vital to people's way of life, water is essential to life for all biological forms. Because arid Nevada is the driest state in the United States of America, the state's water resources are that much more precious. Without careful planning, Nevada's citizens may find opportunities diminishing from a lack of available water, if planning is not implemented. As the demand for water grows, either new supplies must be developed (supply side management) or future demands need to be controlled (demand side management). Water Conservation Planning is demand side management and can assist in the more efficient use of current water resources.

Currently, almost all of the state's available surface water has either been appropriated or is under adjudication[1]. Some of the state's individual hydrographic basins, especially basins with large populations are fully allocated and increasingly more hydrographic basins in the state are reaching a fully allocated condition. As local underground water sources become strained, large population centers have begun seeking water resources from outlying basins for import.

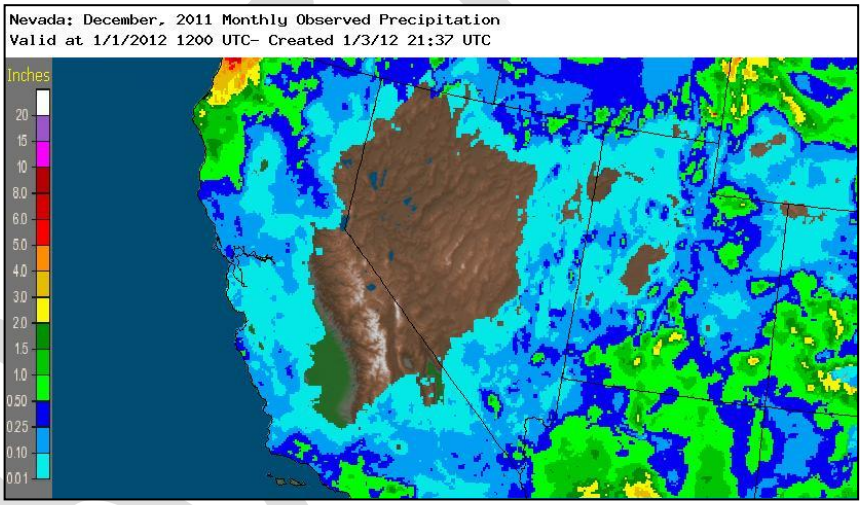


Figure 1.1: December 2011 Observed Precipitation (Courtesy National Weather Service)

With its arid climate and therefore limited water supply, Nevada is particularly susceptible to drought. It is rare that Nevada has an "average" year; it is often the case that a given year sees wet or dry extremes, making water supply highly variable. In wet years, it might not be possible to capture or store the "surplus" water and in dry years the water simply isn't available. The development of new water supplies in most cases comes at a very high cost (e.g. treatment plants, wells, pipelines or pump stations). Instead, effectively implemented water conservation programs can increase available water through reduction in demand. Through demand side management, a water purveyor can stretch out the current supply to meet demands and reduce the high capital expenditures needed to find new supplies. . . Even if development of new water supplies and increased treatment capacity will

[1] Adjudication is a legal process through the judicial courts system to determine who has a valid water right claim.

be needed in the future, conservation can serve to delay such costs, which can provide the time needed to plan and finance the needed projects. Cost/benefit analysis always needs to be performed when investigating a water resource enhancing project, whether it is supply side or demand side management.

The benefits of water conservation are not solely water savings but also include:

- ◊ Savings in energy used to convey water supplies.
- ◊ Savings from not building or enlarging water supply reservoirs or from prematurely developing new groundwater sources.
- ◊ Savings in the cost of water and wastewater treatment, including plant operation costs and chemical costs.
- ◊ Savings in eliminating or postponing expansion of water and wastewater treatment plants by the implementation of water saving measures.
- ◊ Guarding and planning for dry periods.
- ◊ Enhancing the environment by increasing or maintaining stream flows and reservoir water levels, reducing drawdown stresses on groundwater and reducing wastewater volumes.
- ◊ Preserving recreational and sporting activities by increasing or maintaining stream flows and reservoir water levels.
- ◊ Improving drought preparedness or reliability and margins of safe and dependable yields.
- ◊ Educating customers and the public about the value, scarcity and permitted limits of water resources.

(Nevada, 1991, p. 1.2 and USEPA, 1998, p.45)

Myths
Conservation:

- ***Eliminates the need to develop more water.***
- ***Will cost purveyors revenue.***
- ***Water is wasted.***
- ***Results in major lifestyle changes***

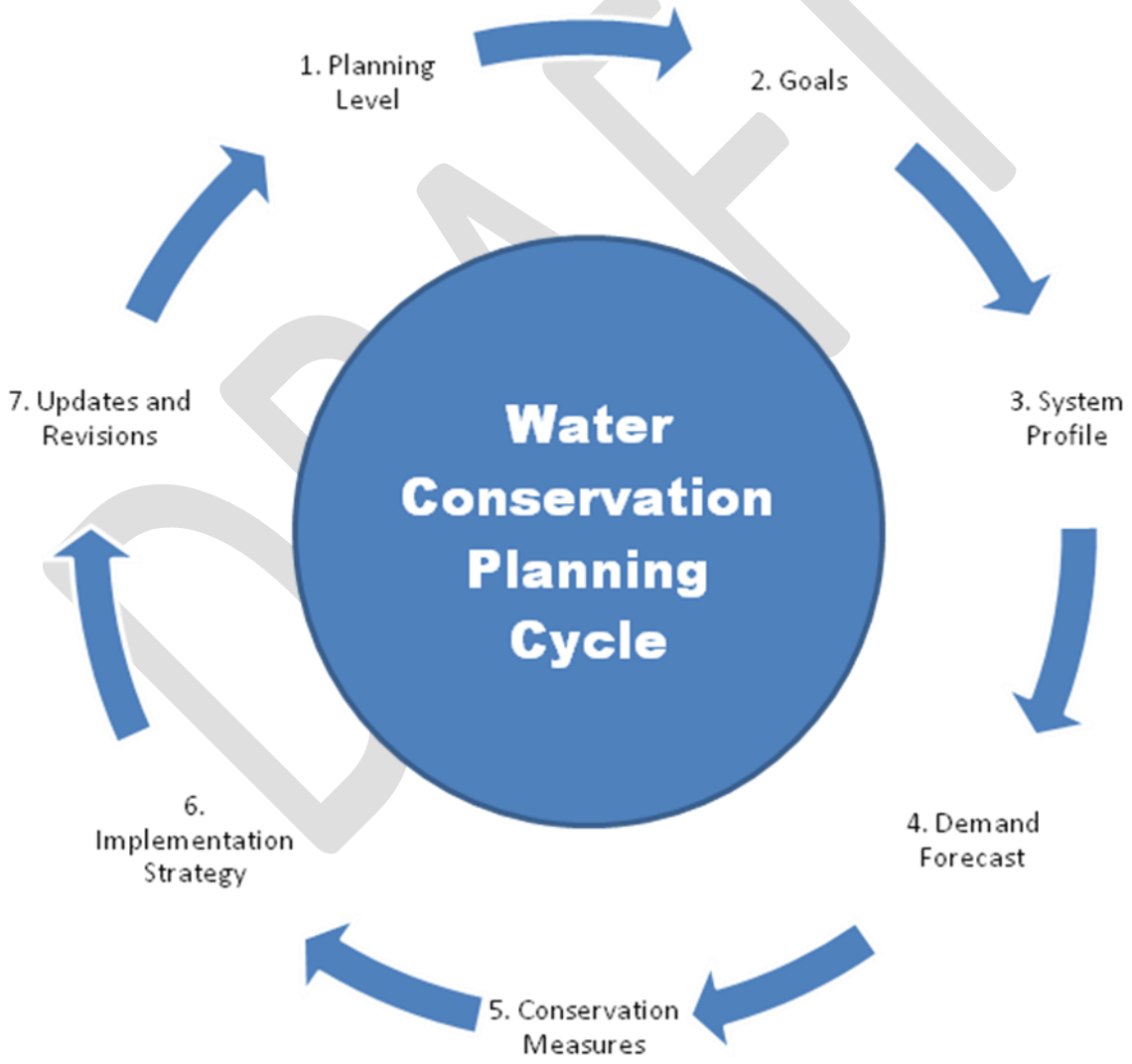
(Utah, 2012)

The bottom line is that Nevada is largely desert and is the driest state in the United States of America, receiving an average annual precipitation of less than ten inches and in some regions of the state, less than five inches annually. Solutions to growth cannot be strictly on the supply side since that side is at best fixed and at worst declining due to overuse or climate change. It must also be on the demand side and that means water conservation.

♦ ♦ ♦

2.0 Water Conservation Planning Process

There is no "right" approach to water conservation planning but a good framework will facilitate the process. Several sources provide an outline for the conservation planning process (see Works Referred and Recommended Resources sections). These sources tend to have common elements such as establishing a goal, developing a system profile, forecasting supply and demand, considering existing and proposed measures, implementing the plan and reevaluating the plan. This planning guide presents the following steps:



2.1 Planning Level

Not every water system is the same; they can range from small or rural systems to large interconnected urban systems. Thus, water system managers must decide on the level of planning based on the current and future demands of their water system. The United States. Environmental Protection Act (U.S. EPA) Water Conservation Plan Guidelines provides tiered guidelines for what measures to take based on the size of the water system (USEPA, 1998, pp. 39, 42). While this is a helpful guide, the water manager must be careful to still comply with NRS Chapter 540 as well as NRS 704, if utility is a Investor Owned Utility (IOU) regulated by the Public Utilities Commission. For example, pressure management is given as an "intermediate guideline," but NRS § 540.131(1)(c) provides that this must be addressed in a water conservation plan. Also, the EPA guidelines are not absolutes; a smaller system that is metered and has extensive records may find it feasible to perform more sophisticated demand forecast or to implement a formal leak detection program.

2.2 Establish and Revisit Goals

In order to guide the planning process and develop a water conservation plan, goals should be decided upon and should be something measureable (e.g. reduce cost by 10%, delay facility construction until 2035, etc.), rather than something vague (e.g. reduce water use, reduce leaks). If the goal is quantifiable, then it can be determined how quickly the goal is being met and when the goal is met. Objectives that support achieving the goal should likewise be measureable (e.g. if the goal is to delay expansion of a water treatment facility until 2022, then an objective might be to reduce production of water by 5% through conservation measures).

During periodic review process, the goals should be examined. Have they been achieved? If so, are there new goals or other goals that can be better focused on? If not, what objectives are not being met and why? Do the objectives need to be reexamined? Revisit the water conservation goals whenever a goal is met or an objective is achieved or whenever a critical performance indicator is missed. Evaluate what measures are effective and which should be abandoned. The goals and the means to achieve the goals will change over time as circumstances change.

After moving on to develop or update a water conservation plan, it is advisable to revisit the goals to see if they are reasonable, measurable, are achievable by the means presented in the plan and still reflect the system's changing needs and conditions.

2.3 System Profile

The water system manager should take an inventory of existing resources and capabilities. The following questions should be answered:

- ◊ What is the current service area and population?
- ◊ What is the annual water supply (all sources)?

- ◊ What are the type and number of service connections?
- ◊ What is the annual water demand and type of demand?
- ◊ What is the peak demand?
- ◊ What is the pricing system?
- ◊ What planning is already in place?
- ◊ What other conditions affect water supply or demand (e.g. are shortages common, is growth at a high rate, or is facility improvements planned)?
- ◊ What conservation measures are already in place and how effective are they?
- ◊ What facilities are planned and how does this affect future supply?
- ◊ What water rights are or can be secured and how does this affect future supply?

The U.S. EPA Water Conservation Plan Guidelines provides helpful worksheets for answering these questions, with three versions based on the level of detail required (USEPA, 1998, pp.48-49, 67-69, 107-109).

2.4 Demand Forecast

Demand Forecasting is not always guaranteed, but can at best be a projection based on certain assumptions or anticipated conditions. Depending on whether those assumptions are true or whether the conditions are met, the forecast may or may not prove to be accurate. Depending on the water system, the system manager must take into consideration what types of forecasting is suitable for the plan. For example, if the system is strictly for a residential service area, a per capita or per connection forecast may serve well enough. On the other hand, a city with a variety of residential, commercial, industrial, recreational or other uses may have one sector outpacing another in terms of demand. A per capita or per connection forecast may prove limited in such cases. Forecast should be made in 5 to 10 year intervals.

Water Conservation Plan Nexus

NRS §540.131(4)(1) requires that the water conservation plan be updated every five years, so this should be kept in mind as the timeframe for forecasts are considered.

In making the demand forecast, planners should consider conservation measures that are already in place but not those conservation measures proposed to be implemented by the plan being developed. Planners should consider plumbing fixture requirements and their effect on usage. Planners should also consider population projections but may also need to consider land-use planning and construction estimates. A small, single use (or predominately single use) system may be able to gain a useful insight from a demand forecast of the whole system. For larger or multiple use systems, a demand forecast by type of use will be of greater benefit (USEPA, 1998, pp. 50-52, 110-113).

Some resources for selecting a forecast method or model are available. The U.S. EPA Water Conservation Plan Guidelines (USEPA, 1998, p. 111) discusses the IWR-MAIN computer model (USACE, 1996, p. K1-K5) for forecasting. Means to utilize this model is discussed in various literatures (see Works Referenced and Recommended Resources). Other methodologies include use of software like Microsoft™ Excel for analyzing data (Wong, 2009). *Forecasting Urban Water Demand* from the American Water Works Association provides a discussion on the selection of demand forecasting methods (Billings, 2008, pp 35-41). *Water Resource Economics* provides techniques and discussions from an economics viewpoint (Griffin, 2006).

The level of detail depends on the size of the system and the resources available to the managers. This is why planning level is a vital first step (see Section 2.1 above).

2.5 Conservation Measures

Existing measures should have been identified under the system profile (see Section 2.2 above). If a measure has been proving to be effective, then continuation or expansion of the measure is likely warranted. Conversely, if a measure is not proving to be effective, it should be revaluated, modified, or discontinued. In this guide, Chapter 3 discusses education, Chapter 4 discusses indoor, outdoor and agricultural conservation measures and Chapter 5 discusses supply management.

Water Conservation Plan Nexus

NRS §540.141(1)(b) requires that water conservation measures required to meet the needs of the service area be specified. NRS §540.141(1)(e) requires that a schedule for carrying out the conservation plan be included. Often this is satisfied by stating that all provisions of the plan are in place but this neglects the benefit of staged implementation. If all measures are implemented simultaneously, it may be difficult to determine which measures were responsible for effecting the most (or most cost-effective) water conservation.

Criteria should be associated with each measure to assess performance with respect to an objective or goal. The U.S. EPA Water conservation Plan Guidelines provides a list of possible criteria (USEPA, 1998, p. 54) but these criteria can be categorized broadly as:

- ◊ Monetary
- ◊ Social
- ◊ Legal/Regulatory
- ◊ Environmental

When considering which conservation measures to implement, a cost-benefit analysis should be performed. An estimate of the total implementation cost should be compared to the anticipated water savings. An assessment can then be made as to the cost effectiveness of specific conservation measures. The water manager may also wish to compare the cost of implementing the program to the savings from avoiding supply-side costs such as delays in capital improvements, reduction in pumping, etc. (Nevada,

1991, pp. 3.1-3.8 and USEPA, 1998, pp. 54-55). Some research in the effectiveness of certain types of measures has been undertaken, so a literature review by the water manager may help guide in what measures will be most effective. Example, "Do Residential Water Demand Side Management Policies Measure Up? An Analysis of Eight California Water Agencies" [Renwick, 2000].

Selection of conservation measures can now be undertaken with the understanding of past successes and failures, cost effectiveness and system demands. This is why inventorying the water system and making demand forecasts are the first steps in making decisions about what conservation measures make the most sense.

2.6 Implementation Strategy

A strategy should address "any specific factors or contingencies that might affect or prevent the implementation of specific conservation measures" (USEPA, 1998, p. 58). This can be permitting requirements, long-term implementation, staffing needs or other challenges that must be overcome.

Planning is an on-going process but a timetable for meeting specific objectives and goals will provide some direction to implementation.

An important component of any strategic plan is the establishment of performance metrics. For each objective, a performance measure should be determined so that the manager can evaluate the effectiveness of a conservation measure.[2] This is achieved through monitoring and evaluation, so these components should be in the conservation plan. These metrics can be difficult to determine on unmetered systems. The main/master meter(s) for the system as a whole can provide insight into the overall reduction in water use but will not provide the detail for determining individual uses, identifying leaks, uses by type; changes in water use, etc. (see Chapter 5).

Part of implementation is a plan for updates and revisions. This is more fully addressed in Section 2.7 of this guide.

The U.S. EPA Water Conservation Plan Guidelines provides helpful worksheets for laying out a schedule and addressing public involvement, monitoring, evaluation and plan updates (USEPA, 1998, pp. 59, 98-99, 140-141).

Water Conservation Plan Nexus

NRS §540.141(1)(d) requires that the water conservation plan include provisions relating to measures to evaluate the effectiveness of the plan. The establishment of performance metrics related to the conservation objectives will guide decision making by the system manager.

[2] Note that "measure" is being used in two senses: First, to indicate a gauge and, second, to express an action. Often the latter use occurs in planning documents but both the former and the latter are used in NRS 540.141 and are expressed here in both senses despite the potential for confusion.

2.7 Updates and Revisions

Revisit and revise the water conservation plan. An existing plan provides the groundwork for going through the above six steps in a continual processes of planning. The water conservation plan can be updated to meet current needs and to address future needs as they have been redefined.

The revision process is to be done every five years to satisfy the requirements of NRS 540.131(4)(1). However, if there are any major changes in the water system or measures are not meeting objectives, then a more frequent revision is justified. For PUCN regulated utilities, NRS 704.6624(2)(b) requires for the periodic updating to reflect the changing needs and conditions of the service area. Each such revision must be filed with the PUCN and made available for inspection by members of the public within 30 days after its adoption.

Water Conservation Plan Nexus

NRS §540.131(4) requires that the water conservation plan be revised every five years but may be revised from time to time to reflect the changing needs and conditions of the service area.

Data collected during the planning timeframe can improve demand and supply forecasts. Helping the planner determine which conservation measures proved effective or cost-effective. The technological advances within this timeframe can also be considered with the development or a revised plan.

♦ ♦ ♦

3.0 Meeting the Requirements for NRS §§ 540.121 through 540.151.

No one plan can meet the requirements for all suppliers of water. To satisfy a supplier's needs, a plan must be suited to that supplier. A large urban utility will have a different approach to water conservation than a small rural water system but the general approach to developing a water conservation plan will be the same.

NRS §§ 540.121 through 540.151, inclusive, defines a supplier of water and provides specific requirements for the contents of water conservation plans to be reviewed by the Water Planning Section within NDWR. This chapter of the Water Conservation Planning Guide will provide guidelines on how to use the information presented in the previous chapters to satisfy these statutory requirements. A checklist is provided in Appendix A to assist the supplier in water in confirming that all the provisions of NRS §§ 540.141 and 540.151 are addressed in the water conservation plan.

NRS §§ 704.662 through 704.6624, inclusive, defines water conservation plan requirements for rate regulated IOU suppliers of water and provides specific requirements for the contents needed to be reviewed by the PUCN. Per the Commission's Order in Docket 15-05019, the PUCN only has jurisdiction over rate regulated water utilities. Private co-op and non-profit water systems will need to gain approval through NDWR. It is up to the water purveyor to determine which set of NRS's the water system needs to adhere to.

3.1 NRS 540.141(1)(a) Public Education

NRS § 540.141(1)(a) requires that public education methods are to increase public awareness of the limited supply of water and the need to conserve water, encourage reduction in the size of lawns and promote the use of arid and semi-arid plants. These should be the minimum requirements of any public education program. Chapter 3 of this guide provided discussion on three targets for education: employee, student and adult.

3.2 NRS 540.141(1)(b) Specific Conservation Measures

NRS § 540.141(1)(b) requires that specific conservation measures are to meet the needs of the service area including those required by law. Chapter 4 of this guide provided a discussion of those possible measures beyond education and system management.

3.3 NRS 540.141(1)(c) Management of Water

NRS § 540.141(1)(c) requires that the plan address the management of water to identify and reduce leakage in water supplies, inaccuracies in water meters, high pressure in water supplies and where applicable increase the re-use of water. Chapter 5 of this guide discussed system management practices which can be used to address these issues.

3.4 NRS 540.141(1)(d) Drought Contingency Plan

NRS § 540.141(1)(d) requires that a drought contingency plan be a component of the water conservation plan. Chapter 6 of this guide discussed effective drought contingency planning and development of a drought contingency plan.

3.5 NRS 540.141(1)(e) Schedule

NRS § 540.141(1)(e) requires that a schedule for implementing the plan be a component of the plan. Rather than hand-waving this requirement by stating that all measures are in effect, it may be in the best interest of the planner to consider staged implementation of conservation measures, scheduling of reviews of objectives and goals and timeframes for re-evaluating the water system or conducting audits.

3.6 NRS 540.141(1)(f) Measures of Effectiveness

NRS § 540.141(1)(f) requires that there are measures for evaluating the effectiveness of the plan or joint plan. This is discussed as part of the planning process in Chapter 2 of this guide.

3.7 NRS 540.141(1)(g) Savings Estimate

NRS § 540.141(1)(g) requires that for each conservation measure described in the plan that an estimate of the water expected to be conserved each year be included. This is required to be expressed in gallons per capita per day. This can be one of the more difficult requirements for a planner to meet but not an impossible task. If data exists for previous measures implemented by the water system, then a reasonable estimate can be derived from these data. If measures involve retro-fits or turf buy-backs, then the difference in old and new water use, assuming a certain percentage of compliance, can provide a basis for an estimate.

In some water plans this requirement is reflected in its own section but in other water conservation plans it is incorporated into the description of the individual conservation measure.

3.8 NRS 540.141(2)(a) and (2)(b) Water Rates

NRS § 540.141(2)(a) requires that an analysis be included that considers the feasibility of variable water rates and NRS § 540.141(2)(b) requires that an analysis be included that considers how much water might be conserved by proposed water rates including the manner of how such conservation will result. Section 5.2 of this guide discusses issues regarding water system pricing related to water conservation.

♦ ♦ ♦

4.0 Public Education

Depending on the needs and resources of the water supplier, the methods and opportunities for educating their users and the general public on water conservation can vary from a poster or pamphlet to classes taught in grade school or at community events. Education programs are important because individual conservation can have a considerable aggregate impact at relatively minimal cost.

This chapter is split into three sections: employee education, elementary education and adult education.

> ***"One of the most critical components of a [water conservation] program is a robust education and outreach program that reaches water provider employees, school children and adults. Furthermore, investments in public and targeted education have high water conservation returns and public awareness tends to build political support and participation."***
>
> ***(Georgia, 2007 p. 3)***

4.1 Employee Education

Water conservation education can begin with employees. By adopting a water conservation policy or including water conservation as a component of standard operating procedures, the water system manager can emphasize the importance of water conservation. By performing water audits, employees can also learn about where water losses can occur and will be better prepared to handle or anticipate problems (see Section 5.1). Finally, providing educational materials or educational opportunities (such as classes, professional seminars, etc.) can help improve the employee's knowledge; this includes having them read the water conservation plan developed by this planning process. (Georgia, 2007 pp. 4-5)

4.2 Elementary Education

An elementary education program serves to introduce water resource terminology and water conservation practices to young students. It is unlikely to be an option with smaller or rural water systems but large systems such as municipal or quasi-governmental bodies have opportunity and resources to introduce water conservation education into an elementary school program. What follows is an outline of steps for implementing an elementary school education program and the learning objectives that should be met by such a program.

Steps for implementing an elementary education program:

1. Set up a water conservation education committee comprised of a local government representative (chairperson), school district curriculum coordinator, local cooperative extension agent and water utility representative(s).
2. Hold a public meeting with the water conservation education committee to discuss objectives to be accomplished through a water conservation education program.

3. Identify if funding will be necessary to accomplish an education program. Identify, if necessary, sources of funding (e.g. local government, local water utility, etc.).
4. Obtain educational materials and establish media contacts.
5. Establish dates by which a program will be initiated, completed and repeated.
6. Implement the education program.

(Nevada, 1991)

In-school learning objectives:

1. The students will be able to describe the hydrologic cycle in terms of evaporation, condensation and precipitation. They will also be able to describe the importance of potable water to life. The students will be able to explain where drinking water comes from what happens to wastewater in their community and the relationship of drinking water and wastewater to the hydrologic cycle.
2. The students will be able to recognize sources of pollution and how to prevent the pollution of groundwater and surface water supplies. The students should also be able to explain how water conservation helps with water quality and provides environmental benefits.
3. The students should gain an understanding of the costs involved in providing water and how efficiency and conservation can reduce these costs by delaying infrastructure improvements, treatment costs, etc. The students should also gain an understanding of how conservation in the home can provide long-term savings.
4. The students will be able to explain the importance of water conservation and participation in water conservation activities. They will learn how to inform others and continue their own education regarding water conservation.
5. Students will understand the concepts and/or definitions of acre-feet, aquifer, conservation, cubic feet per second, gallons per minute, groundwater, hydrologic cycle, in-stream flow, irrigation, liquid, pollution, solid, surface water, vapor, wastewater treatment, water treatment, water quality, water quantity and Xeriscape™.

(Nevada, 1991 and Georgia, 2007)

4.3 Adult Education

One of the simplest and least costly forms of public education is bill inserts. Pamphlets that explain how an individual consumer can reduce their water use and in a tiered rate system reduce their water bill, may give the consumer the motivation to take some water conservation action. These bill inserts should emphasize the benefits to the customer when water conservation

is practiced. An insert could explain how to read a water meter. When providing an insert to explain implemented water restriction(s), clearly explain why such restriction(s) are necessary. Examples: To accommodate peak demand, to reduce costly infrastructure upgrades or to mitigate drought conditions.

The water bill in itself can serve to help educate the customers. Explain on the bill how the current rate could be reduced through conservation measures Clearly explain how a tiered rate structure will allow a disproportionate decrease in charges with respect to a decrease in water use (see Section 5.2 for explanations of pricing systems). Provide a note of what the bill would have been had the customer used only enough water to stay within the lower tier of an inclining block pricing system.

In our current "connected age", a webpage developed with information on water conservation, programs offered by the supplier of water, links to helpful sites like WaterSense, cooperative extension offices (e.g. at UNR or UNLV), Xeriscape™ and native plant guides, etc., can help serve to educate customers and perhaps the public at large.

Water Conservation Plan Nexus

NRS §540.141(1)(a) requires that public education methods are to increase public awareness of the limited supply of water and the need to conserve water and encourage reduction in the size of lawns and the use of arid and semi-arid plants. These should be the *minimum* requirements of any public education program.

NRS §540.131(2) provides that as part of the procedure for adopting a plan, the supplier of water shall provide an opportunity for any interested person to present written views and recommendations on the plan.

Another way that people can be educated is by including the public in the planning process (USEPA, 1998, p.45). This can be through an invitation to review and comment on a proposed water conservation plan or by providing meetings in which information on conservation can be presented and comments can be accepted. Inclusion in the water conservation planning process will encourage participation by giving people a say in that process.

5.0 Specific Conservation Measures

This chapter describes water conservation measures other than education (Chapter 3) or system management (Chapter 5). Many of these are end-user conservation measures rely either on voluntary behaviors, product upgrades or mandatory behavior changes through ordinances and enforcement. The measures are presented in four categories: indoor, outdoor, agricultural and system-wide. While a number of possible measures are provided, these are by no means an exhaustive list of options.

Water Conservation Plan Nexus

NRS §540.141(1)(g) requires that the plan include estimates of the amount of water will be conserved for each conservation measure specified in the plan. This estimate is to be in terms of gallons of water per person per day (gpcd).

5.1 Indoor Water Conservation

Indoor water conservation applies to all residential, commercial and industrial buildings. These practices should be initiated by the local government in cooperation with the local water utilities. Some of these measures may be voluntary, implemented through programs such as education or incentives and some of these measures may be mandatory, implemented through programs such as by water system rules, local government ordinance or other authority.

Residential water conservation measures:

1. Change to less wasteful habits:
    a. Do not run water while brushing teeth or shaving.
    b. When possible, take short showers instead of baths. Long showers will reduce or negate the benefit of showering over filling a tub.
    c. When preparing food, use a bowl of water for peeling and cleaning vegetables rather than running the tap.
    d. Keep water in a container in the refrigerator for drinking to avoid running the tap to get cool water.
    e. When washing dishes by hand, soak and wash them in the filled basin rather than under running water. Rinse them under the tap after they are cleaned.
    f. Run the dishwasher when full. If the dishwasher has such a capability, run on "top rack only" when washing just a few dishes (on the top rack, obviously).
    g. Minimize the use of the garbage disposal to reduce water use.
    h. Wash only full loads of laundry or use the load-size adjustment to match the appropriate load. Likewise, do not use more detergent than necessary

(see the instructions for the detergent; this is not only important for reducing the amount of soap in the waste water system but will improve the longevity of clothes).

i. Instead of throwing old ice down the drain, place some in the containers of potted plants.

2. Replace or adjust fixtures with water-saving equipment:
    a. Toilets:
        i. Install a new toilet with consideration for a low-flow model.
            1. Modern toilets are effective and use considerably less water per flush than those of decades past.
            2. Some models have half and full flush capabilities.
        ii. Consider retrofitting the existing toilet with water saving devices.
            1. Use a weighted jug or toilet dam in the toilets tank and place the device in a location that won't interfere with the flushing mechanism.
            2. Install a low flush replacement system.
                a. Some products have half and full flush capabilities.
            3. Install a adjustable fill valve.
    b. Install faucet with aerators and reduce the maximum flow rate to 2.5 gallons per minute.
    c. Install low-flow shower heads that restrict the maximum flow rate to 2.5 gallons per minute.
    d. Insulate hot water lines so as to reduce heat loss and the need to run the water longer to get the appropriate temperature.
3. Maintain fixtures:
    a. Repair leaky faucets, pipes, toilet valves, etc.

<u>Industrial water conservation measures:</u>

1. Replace or adjust fixtures with water-saving equipment:
    a. Toilets:
        i. Install a new toilet with consideration for a low-flow model.
            1. Modern toilets are effective and use considerably less water per flush than those of decades past.

2. Some models have half and full flush capabilities.

ii. Consider retrofitting the existing toilet with water saving devices.

1. Use a weighted jug or toilet dam in the toilets tank and place the device in a location that won't interfere with the flushing mechanism.
2. Install a low flush replacement system.
    a. Some products have half and full flush capabilities.
3. Install a adjustable fill valve.

b. Install faucet with aerators and reduce the maximum flow rate to 2.5 gallons per minute.

c. Install low-flow shower heads that restrict the maximum flow rate to 2.5 gallons per minute.

d. Insulate hot water lines so as to reduce heat loss and the need to run the water longer to get the appropriate temperature.

2. Maintain fixtures:
    a. Repair leaky faucets, pipes, toilet valves, etc.
3. Incorporate processes for reusing and recycling water to minimize the amount of make-up water required. Even if the industrial application cannot reuse the water, it may be usable for other industries, agriculture or recharge.
4. When non-potable water is acceptable, use alternative sources such as treated effluent.
5. Use another material (such as a liquid salt or refrigerant fluid) that may be used in lieu of water.

5.2 Outdoor Water Conservation

Outdoor water conservation applies to all residential, commercial and industrial buildings. These practices should be initiated by the local government in cooperation with the local water utilities. Some of these measures may be voluntary (implemented through the education program) and some of these measures may be mandatory (implemented by water system rules, local government ordinance or other authority).

Water conservation measures:

1. Lawns
    a. Minimize lawn size for existing or new construction.
    b. Restrict the proportion of landscaping that can be lawn.

c. Have automatic watering systems that require rain or moisture detectors.

d. Maintain irrigation systems.

2. Other landscapes

a. Encourage Xeriscape™ or native plant landscaping.

b. Use mulch of at least three inches to reduce evaporation.

c. Use only porous weed barrier.

d. Install automated drip irrigation systems.

e. Maintain irrigation systems.

3. Other water uses

a. Restrict washing of vehicles on nonporous surfaces such as driveways

b. Limit washing of vehicles to commercial facilities with recycling system.

c. Restrict washing of sidewalks.

d. Require hoses to have operator controlled spray valves so water is not running when not manually used.

e. Require use of treated effluent/re-use water for water features such as fountains or ponds. Such features should recycle most of its water and these other water supplies should only be used as make-up water.

f. Restrict or ban swimming pools or require covers to minimize evaporation loss.

g. Use treated effluent for dust control and construction.

4. Enforce water use ordinances or restrictions

a. Time of day or day of week water schedules.

b. Water wasted by allowing excess water being permitted to run onto nonporous surfaces or into storm drains.

i. In some instances such as in the Las Vegas area, water entering storm drains can in part, be returned to Lake Mead and a water credited for future withdrawal measured.

5. Implement incentive programs

a. Lawn/Turf buy-back programs.

b. Inclining block pricing structures to encourage smart water use.

See the recommended resources section for a variety of helpful literature and websites that provide advice for irrigation systems, Xeriscape™ planning and landscape design.

5.3 Agricultural Water Conservation

Agricultural water conservation should be initiated by water districts, extension offices and conservations districts. Technical assistance can come from these agencies or other agencies such as Natural Resource Conservation Service (NRCS).

Efficient, economical control of irrigation and drainage water on the farm will provide the necessary crop irrigation and leaching requirements while maintaining soil conditions suitable for plant growth and preventing degradation of downstream water quality.

Agricultural Water Management Practices:

1. Agriculture water planning
    a. Process design where inventory and analysis results in custom fit practices, measures and methods; or
    b. Use of standard practices where a selection is made from a list of canned or fixed methods, measures or practices such as the ones listed in this plan.
2. Planning Criteria
    a. All facilities and their use, including the diversion and discharge of water, *must conform to applicable state law and environmental regulations (e.g. water rights).*
    b. Know the amount of water that should be applied.
    c. Apply water as infrequently and for as long a duration as proper irrigation scheduling will allow to minimize total erosion and runoff.
    d. Apply water uniformly by measuring flow, carefully grading land and effective irrigation system design.
    e. Avoid applying fertilizers, biocides or amendments in the irrigation water when the runoff cannot be confined to the farm.
    f. Develop a tail water recovery system, including an adequate drainage system.
    g. Utilize sediment retention basins such as specific basins, regulating reservoirs or small check basins in the drain ditches.
    h. Utilize vegetated buffer strips or drainage-ways. Another alternative is to use runoff from row crops to irrigate close growing crops.
    i. General design considerations include soil (agricultural and foundation) characteristics, crop water requirements, material (equipment and supplies) availability, irrigation and drainage water flows, on-farm management capabilities and relative cost effectiveness of implementation.

j. Specific determinations necessary include water application amount and rate, leaching requirement, system capacities, optimum slopes and/or hydraulic gradients, facility sizes and configuration, time of irrigation set and uniformity of application.

3. Maintenance

   a. Perform regular preventative maintenance on all facilities.

   b. Repair or replace facilities as required.

(Nevada, 1991)

6.0 Management of Water

6.1 Utility System Water Audits

The principle behind a water audit is to collect data for all water in the system. This provides the water manager the knowledge of where water is going in the system and provides an estimate of unaccounted water losses.

U.S. EPA Water Conservation Plan Guidelines provides a figure showing the breakdown of water use categories in Appendix A (1998, p. 157). It also provides worksheets for performing a water accounting and loss audit and developing a strategy for loss control (pp. 158-159). Systems that use Geographic Information Systems (GIS) in their operation may find that "plugging in" data and tracking components will assist in performing audits.

Water Conservation Plan Nexus

NRS §540.141(1)(c) requires, in part, that the plan has provisions for identifying and reducing the leakage in the water supply and the inaccuracies in water meters. Water audits can help the manager meet these provisions. Water audits can also help the manager evaluate the effectiveness of the conservation plan as required under NRS §540.141(1)(f).

The first step is to determine the total amount of water produced. This is the water metered or otherwise measured from the production source (well, canal, etc.). Factors such as meter accuracy and transmission losses should be considered.

The next step is to determine where the water is going. There are two broad categories. First, "Account Water" is the water that is metered and billed to customers. This might be subdivided into the class of customer: residential, commercial, industrial, agricultural. Second, "Non-account Water" is water that is not billed. The Non-account Water category can be further subdivided into water that is metered or unmetered. The metered Non-account Water is likely public use water that is not billed to customers for water that may be supplied by, say a county purveyor to a county park. The unmetered water is water that is neither metered nor billed. The use may be authorized, such as fire hydrant flushing/fire fighter training or unauthorized use. In the latter case, the unauthorized water use may be identifiable or unidentifiable. "Identifiable Unauthorized Use" could be accounting errors, malfunctioning controls, illegal connections, meter inaccuracy, etc. What remains is "Unaccounted-for Water," which is water losses and leaks that could not be accounted for or identified (USEPA, 1998, p. 157).

Once the audit is completed, a plan of action can be formulated to reduce losses in the system. Auditing is a repeated process that provides the means to quantify water loss and to ultimately gauge the success of conservation measures.

6.2 Utility System Water Pricing

Proper pricing of water delivery can influence water use. Water demand is responsive to pricing changes under certain circumstances. The response tends to be greater when more discretionary water use occurs such as for landscape irrigation (Renwick, 2000). Figure 5.1 on the next page illustrates four typical rate schemes: flat, seasonal, inclining and declining.

Water Conservation Plan Nexus

NRS §540.141(2) requires an analysis of the feasibility of charging variable water rates to encourage water conservation and how these rates will maximize water conservation.

A "Flat" rate does not alter the unit price with respect to demand. It will neither encourage conservation nor discourage it. It's the simplest type of rate and easiest to understand but will not reflect the actual cost of water. The flat rate structure is typically found in un-metered water systems.

"Seasonal" rates are the same as the flat rate in terms of unit cost, except the rate is different in the summer months (growing vegetation season) than in the winter months (dormant vegetation season). This does serve to reflect the increased demand in summer and thus can better reflect actual cost of the water but like the flat rate neither promotes nor deters water conservation, except perhaps to curtail some summer use.

The "Declining Block" rates reduce the unit price of water as more is consumed. This can be likened to getting a discount for buying a good in bulk. However, from a water conservation stand-point, it is the exact opposite of the approach needed to reduce water use. This model might make sense if the good being sold could increase its supply and reduce the unit cost of the supplier but with water the supply is often fixed or possibly decreasing and when supply can be increased, the infrastructure and operational costs would increase (wells, pumping, pipelines, maintenance, etc.).

This leads to the "Inclining Block" rates where the unit price of water for basic necessities (indoor use, i.e. clothes washing, culinary, drinking, sanitation, etc.) is low but once that basic threshold is exceeded, the rate rises, sending a clear message to the consumer that use in excess of the basic necessities is now in the luxury range (landscaping, swimming pool, fountain, long showers, etc.). As water use continues to rise, so does the rate.

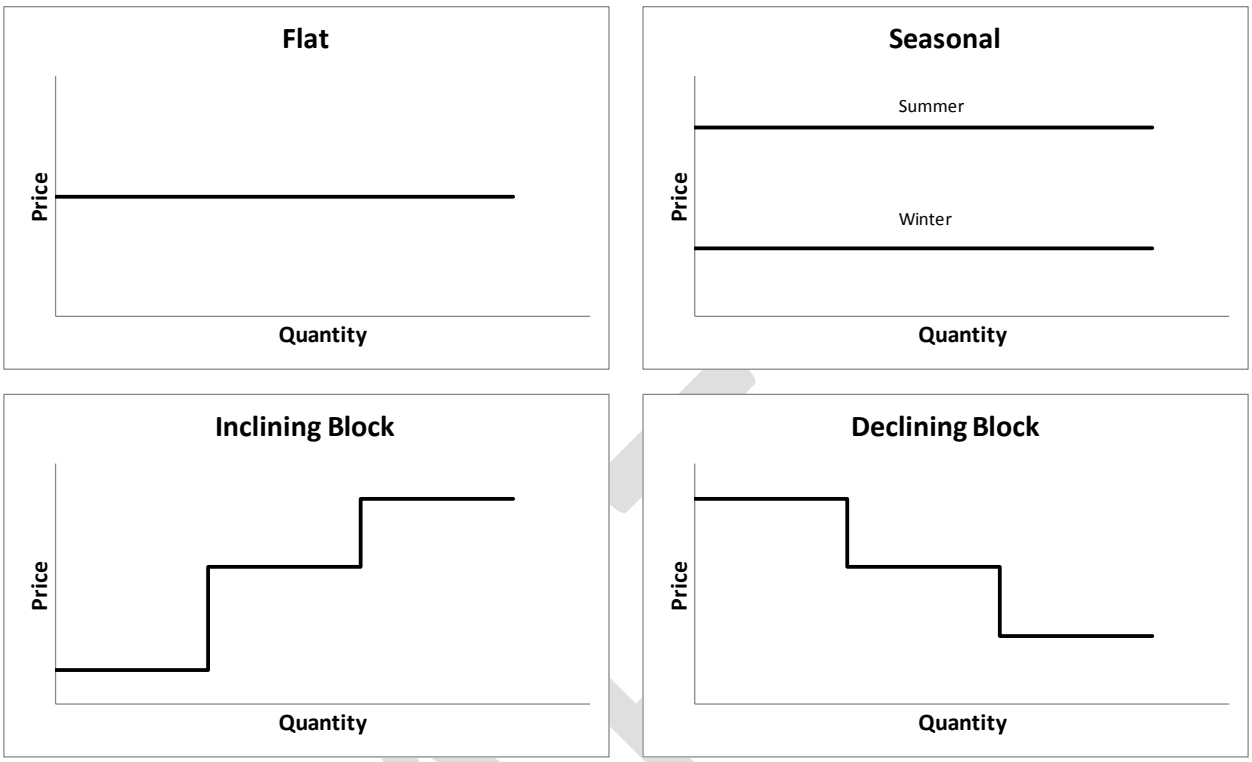


Figure 6.1: Types of Rate Blocks for Marginal Prices

The Carson City Water Conservation Plan (Carson City, 2011) provides a comparison of inclining rate structures and how they will send a signal to customers that increased use will begin to sharply increase average price per gallon. Even under an inclining rate block, the average price per gallon will decline with increased use until the higher tiers are met and begin to overtake the base price.

> ***"Because consumers respond to what they see on their monthly bill, the most effective inclining block rate structures are those that send a strong price signal to customers as consumption increases."***
>
> ***(Carson, 2011 p.10)***

Water conservation is a consideration in determining pricing and pricing structure but it is not the only consideration. A structure that appears ideal in terms of water conservation must still account for how the customers use water and how the system will need revenue generated for operational costs and for capital improvements.

Per unit pricing requires sub-metering so as to measure individual customer usage. See Section 5.4 on metering and sub-metering.

Marginal prices are important for establishing the rate block but it is the resulting average price that needs to be determined. When a customer is viewing a bill, it is the usage and the price that they will examine. To effectively send a message to the consumer that higher usage will be disproportionately higher in price, the rate structure should demonstrate a sharp increase when consumption reaches high levels.

Consider Figure 5.2 and the three curves presented. All represent inclining rate blocks but depending on when and how steeply the changes in rate occur, the average price per unit volume curve is distinct. "C" does little to encourage conservation because it still reflects a decrease in unit cost per gallon consumed. "A" shows the sharpest change as the consumption enters a new tier but this may be a difficult pricing structure to operate under, depending on the system's circumstances. "B" demonstrates the sharp indicator but may be more practical for a water system to implement.

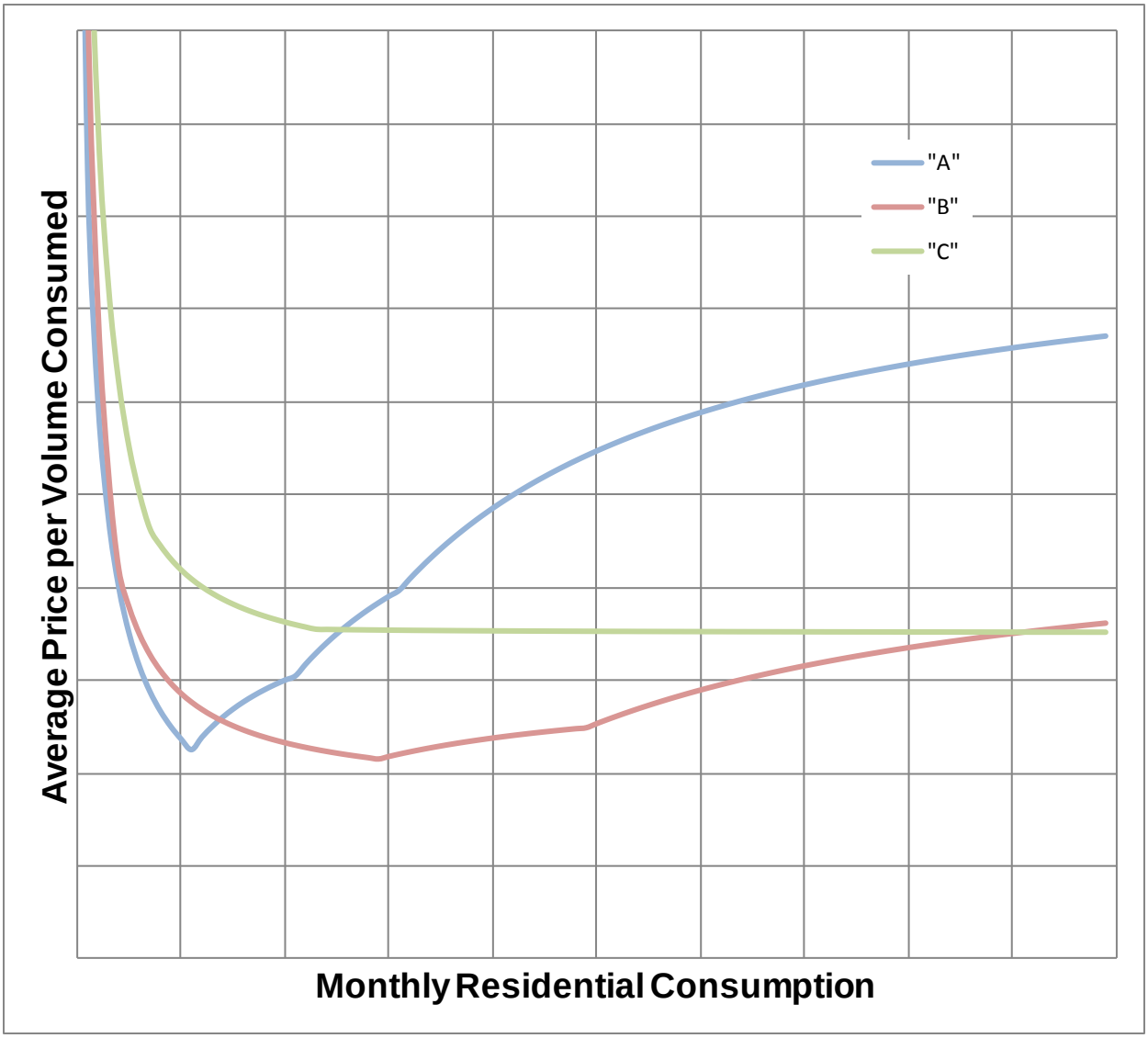


Figure 6.2: Representative Curves of Average Price Per 1000 Gallons Consumed by a Residence Monthly

Although pricing for water conservation is the focus of this document, clearly such pricing must be balanced with other issues. The USEPA's *Case Studies of Sustainable Water and Wastewater Pricing* (2005) describes sustainable pricing for better management practices, full-cost pricing, efficient water use and protection of watersheds. While informative, the much more practical document for water pricing from the USEPA is *Setting Small Drinking Water*

System Rates for a Sustainable Future (2006). This guide explains why pricing should be set to match actual cost of water and how to make such calculations. The seven step process can serve small water systems well in the development of a pricing scheme that doesn't just help with water conservation but allows for sufficient resources to provide high quality water, gradual rate increases for customers and sustainability of infrastructure.

6.3 Water Pressure

From the U.S. EPA *Water Conservation Plan Guidelines* (1998, p. 151):

> Reducing excessive pressures in the distribution system can save a significant quantity of water. Reducing water pressure can decrease leakage, amount of flow through open faucets and stresses on pipes and joints which may result in leaks. Lower water pressure may also decrease system deterioration, reducing the need for repairs and extending the life of existing facilities. Furthermore, lower pressures can help reduce wear on end-use fixtures and appliances.

Through pressure zone management, pressure reducers and supervisory control and data acquisition (SCADA), a water system can control the pressures delivered to customers to minimize excess flow rates or minimize the volume of water loss.

Water Conservation Plan Nexus

NRS §540.141(1)(c) requires, in part, that the plan has provisions for identifying and reducing high pressure in water supplies.

The target for system pressure in residential areas should be no more than 80 pounds per square inch (psi). However, the management of water pressure should not override other considerations such as system integrity or quality service to customers (USEPA, 1998, p151). In Nevada, NAC 445A dictates the pressure requirements for water systems. Per NAC 445A.6711, the static pressure at the lowest ground elevation of the zone should not exceed 100 psi.

6.4 Metering and Sub-metering

In order to effectively carry out many of the supply management practices described in earlier sections, universal (both system sources and all user accounts) metering is necessary. Accurate metering will enable audits and accounting/loss control. Just by virtue of metering customers and charging for quantities actually used, customers will have an economic incentive to reduce water use. A vital component of universal metering is maintaining the accuracy of meters and this is often done through a meter replacement program.

Water Conservation Plan Nexus

NRS §540.141(1)(c) requires, in part, that the plan has provisions for identifying and reducing inaccuracies in water meters. A meter replacement program can help achieve this objective.

♦ ♦ ♦

7.0 Drought Contingency Plan

A drought might reduce the supply of water or hinder its quality. A means to either reduce demand or otherwise supply the people in the water system with potable water is a responsibility undertaken by a supplier of water. A plan to address this contingency will allow for action to be taken quickly.

Water conservation and drought contingency is not synonymous (Shepherd, 1998). Water conservation is a tool to help mitigate drought and water conservation measures like curtailment of certain types of water use is a tool to reduce demand when supplies are limited during a drought.

Water Conservation Plan Nexus

NRS §540.141(1)(d) requires provisions relating to a contingency plan for drought conditions that ensures a supply of potable water.

A pro-active approach to drought contingency planning can minimize impacts from drought (Shepherd, 1998). By preparing for drought by building cash reserves, making agreements with neighboring water suppliers, having back-up systems in place, etc., drought can be met without operating in a crisis management mode.

Including stake holders in the drought contingency planning process can help gain support in its implementation (Shepherd, 1998).

While the State Drought Response Plan is an important document to reference, its purpose is to be a strategy for interagency cooperation at the state level (Nevada, 2012). For the water system manager, a more specific plan suited to the needs of the system and the community it serves is required. Wilhite (2005) provides a ten-step plan for drought contingency planning.

7.1 Water Restrictions

One approach to mitigating drought is to implement increasing restrictions on water use (e.g. prohibiting use of water for washing cars, sidewalks, etc. and establishing days and or times of days when lawns or other landscaping can be irrigated), often tied to stages of drought.

When this approach is taken, the typical contingency plan establishes stages of drought that parallel the State Drought Response Plan and scales the local response accordingly. If this approach is taken, the water manager should take care to decide what the state of drought is for the service area, since the State of Nevada Drought Response Committee under the state plan will be looking at county-sized determinations. The local situation may be different from what the broad strokes of the Drought Monitor may indicate. Also, the local water supplier is in a much better position for taking immediate or at least swifter action (Nevada, 2012).

7.2 Alternative Supply

An approach to help guarantee a supply of potable water for the community it serves, a water system may seek an alternative supply. Examples of such supplies sources are:

- ◊ Conjunctive use of surface and underground supplies
- ◊ Additional storage of surface water Aquifer storage and recovery
- ◊ Metered interties with neighboring water systems for water sharing
- ◊ Back-up wells or deepening of production wells

The water system manager must consider issues such as water rights and funding for capital improvements or emergency actions.

♦ ♦ ♦

8.0 References

8.1 Works Cited

Billings, R. Bruce and Clive Vaughn Jones. *Forecasting Urban Water Demand. 2nd Ed.* American Water Works Association. 2008.

Carson City Public Works Water Division. *Water Conservation Plan.* March 2011

Georgia Environmental Protection Division. *Water Conservation Education Programs Guidance Document.* August 2007.

Griffin, Ronald C. *Water Resource Economics : The Analysis Of Scarcity, Policies And Projects.* MIT Press 2006.

Nevada Division of Water Planning. *State Water Conservation Planning Guide.* April 1991.

Nevada State Climate Office, Division of Water Resources and Division of Emergency Management. *State of Nevada Drought Response Plan.* April 2012.

Renwick, Mary E. and Richard D. Green. "Do Residential Water Demand Side Management Policies Measure Up? An Analysis of Eight California Water Agencies." *Journal of Environmental Economics and Management*. **40** 37-55. 2000.

Shepherd, Anne. "Drought Contingency Planning: Evaluating the Effectiveness of Plans" in *Journal of Water Resource Planning and Management.* Vol. 124 No. 5 September/October 1998.

Utah Department of Natural Resources, Division of Water Resources. "Why Conserve?" Utah Division of Water Resources. January 23, 2012. http://www.conservewater.utah.gov/whyconserve/

U.S. Army Corps of Engineers (USACE) *Managing Water for Drought.* IWR Report 94-NDS-8. Water Resource Support Center, Institute for Water Resources. September 1994.

U.S. Environmental Protection Agency (USEPA). *Case Studies of Sustainable Water and Wastewater Pricing.* EPA 816-R-05-007. Office of Water. December, 2005.

U.S. Environmental Protection Agency (USEPA). *Setting Small Drinking WaterSystem Rates for a Sustainable Future.* EPA 816-R-05-006. Office of Water. January, 2006.

U.S. Environmental Protection Agency (USEPA). *Water Conservation Plan Guidelines.* August 6, 1998.

Wilhite, Donald A., Michael J. Hayes and Cody Knutson. "Drought Preparedness Planning: Building Institutional Capacity" in *Drought and Water Crises: Science, Technology and Management Issues*. Ed. Donald A. Wilhite. CRC Press. 2005.

Wong, Jennifer and Susanne Porter-Bopp. *Water Conservation Planning Guide for British Columbia's Communities*. The POLIS Project on Ecological Governance with the BC Ministry of Community Development. March 2009.

8.2 Works Referred

Kenny, J.F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K. and Maupin, M.A. *Estimated Use of Water in the United States in 2005: U.S. Geological Survey Circular 1344.* 2009.

8.3 Recommended Resources

Davis, William Y. *Water Demand Forecast Methodology for California Water Planning Areas - Work Plan and Model Review*. Report Submitted to California Bay-Delta Authority. July 29, 2003.

planning.usace.army.mil/toolbox/index.cfm – The United States Army Corps of Engineers planning toolbox is another resource with publications on water planning, conservation planning and drought planning.

tmwa.com/conservation − This webpage on the Truckee Meadows Water Authority website provides a variety of helpful information, including water saving tips, educational materials and an excellent landscape guide.

U.S. Army Corps of Engineers, Institute for Water Resources, April 1994: Water Use Forecasts for the Boston Area Using IWR-MAIN 6.0 (IWR Report 94-NDS-11).

U.S. Army Corps of Engineers, Institute for Water Resources, (to be published in 1994) Trigger Planning for the MWRA Service Area (IWR Report 94-NDS-12).

U.S. Environmental Protection Agency. *Water Conservation Plan Guidelines*. August 6, 1998.

www.awwa.org/ − The American Water Works Association provides a variety of educational and technical resources.

water.epa.gov/infrastructure/sustain/Water-and-Wastewater-Pricing-Introduction.cfm - The US EPA has helpful resources on water and wastewater pricing, with an eye towards pricing water to support aging infrastructure and to represent the scarcity of water.

www.irrigationtutorials.com/ − Not only does this website have many useful articles on installing and maintaining irrigation systems (including drip irrigation) but also it provides tips, suggestions and instructions for water efficient landscaping (how and when to irrigate in windy areas, reducing loss due to low head drainage from sprinklers, use of automatic sensors and controllers, etc.).

www.nrcs.usda.gov – The Natural Resource Conservation Service (NRCS) not only has educational resources on its website, it provides certain technical assistance that farmers and ranchers may find of use.

www.snwa.com/consv/conservation.html − This webpage on the Southern Nevada Water Authority website is an example of how the internet can be used to provide a variety of customer specific information in promotion of water conservation.

www.wateruseitwisely.com/ − This website provides tips and links to other resources that may prove to be a useful reference in water conservation education programs.

Project WET

UNR Cooperative extension

WaterSENSE – materials available to partners

Appendix A: Water Conservation Plan Checklist

NRS § 540.141 (Required by NRS §540.131)

1. Provisions relating to:

(a) Methods of public education to:

- ☐ Increase public awareness of the limited supply of water and the need to conserve water
- ☐ Encourage reduction in the size of lawns and the use of arid and semiarid plants
- ☐ (b) Specify water conservation measures required to meet the needs of the service area

(c) The management of water to:

- ☐ Identify/reduce leakage in water supply, inaccuracies in water meters and high pressure in water supply
- ☐ Increase the reuse of effluent, where applicable
- ☐ (d) Provide a drought contingency plan that ensures a supply of potable water
- ☐ (e) Schedule for carrying out the conservation plan
- ☐ (f) Measures to evaluate the effectiveness of the conservation plan
- ☐ (g) Estimate the amount of water conserved yearly, in gcpd, as a result of the plan

2. Analysis of:

- ☐ (a) Feasibility of charging variable water rates to encourage the conservation of water
- ☐ (b) How the rates to be charged for the use of water will maximize conservation

NRS § 540.151 (Filed for informational purposes)

- ☐ Provide incentives to encourage water conservation
- ☐ Provide incentives to retrofit existing structures with water fixtures that conserve water
- ☐ Provide incentives for the installation of landscaping that uses a minimal amount of water

Appendix B: Nevada Rural Water Association: Water Conservation Plan Template for Small Water Purveyors