A Template to Enhance Regional Water Supply Planning

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Master's Thesis submitted to the Faculty of Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Urban and Regional Planning

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June 22, 2004
Blacksburg, Virginia

Keywords**:** regional, water supply, integrated, planning, comparison.

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(ABSTRACT)

Regional water supply planning can be performed in a variety of ways and the impetus behind the creation of a regional water supply plan is as diverse as the constituents the plan serves. Formal water supply planning has been occurring for the last fifty years and a review of recent literature suggests that trends in water supply planning are leading to regional, integrated planning. Integrated regional water supply planning includes aspects of land use, population growth, environmental impacts, and planning for water supply to meet the needs of a region.

A water supply plan outlines the water goals of a region. The regional water supply planning process can be assisted through the use of planning instruments such as an integrated plan template and a regional plan comparison checklist. The primary function of this thesis is to offer tools to guide the water supply planning process. The purpose is to enhance water supply planning by providing a template for integrated regional water supply planning. This thesis provides the planner with three tools: 1) an integrated plan template; 2) a condensed template; and 3) a regional plan comparison checklist. The primary contribution, the integrated plan template, is the result of a list of common water supply plan elements drawn from the current body of knowledge that can serve as a guide to inform community learning about regional water supply planning and/or aid in the structure of new plans.

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Chapter 1: Introduction

Introduction to Water Supply Planning

Water supply planning involves evaluation of the capacity of alternative water supply sources to meet projected demands (Prasifka, 1994). Water supply planning covers a broad spectrum of issues and deals with specific aspects of water management such as demand management or pollution control. The water supply planning process concentrates on planning and management of water supplies over a broad area (Dzurik, 2003). Formal water supply planning has been occurring for the last fifty years and a review of recent literature suggests that trends in water supply planning are leading to regional, integrated planning. Integrated regional water supply planning includes aspects of land use, population growth, environmental impacts, and planning for water supply to meet the needs of a region.

A formal water supply plan helps coordinate land use planning, growth management, and natural supply management efforts. A water supply plan outlines the water goals and needs of a region. Planning tools such as the integrated plan template and the regional plan comparison aid integrated planning for water supply. This thesis provides the planner with three tools: 1) an integrated plan template; 2) a condensed template; and 3) a regional plan comparison checklist. The tools can be used to create a wide-ranging, integrated, regional water supply plan.

Statement of purpose

The primary function of this thesis is to offer tools to guide the water supply planning process. The tools intend to enhance water supply planning by providing a template for integrated regional water supply planning.

Often water supply problems are regional in nature. A group of local governments, municipalities, or communities who elect to work together on a water supply plan generally define a "region." Often a region includes localities within a geographic boundary or geographic proximity to each other. Integrated regional water supply planning considers the supplies and demands for a regional area. Integrated water supply plans manage supplies for the entire area to assure that all localities can continue to grow and have adequate water.

Integrated planning incorporates other types of planning such as transportation planning, natural resources planning, and land use planning into a water supply planning process. The integrated plan template presents ideas for new supplies, demand reduction, and facility management to improve the use and delivery of water.

A template can aid the creation of an integrated regional water plan and guide the planning process. This thesis offers an Integrated Plan Template for consideration during a regional water supply planning process. For the purpose of this thesis, a template outlines a possible list of elements that can be included in a regional water supply plan, and it proves capable of modification to meet local conditions.

The Integrated Plan Template is a list of elements taken from current literature and documents in the field of water supply planning. The combined elements cover general areas that a regional water supply planning effort can include to create an integrated regional water supply plan. The template can be a guide during the scoping phase of the planning process and it can outline

elements to include in the remainder of the process. The template can also be a reference throughout the planning process to integrate elements of land planning, transportation planning, and natural resource planning into the water supply plan for a region.

Utilizing the template can advance the quality of regional water supply plans. The template provided in this document to serves as a reference for future planning efforts and as a summary of current knowledge. One purpose of the template is to guide an integrated regional water planning effort. This thesis creates the template to assist current and future planning efforts, and compares the template to four regional plans to demonstrate how the template is used in part of the planning process.

Research Objectives

This thesis proposes two research objectives. First, a template will be developed for integrated regional water supply planning through the incorporation of literature and practice by delineating necessary elements of an integrated regional water supply plan. Second, the thesis will apply the template at one stage of the planning process by comparing a sample of existing regional water supply plans to the template.

Methodology Overview

This research structures a process for utilizing the template during one part of the planning process. Regional plan content is compared to the integrated plan template through the use of a regional plan comparison checklist. Chapter 5 contains a description of research methodology. Four criteria determine the selection of regional plans for evaluation: 1) Currency, 2) Geographic Location, 3) Plan Scale, and 4) Scope of Information. Chapter 5 also cites adapted definitions of metropolitan and regional areas, further clarifying regional plan selection criteria.

Document Overview

This thesis provides a method for regional, integrated water supply planning. Chapter 1 gives an overview of water supply planning, the purpose of this research, the research objectives, and the approach to research taken in this document. Chapter 2 explores water supply planning literature. The second chapter includes a review of the history of water supply planning, a summary of the current state of affairs, a listing of non-traditional elements in water supply planning, and an overview of the connections between water supply planning and land use planning. Chapter 3 provides an overview of the creation of the template and the content of each of the template sections. Chapter 4 describes how the water supply planning process utilizes the template. Chapter 5 outlines the research methodology for this thesis and summarizes the results of regional plan comparison with the checklist. The final chapter provides a summary of the document and information for the future of the research.

Chapter 2: Water Supply Planning

Regional Planning

Water supply planning plays a large role in determining the future of a community, town, city, or region. Localities often limit consideration to only their own comprehensive plan and independent vision for development and water use in their own area when deciding on new directions for growth. However, water supply problems tend to be local or regional in nature (Bagwell & Personett, 1997). Water supply sources fail to respect political boundaries and require protection on a regional basis (Southworth, 1998). Due to the regional nature of water supplies, regional water supply plans should manage supplies for an entire area to assure that all localities can continue to grow and have adequate water now and in the future.

Regional water supply plans provide guidance for water supply management and growth strategies for a region. Such plans integrate local water supply plans into one integrated vision. The term "regional" in this context means a collection of local governments, municipalities, or communities, which have elected to work together on a water supply plan. The region may include those that desire to be involved in the planning process, or those localities within a geographic boundary or geographic proximity to each other. The United States Census Bureau defines a region as "a core area with a population nucleus, together with adjacent communities that have a high degree of economic and social integration with that core" (U.S. Census Bureau, 2001, 8) and as "designated by one or more counties or by a group of cities and towns" (U.S. Census Bureau, 2001, 8).

Regionalization of water systems "creates an appropriate management or contractual administrative organization or a coordinated physical system plan of two or more community water systems in a geographical area for the purpose of utilizing common supplies and facilities to their optimum advantage" (Prasifka, 1994, 27). Regional water plans not only give structure to regional governmental coordination, but they also provide a vehicle for data compilation on the state of water supplies. Regional water plans may explore innovative methods of growth management, environmental preservation, water supply creation, social equity, and demand management.

A variety of ways exists to approach regional water supply planning. Likewise, the impetus behind the creation of a regional water supply plan proves as diverse as the constituents the plan serves. Upon comparison; however, some regional plans contain similar elements. This thesis results in a list of common water supply plan elements drawn from the current body of knowledge that can serve as a guide to inform community learning about regional water supply planning or aid in the structure of new plans.

A review of literature suggests that water supply planning is best performed at a regional level. Lampe, Andrews, and Kisinger, 1996, 42, state that logical water supply planning occurs at the watershed or regional unit and "natural hydrologic units are the only foundation for successful comprehensive planning efforts". Local agencies fail to achieve their optimal supply mix without wasting time and money, obstructing regional solutions or exploiting neighbors (Atwater & Blomquist, 2002). Combining the human talents of the region to coordinate the finances and natural supply available to multiple agencies holds greater promise than determining the fate of shared supplies in a dispersed and segregated manner (Atwater & Blomquist, 2002). Regional

water supply planning also allows for greater regional flexibility, a more efficient supply of peak day demand, and provides a central emergency reserve to replace any community water impacted by contamination or other emergency (Toneatti & Stinson, 2002). The North Carolina State Water Supply plan summarizes the main benefits of regional water supply planning by stating:

> Water is a regional resource and local governments will need to seek regional solutions to water supply issues. Regional water supply planning and management is critical to successful long-term protection of quality and quantity of water. The increasing costs and requirements for planning and permitting new facilities, treating water, and developing additional water sources will make it less practical for many communities to act independently to meet future water supply needs. (North Carolina State Water Supply Plan Executive Summary, 2, 2001).

The state of Texas presents a case study of regional water planning on a large scale. In 1997, the Texas legislature passed Senate Bill One, which completely redefined water planning in the state (Ashworth, 2002). The bill delegated responsibility for water planning to 16 designated planning regions. The regional water plans provide for the orderly development, management, and conservation of water supplies, prepare for, and respond to drought conditions (Texas State Water Plan: Drought, Conservation, Development and Management, 1997). The Texas regional plans "ensure that all communities have available water supplies and infrastructure to develop those supplies during especially severe drought conditions over the next 50 years" (Ashworth, 24, 2002).

The regional coordination inherent in regional water planning creates economies of scale. Cost savings are evident when regional systems are compared to the alternative of multiple water supply and treatment systems serving the individual needs of counties and municipalities ("Regional water system offers solutions to water needs", 1996). Regional water planning can broaden participation in the development of the plan and increases the plans' overall effectiveness (Bagwell & Personett, 1997). The regional planning process can also improve cooperation among state agencies, local, and regional water interests, and the public (Bagwell & Personett, 1997). The Virginia Water Policy Technical Advisory Committee suggests that areas incorporate incentives to encourage regional cooperation and economies of scale (Virginia Department of Environmental Quality, 2003). The committee also indicates that a local or regional focus in water planning is appropriate and in doing so, a planning team can view water supplies more broadly. (Virginia Department of Environmental Quality, 2003).

A regional planning effort

- Offers economies of scale because the cost of doing water supply analysis as individual providers is prohibitive.
- Helps individual localities understand the "big picture". By examining issues in regional, sub-regional, and hydrologic sub-basin contexts, regional planning provides an understanding of complex, interconnected issues that extend beyond jurisdictional and service area boundaries.
- Encourages program and project development. Using an integrated approach helps ensure the success of regional demand management efforts and reduce the risks associated with permitting of supply projects.
- Facilitates public involvement and decision-making. An integrated planning process incorporates public values into the analysis, and displays the benefits, costs, impacts, and risks of "alternative water supply futures" in ways that people can understand.

- Demonstrates accountability as a public service provider. Participating in a planning effort provides the opportunity to plan and operate regionally as a responsible water provider (Stickel & Fiske, 1996, 316).

Regional water planning necessarily coordinates future demands for water and land to retain the potential for high quality water and community growth. Individual water utilities are necessarily affected by, and dependent upon, decisions made by separate multiple land use permitting agencies. Streamlining the process will only help small water providers. Further, land use decisions affecting drinking water supplies are intricately interwoven with ecological, economic, hydrogeological, park and recreation management, civic and other considerations (LoGrande, Corwin & Hopkins, 1995). Water supply protection in a multi-agency context requires coordination throughout the geographic watershed, across government entities, and permanently into the future (LoGrande, Corwin & Hopkins, 1995). Integrated water supply planning at the regional level is "inevitably multidisciplinary" (Whipple & Werick, 1994, 1003). A responsible water supply planner at the regional level must review alternative solutions to water supply and demand (Whipple & Werick, 1994).

Planning Approach and Theory

In addition to reviewing alternative solutions, water supply planning must also incorporate a suitable approach to planning and planning theory during the planning process. The planning process generally uses one of four theories: rational-comprehensive, incremental, participatory, or advocacy (Randolph, 2004). The rational-comprehensive approach consists of five basic steps; forming objectives, gathering information, forming alternatives, evaluating impact assessment, and plan evaluation (Randolph, 2004). One criticism of rational-comprehensive planning is that the approach is characterized by the belief that outcomes are predictable and plannable, and often one approach or plan cannot predict every possible outcome or result from the interactions of a complex social system (Lane, 2001). In reviewing the model's flaws, the rational-comprehensive planning model has given rise to several other planning models, and has matured with adaptations to the original.

Despite the dominance of rational planning throughout much of the history of planning, alternative perspectives on planning approach have developed in recent years (Lane, 2001). The rational-comprehensive model of planning provides a foundation for other models to build upon. The incremental approach focuses on short-term goals and objectives and small sequential actions (Randolph, 2004). Recent planning theory, a form of incremental planning, is generally labeled "adaptive" planning (Randolph, 2004). A participatory approach focuses on including the public and stakeholders in decision-making and other aspects of the planning process (Randolph, 2004). An advocacy approach generally requires the planner or planning process to focus on representing underrepresented and often less vocal groups (Randolph, 2004).

The most recent approaches to planning theory are participatory in style and are concerned with developing shared solutions to planning issues (Lane, 2001). Most approaches advocate learning the perceptions and concerns of others and share responsibility for planning outcomes (Lane, 2001).

This thesis assumes a planning process that generally follows a rational-comprehensive model of planning; however, the purpose of the template is to guide the planning process. The guiding philosophy of the template steers the process toward a more adaptive and participatory style. The template is intended for use as a tool to complement the existing strategies, goals, and values of a particular community. Use of the template as a supplement to existing strategies helps to produce a participatory planning process and informs community learning.

Water Planning History

Though water supply planning occurs in most of the world, international examples of water planning have less in common with examples of water supply planning in the United States. Because comparisons of regional planning may differ on an international scale, this thesis focuses on comparisons of regional water supply planning in the United States.

In the United States, water historically has been considered an inexhaustible resource, with little concern for pollution, purification, development of future supplies, or actual costs. Water most often comes from individual wells or surface water, and has been consumed and provided individually. Because there has been such free access to water, water is viewed as a public good, without limit to its supply. More formal management of water in the United States came with the introduction of irrigation through large ditches and the construction of canals in the 1870's (Dzurik, 2003). At that time water still had a very low market price but it began to be recognized as a supply that did have costs (Dzurik, 2003). Water supply planning exists on a false foundation due to the artificially low price of water in recent times. "There is not a shortage of water, but only difficulty in getting the available water to where it is needed at low cost and with minimal negative impacts" (Dzurik, 2003, 5).

The availability of water has been generally taken for granted, especially in water rich states. Most of the Unites States enjoys the luxury of constant, free, pure, water. Because of readily available water, modern society has found many ways to provide water at a low cost. Millions of dollars have been spent developing water supply and distribution systems to satisfy the requirements of domestic, commercial, and industrial users (Dzurik, 2003). Increasing demand, increasingly urbanized areas, and rising populations place financial burdens on water suppliers (Dzurik, 2003).

In the 1870's water economies in the western United States began in an "expansionary" phase, when new supplies were readily available, few interdependencies existed among users and, after accounting for federal subsidies, projects were relatively inexpensive (Luecke, 1993). In western water economies today; however, new supply costs are escalating; elaborate physical and economic systems link water users, and federal subsidies have evaporated, moving western economies into a "mature" phase (Luecke, 1993). This scenario proves common to water users in other parts of the country. Western water economies provide a reference to help existing systems determine which direction their supply planning should go to prepare for the future.

Like western water economies, eastern and other water systems find themselves in similar "mature" states and look to collaboration and interdependence to use water supplies wisely to meet future demands. A review of historic water supply allocation determines whether treated and pure waters are being used to their highest value. Mature water systems rarely segregate water uses for domestic or agricultural uses (Luecke, 1993). Some water uses may not require

the same level of water quality that is necessary in others. Water providers are beginning to recognize the value of "instream uses" that benefit natural areas and the value of providing water for potable and non-potable uses. Water providers have recently questioned whether "premium" water should be supplied indiscriminately for all purposes.

Drinking Water Standards

Water supply plan creation occurs within legal and political constraints, and varies based upon the situation. Burson, 2000, 562, states, "Any regional water plan must attune itself with the institutional restraints of the water management system." Two such restraints on water supply planning are federal drinking water standards and the Safe Drinking Water Act.

Federal drinking water standards originated with the Interstate Quarantine Act of 1893 (Raucher, 1996). The act authorized the Surgeon General to make and enforce regulations to prevent the introduction, transmission, or spread of communicable diseases in the U.S. (Raucher, 1996). Additional regulations followed including a 1942 regulation requiring bacteriological samples to be taken from water distribution systems, the application of quality standards to all water supplies in 1946, and the requirement of qualifying personnel to operate water supply systems in 1962 (Raucher, 1996). The inadequacy of the 1962 regulations became apparent by 1969, when only 59% of the nation's water systems met the existing standards (Raucher, 1996). Efforts to revise drinking water regulations began in Congress in 1971 and eventually succeeded with the passing of the Safe Drinking Water Act into law in 1974 (Raucher, 1996).

The purpose of the Safe Drinking Water Act (SDWA) is to assure that the public is provided with safe drinking water and that water supply systems meet minimum national standards to protect human health (Raucher, 1996). The SDWA provides community drinking water standards and water supply monitoring and reporting requirements (Randolph, 2004). The SDWA has since been amended in 1986 and 1996. The amendments recognize the limitations of water treatment to ensure safe drinking water and increase emphasis on the protection of water sources (Randolph, 2004). The SDWA applies to every public water system in the United States (Environmental Protection Agency, 1999).

To ensure that drinking water is safe, SDWA sets up barriers against pollution including, source water protection, treatment, distribution, system integrity and public information (Environmental Protection Agency, 1999). The purpose of a water supply plan under the SDWA is to maintain the quality of the ground water in critical protection areas in a manner that protects human health, the environment, and ground water resources (Safe Drinking Water Act Amendments, 1986). In Part C, Section 300h-6(f) of the SDWA, the act lists specific requirements of a comprehensive plan for critical area or source protection. SDWA source protection plan requirements include:

- A map showing the boundary of the area
- An identification of existing sources
- An assessment of the relationship between activities on the land surface and ground water quality
- Actions and management practices to be implemented to prevent adverse impacts on water quality
- Identification of the authority adequate to implement the plan and an estimation of program costs.

The source protection plan requirements in the SDWA present a basic framework for an overall water supply plan and provide a starting point for water supply planning. Each water supply plan must accomplish the basic requirements mandated by the SDWA and secondarily provide for the specific needs of a region. By assuring that water is safely provided and impacts on the environment are considered, the SDWA sets up the base level of study necessary to complete a thorough water supply plan.

Current Trends

Referencing the SDWA and other historic water policy provides valuable lessons about the process of water supply management. To create a more sustainable and well-planned future, the challenge is to move away from the historically detrimental practices of minimal water costing, water pollution and excessive use or waste of water supplies. The historic trend of water as an inexpensive, inexhaustible supply is waning, and new movement toward adaptable regional provision, environmental protection, and adequate supplies is taking hold.

Current water supply planning comes in many forms, from a small town drawing water off a single well to a metropolitan area providing water and sewer for millions of people. Due to the diversity seen in water supply plans, regional plans vary in their focus. "Balancing economic viability while protecting important environmental resources," (Bagwell and Personett, 1997, 66) provides one focus. Water supply planning can also "protect against water supply shortages, protect future water supply areas, allow a water supplier to prepare a capital budget, and promote management of existing supplies including leak detection and water conservation" (Wetzel, 1990, 137).

Water managers evaluate options to serve their local constituents and do not always consider the implications of their actions regionally. To provide the highest quality service, to the most users, with the least impacts, recent focus is shifting toward regional management of water supply (Dzurik, 2003). In southern California, one regional water supply plan has been created and revised several times to adjust to changes in law and water supplies (Atwater & Blomquist, 2002).

The Metropolitan Water District (MWD) in Southern California provides an example of an adaptable water management plan. The MWD was created in 1928 and Metropolitan is one of the earliest examples of a regional water supply planning district (Atwater & Blomquist, 2002). The MWD has financed, built, and operated facilities to deliver water to 14 cities, 11 municipalities, and 1 county since its inception. Recently the MWD made changes to update its services and vision. The changes include a revisioning of the agency, a reexamination of how MWD will meet future water needs and allocate water during shortages, and a restructuring of MWD's rate system (Atwater & Blomquist, 2002). The MWD also shifted its role from a water supplier to a water supply manager and focused on selecting a "supply mix" for the region (Atwater & Blomquist, 2002). The MWD utilizes Integrated Resource Planning (IRP) to determine if current supplies will meet current and future demands. During the course of the IRP process, the MWD determined that imported water supplies fail to meet future demands and developing additional imported supplies will be more expensive and more risky than meeting demand with local water supplies (Atwater & Blomquist, 2002).

The MWD example demonstrates the type of process and analysis that will need to occur for other new or existing regional water supply plans. The MWD process illustrates three important pieces: 1) creating a vision for the agency and the plan, 2) examining how to meet future water needs and allocate water during shortages, and 3) restructuring rates to more accurately convey the cost of water. Critical issues in the MWD plan include infrastructure coordination and planning for water, sewer, and flood control to meet the needs of a region (Atwater & Blomquist, 2002). Each locality could "take care of its own" and manage water independently of the MWD. However, individual water management is not the best approach in this situation (Atwater & Blomquist, 2002). Regional leadership in the planning of flood control, wastewater, and water facilities, potentially saves billions and avoids needlessly redundant local projects (Atwater and Blomquist, 2002).

Future Trends

Water supply planning presents an expensive future. Components of a water price include increased treatment requirements, longer distances to receive or supply water, and mounting repair costs on facilities and water lines, all of which - in combination or singly - make new water supplies more expensive. The expense and the critical nature of water in our daily lives earn water supply planning a prominent place among the most pressing issues for the future. Water planning must ensure that scarce resources of money, time, and water are not wasted (Atwater & Blomquist, 2002). If population growth proceeds at current rates, projections show enough water in the United States to meet demand until 2010 or 2020. In this decade, planners need to plan, fund, and finish water supply projects before water supplies reach a critical point (Atwater & Blomquist, 2002). "Without proper planning we will almost certainly be forced to dramatically change the way we use our water resources" (Wetzel, 1990, 139).

The future of water supply planning lies in regional cooperation and management. Individual water managers will no longer be able to serve their communities without affecting their neighbors at some point. Water resources are not bound by jurisdictions and management of those resources should also cross boundaries. Future planning will include traditional elements and new approaches to supply and demand issues. The coming years will bring greater connectivity between water supply, comprehensive, land use, and transportation plans. All plans share common elements and economic considerations will dictate the necessity of coordinating these plans.

Emerging Elements in Water Supply Planning

Current plans are beginning to include the supply planning elements of conservation, drought management, environmental and groundwater protection initiatives, long term financing needs, water quality projects, and diverse water supply sources. Newer plans align environmental preservation goals and water supply planning objectives. In urbanizing areas, "the protection of watersheds draining into water supply reservoirs against development pressures often presents problems and similar situations confront water supply systems" (Whipple, 1993, 495). While water projects often support well-defined activities such as irrigated agriculture, recreation, municipal water supplies, flood control and hydropower, few include in-stream values such as fish and wildlife as an integral part of project planning and construction (Piper and Platt, 1998). One plan seeks to bridge the gap between water supply planning and environmental planning. In North Dakota, a land use management plan allows land development for irrigation while preventing the decline of wetlands (Piper and Platt, 1998). Additionally, "with a suitably

adapted non-point source control strategy, it should be possible to allow development, but with restrictions such as to avoid much of the pollution" (Whipple, 1993, 495).

Water supply plans now often include the related concepts of drought management and demand management. Guidebooks for drought planning exist to assist water supply planners. Some researchers now view drought management as a subset of water supply planning and include drought response problems as water management problems (U.S. Army Corps, 1994). The Army Corps, 1994, 3, states, "The distinction between a "drought" problem and a "water supply" problem is essentially defined by the nature of the best solution." Strategic water supply planning often mitigates the consequences of drought well in advance of the actual event.

Drought Planning

Drought planning also relates to water scarcity. Information on the availability of water and trends in water availability provide a context for governments and water planners as they address water related challenges (Luketina & Bender, 2002). Factors such as population growth, consumption rates, climate changes, the limitations of water storage to offset annual water supply variability, water pollution and land use changes influence water availability (Luketina & Bender, 2002). The revised plan for the Metropolitan Water District in southern California includes drought planning and the creation of a water supply plan covering a 50-year horizon (Atwater & Blomquist, 2002). Drought planning lessens the impacts of continuing drought and helps urban agricultural and environmental interests meet their critical water supply needs (Jercich, 1997). Drought planning influences water supply planning at a regional level and frames what elements planners will want to consider in their supply plan.

Integrating regional water solutions helps to overcome different agency missions and political boundaries. Collaboration between agencies and stakeholders increases effectiveness in the planning process (U.S. Army Corps, 1994). A collaborative approach harnesses the knowledge and creativity of stakeholders near the beginning of problem solving efforts. With additional knowledge, stakeholders will more likely take action to reduce drought vulnerability. Collaboratively reducing drought builds broader, deeper stakeholder support for water supply plans (U.S. Army Corps, 1994).

Demand Management

Demand management provides another way to extend supplies and plan for future water use. Demand management approaches demand as a variable that can be increased or decreased, similar to supply. While water plans often seek to increase supply to meet demand, demand management looks to decrease demand to meet supply. More often than not, plans incorporate both supply and demand management techniques. Demand management measures traditionally rely on modifying consumption patterns and decreasing demand by means of education, low volume water fixtures, water rationing, tiered water pricing, and control of landscaping (Wilchfort & Lund, 1997). One example of an aggressive demand management program in Boston, Massachusetts includes water conservation, leak control, and public education; to maintain demand below the safe yield of the reservoir system. Safe yield information proves critical to planning for additional demand management and water supply augmentation activities (Kirshen& Fennessey, 1995).

Supply Enhancement

Current water supply plans also consider supply enhancement or alternative supplies. Alternative supplies include water reuse, desalination, and rainwater capture. Supply enhancement measures include new water supplies from new reclamation facilities, water transfers, improving existing system operations, and increased use of groundwater (Wilchfort & Lund, 1997). Some areas include planning for ground water as a primary source. The state of Texas uses groundwater to supply 58% of its water needs, and regards planning for ground water as a "critical" element in integrated water supply planning (Mace, Mullican & Williams, 2002). The expense and controversy of expanding most traditional water supply sources encourages efforts to add transferred water to urban supplies (Lund & Israel, 1995). Water supply agencies in the western United States integrate water transfers into their overall water supply planning as a supply enhancement measure (Lund & Israel, 1995). When incorporating water transfers or any additional water source "planning requires greater cooperation and coordination between urban, agricultural, and environmental water users" (Lund & Israel, 1995, 41).

For more integrated regional water provision, inclusion of supply alternatives leads to improved water use efficiency (Bagwell & Personett, 1997). Regionally, a larger set of local supplies become economically viable by treating brackish groundwater or purified wastewater (Atwater & Blomquist, 2002). Using local supplies as supply sources also adds an element of equity to regional water plans. Generally, each locality involved in a regional plan has access to some type of local water source that supplements an individual locality's water supply (Atwater & Blomquist, 2002).

The development of innovative demand management and supply enhancement measures generally occurs in response to water shortages and threats of water shortages (Wilchfort & Lund, 1997). Additionally, inadequate supply adversely influences affected communities. However, excessive water supply development can produce unnecessary environmental disruption and other undesirable effects (Cox, 2003). Comparing existing capacity to current and projected demands on the system leads to identifying surpluses or deficits and planning necessary corrective actions (Cox, 2003).

Supply Alternatives

Many localities struggle with how to meet current and future demands on water without actually increasing the supply of water. "New" supply options include using stormwater runoff as a supply or using other forms of wastewater for non-potable supplies. Some localities look to conservation for new supplies. In the Middle Rio Grande Basin in New Mexico, current water demand in the region consumes all of the available supplies. In the Middle Rio Grande, requiring a gallon for gallon decrease by members of the community is the only way to provide for any new demand on water (Burson, 2000).

Water supply planning includes stormwater management and runoff control. In some areas, stormwater is an additional supply source and contributes to the natural hydrology of an area, if managed properly. Rising costs to develop protected sources and increasing pressures to use polluted sources, makes stormwater an attractive water source (Okun, 1977). However, stormwater treatment is expensive, and many areas are looking into source water protection as an alternative. While water treatment processes remove most of the pollutants introduced by stormwater runoff, the construction and operation of treatment facilities is expensive. In many

cases, the efficiency of maintaining the quality of the water supply through source protection measures such as on-site stormwater control, stormwater treatment and land use management is more economical than utilizing stormwater as a water supply source (Kuhner, de Lucia & Shapiro, 1977).

Source Protection

Source protection allows utilization of current sources to continue and protects potential future sources. Recent studies question whether the application of treatment technology on water sources actually produces safe drinking water (Virginia Water Central, 1998). The retreat from reliance on treatment is due in part to an increased emphasis on preventing contamination of source water (Virginia Water Central, 1998). Coordinating source water protection programs with plans that require an inventory of land uses, such as economic development plans, alleviates the need to rely so heavily on water treatment. A coordinated source water protection program complements an integrated water supply plan. Source water protection provides a cost effective strategy for ensuring safe drinking water supplies because poor water source supply increases the costs of treatment, and development of new water supply is often expensive (Virginia Water Central, 1998).

Some supply problem solutions evolve from a joint review of plans for new source development with plans for protection of pristine sources. One option is to avoid utilizing polluted sources for potable supplies by drawing only upon protected sources for potable water. The use of reclaimed wastewaters or other polluted sources for non-potable purposes allows limited upland and ground water sources to be available for potable purposes (Okun, 1977). Regardless of the strategy adopted, prudent water supply planning identifies protected sources of water, develops sources when necessary, and, where not yet needed, protects pristine sources from industrial and urban encroachment for preservation of future public water supplies (Okun, 1977). Additionally, in areas where protected sources fail to meet public water supply needs, high quality uses restrict use of protected sources by substituting adequately treated wastewaters or polluted river waters for many non-potable uses (Okun, 1977).

Water Pricing

Water supply plans are beginning to include water pricing that reflects actual costs (U.S. Army Corps, 1994). Often this "reflective pricing" includes a revised rate structure and a capital budgeting plan. In a restructuring of its regional water supply plan, the Metropolitan Water District (MWD) of southern California recently included a new rate structure and a capital improvement program to incorporate future costs and revenues (Atwater & Blomquist, 2002). MWD rate restructuring intends to promote conservation and reduce the district's reliance on property tax revenues (Atwater & Blomquist, 2002). The MWD process emphasized 1) unbundling of rates to more clearly identify cost components of water provision, 2) allocating costs across users more intentionally, based on which user behaviors were driving which costs, and 3) incorporating system capacity constraints and promoting conservation by imposing additional charges for peaking and growth of demand (Atwater & Blomquist, 2002).

Additionally, rate structures encourage conservation in communities with metered water (Sudol & Dresdner, 1995). Many communities adopt this technique on the assumption that the demand for water is tied to price and that an increase in the price of water will result in a significant reduction in use (Sudol & Dresdner, 1995). Throughout the United States, increasing numbers

of water utilities implement a variety of conservation-oriented rate structures with a goal of promoting efficient water use among their customers (Cuthbert & Lemoine, 1996).

Traditional rate schedules either charge each water user a set amount, regardless of how much water is consumed, or charge less per unit of water as more water is used (Sudol & Dresdner, 1995). In contrast, conservation rates charge large users more (Sudol & Dresdner, 1995).

Conservation-oriented rate structures include seasonal rates, inverted-block rates, and excess use rates (Cuthbert & Lemoine, 1996). Seasonal rates incorporate two or more different uniform volume charges for different seasons during the year. Inverted block rates increase rates for units of water consumption at higher levels of use. Excess use rates define a base water rate as the average use during a certain non-peak period and water is charged at a base rate during a peak period or season. Water use above a percentage of this base level is charged at the base rate plus an excess use rate. For comparison, a rate structure that is not conservation oriented is the uniform commodity rate structure. Uniform commodity rates are those in which all water use is charged at the same unit rate.

The most aggressive rate structures exist in areas where water supplies are limited and new supplies are expensive or difficult to obtain, particularly in the western and southeastern United States (Cuthbert & Lemoine, 1996). Recent trends point to water utilities shifting away from traditional rate structures toward a more conservation-oriented rate structure. Conservation rates help current utilities manage existing supplies and equitably recover the costs of new, more expensive supplies (Cuthbert & Lemoine, 1996). Intrinsically, conservation-oriented rate structures convey the message that water is a valuable supply worth conserving and using wisely (Cuthbert & Lemoine, 1996).

Water Supply Planning in Conjunction with Land Use Planning

For the long term, using tools to integrate water supply planning with land use planning is beneficial and productive. Protection of drinking water supplies over time inevitably leads to issues of area wide land management policies, demonstrating the link between water supply planning and land use planning (LoGrande, Corwin & Hopkins, 1995). Intensive land uses negatively affect water supplies by polluting potable water sources or affecting water supply yields. Elimination of incompatible land uses, such as heavy industry or commercial agriculture, near water supplies is crucial for future planning. The challenge for water supply planners includes incorporating demand management into long-range water supply planning to achieve an appropriate balance between capacity expansion and conservation (Maddaus, Gleason & Darmody, 1996).

Water projects historically support well defined activities such as irrigated agriculture, recreation, municipal water supplies, flood control, and hydropower. Most water projects include multiple purposes (Piper & Platt, 1998). Given that most water projects already serve many purposes, combining water projects with land use initiatives presents a compatible goal. Land use issues around the world affect water supply, and closely relate to population growth and urbanization (Luketina and Bender, 2002). Integrated land use and water planning eliminates the duplication of efforts at the local level. Inefficiently using or managing local supply with a lack of strategy, results in wasted resources and consequently portends negative impacts on the environment (Sudol & Dresdner, 1995).

Recently, one locality used water supply planning to limit growth based upon available water supplies. Frederick, Maryland is currently experiencing a water shortage brought on by rapid growth and bad land use planning (Poss, 2002). To avoid future problems, the city passed a water allocation ordinance that limits developer access to water. The mayor of Frederick also issued a construction moratorium until the City completes a new pipeline to the Potomac River and regains a surplus of water. Frederick's ordinance represents the first effort to limit development based upon water supply in the east.

Integrated Resource Planning

Several areas utilize a process of Integrated Resource Planning (IRP) for regional water planning. Southern Nevada, southern California, Portland, Oregon, and Eugene, Oregon all utilize IRP. IRP outlines the water planning process from start to finish, and is used in several western regions and states. IRP establishes an objective, based upon community values and goals, defines the various approaches available, and employs techniques to assess the probability of certain outcomes and subsequent actions based on the outcome (Selby & Robinson, 1995). The IRP approach involves the evaluation of the costs, benefits, impacts, and risks of both demand management and supply options (Stickel & Fiske, 1996). The process includes extensive public involvement and assesses the ability of individual option scenarios to meet policy objectives and values of the region (Stickel & Fiske, 1996). The concept develops integrated supply scenarios, allowing for the evaluation of meaningful "alternative water supply futures" from which decision makers can choose (Stickel & Fiske, 1996).

IRP public involvement incorporates values and issues into the design of alternative scenarios. The project scenarios include different mixes of conservation, system interconnections, and supply source development options (Stickel & Fiske, 1996). IRP scenario generation includes risks of supply shortfalls and identification of institutional arrangements. Criteria addressing costs, benefits, and impacts evaluate each scenario presented (Stickel & Fiske, 1996). The primary difference between IRP and traditional water supply planning is the integration of public values and issues into the design of the water supply program.

Southern Nevada used an IRP process for water planning in 1995. The process represented a dramatic break from traditional planning in the area. Prior to the IRP process, individual agencies typically developed individual plans (Selby & Robinson, 1995). The result of the IRP in Southern Nevada was the creation of a planning tool that integrates supplies, conservation, and facilities options in a series of strategies that would meet water supply needs under various scenarios (Selby & Robinson, 1995). Additionally, the integrated supply plan in Nevada is not a static document. The dynamic growth and levels of uncertainty in the region establish IRP as the beginning of a long-term process for integrated water supply management.

In southern California, the IRP process looked at future water supply reliability and set targets for improvements in demand management and water supplies available to the region (Pieroni, Jacoby & Pekelney, 1998). One difference between this IRP process and other IRP processes is how the process views water conservation. In the context of the California IRP process, "conservation is defined as long-term programs that require investments in structural programs such as low-flush toilets, low-flow showerheads, or water efficient irrigation technology, coupled with ongoing public education and information" (Pieroni, Jacoby & Pekelney, 1998, 288). These

strategies demonstrate the flexibility of the IRP process and its suitability for use in "tailoring" a comprehensive, integrated, regional water supply plan.

Regions embarking upon an IRP process often face increasing demands for water that cannot be reliably met with existing supplies and facilities. Often, regions need to evaluate many alternatives and scenarios to create a long-term plan. The IRP process provides one form of an integrated water supply plan that can be useful for large or diverse regions. Whether done as a formal IRP process or as a process that integrates supplies, uses, and plans, integrated planning proves a successful method for water supply management.

Chapter 3: Development of the Integrated Plan Template

Integrated Plan Template Introduction

Integrated regional water planning essentially connects different areas of planning into one document and vision. Land use planning, transportation planning, and comprehensive planning all share an association with water supply planning. To create an integrated water supply plan, organization and framework aid the water supply planner. The Integrated Plan Template is one organizational tool. The template is useful to plan for water supply, and during the scoping phase of a water supply planning process. The template can be used to outline a water supply plan or as guide during the process. The template provides one framework for a water supply planning process and should be modified to fit each individual situation.

Figure 1. Water Supply Plan Template- Condensed

Section 1. Introduction Purpose Vision Study Area Section and Maps Summary of past and current land uses in the area
Section 2. Planning Criteria
Section 3. Goals and Objectives Plan Goals Objectives Community Goals Objectives
Section 4. Existing Supplies Goals
Section 5. Existing Demands Goals
Section 6. Comparison of Existing Supplies & Demands Goals
Section 7. Comparison of Future Supplies & Demands Goals
Section 8. Identification of Alternatives General information Community Input Goals Supply Alternatives Demand Alternatives Assessment of Economic, Environmental & Social, Costs & Benefits
Section 9. Evaluation of Alternatives Goals
Section 10. Recommendations Current Future Forecast Modification General
Section 11. Water Shortage Contingency Plan Goals
Section 12. Emergency Response Plan Examples General Information
Section 13. Water Supply Plan Evaluation
Section 14. Water Supply Plan Implementation
Section 15. Financial Plan Goals Management Utility Responsibilities
Section 16. Water Supply Plan Adoption
Section 17. Supporting Water Supply Policy General Information Goals
Section 18. Management Utility Guidelines General Information Goals Responsibilities

This thesis creates an integrated water supply planning template. Template elements originate in water supply planning literature, regional, local, and state water supply plans, and other existing templates. The integrated plan template evolves from the contents of plans from across the nation. This thesis incorporates and organizes elements from many sources to form an integrative plan template.

The integrated plan template serves as a guide applied during a regional water supply planning process. The template can be applied during the scoping phase or throughout the entire process. Due to the template's many origins, it can include examples that may not be applicable in some localities. The template serves as a resource to focus planning for water supply, and it provides ideas for plan elements and methods to incorporate elements of water supply planning into a regional plan.

Appendix A contains the complete integrated plan template for reference. Additionally, Appendix B provides a condensed template. The condensed template lists the major elements of the integrated plan template without supplementary examples. Figure 1 shows the condensed template.

The American Water Works Association also provides a template for water supply planning. The template created for this thesis includes aspects of the American Water Works template, in addition to other elements and themes from literature and water supply plans.

Purpose of the Integrated Plan Template

The integrated plan template seeks to condense and combine literature and practical documents into a useful guide. Using the literature and practical information from existing water supply plan documents, the template will help create a thorough and integrative water supply planning process. The goal of the template is to introduce different aspects and disciplines of planning into the creation of a regional water supply plan.

Water connects many elements of the natural landscape, including forests, wetlands, and wildlife, to humans. Those elements should be considered when planning for water use to maintain a natural equilibrium between humans and nature. The connection of land and water use on a regional basis needs to be considered more wholly now that water resources are becoming scarce and land use by humans is expanding. The template aims to establish connections between natural and human uses for water, while presenting options to maintain natural and sustainable relationships.

Integrated Plan Template Creation

Creation of the integrated plan template for this thesis began with a review of water supply plans and planning checklists. The integrated plan template contains elements from over forty sources. The sources range from current water supply plans to journal articles and books. Common themes organize the elements. For example, most checklists cite "existing supplies" as a necessary element to include in a water supply plan. To create the "existing supplies" section in the integrated plan template, the template groups all references to existing supplies, combines definitions and wording relating to existing supplies and summarizes all variations on existing supplies into one category. After grouping concepts and elements from the different sources, redundant information was eliminated.

Integrated Plan Template Elements

The integrated plan template consists of 18 sections and is presented in its entirety in Appendix A. Table 1 on pages 18 lists the 18 elements of the integrated template. Vertically, the table outlines the template elements, while horizontally the table lists sources that contributed to the creation of the template. The table demonstrates template elements contained in and relating to some of the sources that created the template. The shaded boxes in the table represent sources containing template elements.

Table 1. Template Elements contained in Sources

Shaded boxes signify sources containing template elements		Sources										
		American Planning Association	American Water Works Association	California State Water Supply Plan	Castaic Lake Water Agency	Environmental Protection Agency	Eugene Water and Electric Board Water Supply Plan	New Mexico State Water Supply Plan	North Carolina State Water Supply Plan	Outline of Virginia State Water Supply Plan	Rappahannock River Basin Commission	Rhode Island State Water Supply Plan
Template Elements	Introduction			■	■		■	■	■	■	■	■
	Planning Criteria	■	■	■		■	■	■	■	■	■	
	Goals and Objectives	■	■			■	■	■		■		■
	Existing Supplies	■	■	■	■	■	■	■	■	■	■	■
	Existing Demands	■	■	■	■	■	■	■	■	■	■	■
	Comparison of Existing Supplies and Demands	■	■	■	■	■	■	■			■	■
	Comparison of Future Supplies and Demands	■	■	■	■		■	■	■	■		■
	Identification of Alternatives	■	■	■	■	■	■	■	■		■	■
	Evaluation of Alternatives		■	■	■	■	■	■		■		
	Recommendations		■	■		■	■	■			■	■
	Water Shortage Contingency Plan	■			■			■	■	■	■	■
	Emergency Response Plan	■			■							■
	Water Supply Plan Evaluation					■	■	■		■		
	Water Supply Plan Implementation		■		■	■	■	■	■			
	Financial Plan	■	■		■		■					
	Water Supply Plan Adoption	■			■	■			■	■		
	Supporting Water Supply Policy	■	■		■		■	■	■			■
	Management Utility Guidelines	■			■			■				■

Sources

The 11 sources provide representative samples of literature contributing to the template. The literature search included an Internet search for relevant articles and plans, a search of Virginia Tech library resources, a search of university resources in partnerships with Virginia Tech, and a search of journal articles from 1970 to the present. Additional reference books uncovered in the literature search, including *Water Resources Planning* by the American Water Works Association, *Water Resources Planning* by Dzurik, and *Water Supply Planning* by Prasifka, provided information and direction in the selection of template sources and sample plans.

Integrated Plan Template Sections

The first three sections of the template establish its foundation. The first section, **Introduction**, provides the purpose and vision for the plan. The purpose outlines the direction for the region and the vision provides an overarching regional water supply goal. Section 2, **Planning Criteria**, provides an outline to structure the planning process. Planning criteria include specific jurisdictional constraints, a period for the process to occur, and ideas on which the water supply planning process will focus. The next section, **Goals and Objectives**, outlines specific directives that the region wants to pursue with its water planning. Goals describe the overall intent of the regional water provider. The goals reflect and expand the vision of the plan. Each goal has at least one corresponding objective. Objectives provide measurable evaluation criteria connected to each goal. Objectives should be clear-cut and are either complete or incomplete. As the conditions of the region change over time, the template encourages goal evaluation. Goal evaluation determines goal contribution or detriment to the plan and reviews the impact of plan goals on the regions' natural supplies. Throughout the period the plan is active, the goals review keeps water planning on track.

The goals section of the template includes plan goals and community goals. When establishing a regional plan, several partners will likely participate in the process. Depending on plan structure, each partner or member utility may need to present its own plan to be part of the regional plan, or the member utility may need to express its needs from the regional provision of water. Each member utility should be included in the plan goals section by creating independent goals. Community goals encourage participation of member utilities, and highlight areas on which the regional plan should focus. Similarly, community goals should have measurable objectives. The structure of the plan dictates whether the community or the regional provider will accomplish the objectives in the community goals section.

The **Existing Supplies** section should be found in any water supply plan and is included in the majority of template and checklist examples reviewed during this research (see Table 1). Some of the documents reviewed include existing supplies as one aspect of demand. Separating the existing supply category from demand provides a current picture of the supply situation. Knowing the current situation affects how supplies are used for the future, and provides baseline information on the water supplies of the region.

Building on criteria and goals, the template includes an existing supplies section to construct the rest of the water supply plan. Many checklists or plan templates fail to clarify the "existing supplies" section. This omission can cause problems of confusion, if not a more serious problem of water shortage, later in the process. The United States Environmental Protection Agency (EPA) water conservation plan guidelines provide a good example of an existing supplies definition. Those guidelines state that an integrated water plan should develop a water system profile including an inventory of existing facilities production characteristics and water use, and the plan should contain an overview of conditions that might affect the water system and planning (NDWC, 1998). Clear definitions and descriptions greatly improve the success of the water supply plan for directing regional water use.

Another integral part of a water supply plan is the **Existing Demands** section. The types of demands should be clearly outlined before planning for future use of water supplies. Existing demand information can be used to determine average, peak and non-peak use, which can then

be used for further analysis, especially for drought planning or during drought events. Items related to existing demand that should be in a water supply plan are; average use in the region per day, average use per household per day, peak day use, average water used monthly and average water used annually. When these statistics are used in conjunction with demand forecasting, they can present an overall demand picture, rather than a future picture only.

The integrated plan template focuses on water supplies controlled by a regional provider. Regional providers do not necessarily control water from private sources such as private wells. Many consumers receive water from private wells and may not seem to be a direct part of the regional water plan; however, regional water planning needs to address private wells and permits for additional wells when considering the composite picture of supply and demand for the region. Consideration of groundwater use by private wells should be part of the evaluation of water supply usage for the region. Additionally, evaluation of existing regional demand needs to consider all types of demand, including demands placed on groundwater sources from individual wells.

The **Comparison of Existing Supplies and Demands** section of the template arose from several different checklists and plan examples, see Table 1. Both existing and future comparisons prove useful in the integrated plan template; however, an in-depth understanding of the state of the natural supplies in a region can be gained by separating the two comparisons.

The existing supply and demand comparison is based upon the existing supplies and demand sections. Integrated water planning seeks to review factors relating to water resources and land use that have a role in water planning. One of those aims is to provide water for the existing population. Comparing the current supply and demand concerns can lead to a more reliable and complete provision of water service to the consuming public.

The **Comparison of Future Supplies and Demands** section follows the comparison of existing supplies and demands section. This section contains estimates for future conditions from population, to supply needs and demand forecasts. Most water supply plans and checklists include a comparison of future supplies and demands section. Demand forecasting estimates future needs.

The template includes an extensive list of alternatives to increase supply and reduce demand in the **Identification of Alternatives** section. Some plans separate the supply or demand alternatives as independent ideas; however, this section of the template focuses on all alternatives because they are often interrelated and utilized in conjunction with other alternatives. In addition to identifying alternatives, this section of the template recommends identifying the costs of alternatives. The template lists several supply and demand alternatives that are appropriate for expansion into individual plans or subsections of the larger water supply plan. Supply alternatives suitable for individual plans include source protection, leak detection, stormwater management, erosion control, natural supply protection, wellhead protection, and water quality. Demand alternatives suitable for a separate plan include water reuse, water efficiency, and water conservation.

The identification of alternatives section in the template includes an assessment of economic, environmental and social costs and benefits of the alternatives. An alternative evaluation should be based upon individual costs and benefits, and on how the alternative would work in conjunction with others.

The **Evaluation of Alternatives** section follows the identification of alternatives section. The alternatives evaluation section seeks to compare and combine the supply and demand alternatives to determine the appropriate supply mix for the region. The evaluation compares the ability of different alternatives to accomplish similar objectives. Objectives for alternative comparison include economic efficiency, environmental sensitivity, and regional feasibility.

The **Recommendations** section ties together all the elements from the previous sections. Recommendations consider the existing situation, the future projections, the alternatives, and alternative feasibility to finalize how the region will use water supplies. Recommendations take all the presented information from the document and summarize it into a succinct series of statements.

This section includes current recommendations, future recommendations, and forecast modification after recommendations have been made. The recommendations address the existing conditions with current recommendations and future conditions with the future and forecast modification sections. Forecast modification takes the recommendations and reevaluates forecasts with new information. New supply and demand forecasts demonstrate whether the chosen supply mix is appropriate for the region. New forecasts determine whether adjustments are necessary to meet the goals of the region to provide adequate supplies for the demand. The modified forecasts allow a regional managing utility to plan for future revenues or losses that might occur with the provision of services.

The **Water Shortage Contingency Plan** section can either be a part of the plan or a separate plan to work in conjunction with the water supply plan. Recently, widespread concern over drought has prompted the creation of water shortage plans (U.S. Army Corps, 1994). During the 1988 drought, fifty percent of all water supply utilities in the nation asked their customers to reduce consumption (U.S. Army Corps, 1994). In a 1990 poll, 41% of U.S. mayors anticipated water shortages in the next several years caused by drought, growing population, water pollution, and leaks from distribution lines (U.S. Army Corps, 1994).

Additionally, there are several provisions of a Texas law intended to improve drought preparedness and response at the state, regional and local levels (Bagwell and Personett, 1997). Currently, the typical water-supply planning procedure plans for enough water for normal times and then has a contingency plan for dealing with shortfalls (Grigg & Vlachos, 1993). Preparing for drought in water supply management must be an ongoing process, not a project or a prescription to be started and finished when the drought is over (Grigg & Vlachos, 1993). The process of drought preparation helps to plan for water shortages in advance of the event, lessening the severity of the drought when it occurs. Including the water shortage plan as part of the integrated water supply plan allows the region to continuously plan for water shortages and be prepared for times of drought or other water loss.

The water shortage contingency plan contains elements such as a three-year worst-case supply projection, consideration of historic shortages compared to future demand, and a determination of the causes of the shortages. Users of this part of the template should organize the section according to the specifics of the region. Local water regimes, consumption rates, and conservation measures already in place should also be considered.

The **Emergency Response Plan** section follows the water shortage contingency plan section in the integrated plan template. Similar to the water shortage contingency plan, this section can be either part of the larger plan or broken out as a separate plan. Emergency response plans for emergencies or disasters other than drought, prepare the community for adequate and safe water use during an emergency. The plan intends to protect water supplies and provides a response to natural disasters such as hurricanes, floods, or tornados. An action plan would be included in the emergency response plan for situations that might involve a power outage, a broken water main, or other issues affecting water supply.

The **Water Supply Plan Evaluation** section serves two purposes: 1) to evaluate the initial regional water supply plan at completion and 2) to update the plan later. The integrated plan template includes plan evaluation to create an active, useful regional plan. Plan evaluation intends to review, revise, and update the water supply plan regularly. Generally, a water supply plan includes an update every five years, but the period of evaluation is at the discretion of the region.

Plan evaluation is one of two factors contributing to the success of the state and regional water planning process in Texas. First, by increasing the level of community and stakeholder participation, the consensus water planning effort in Texas addresses the interdependencies of water supply and demand, water quality and environmental needs (Bagwell & Personett, 1997). Second, Texas water policies and plans now receive periodic evaluation and are better able to reflect changing conditions and priorities (Bagwell & Personett, 1997). By including an array of elements, and keeping the plan current through evaluation, communities take an active part in deciding how to use regional water supplies.

The fourteenth section of the template lists guidelines for implementing water supply plans. Clarifying the **Water Supply Plan Implementation** process helps the plan become active. This part of the plan includes specific action plans for how different elements will be accomplished. When the state of North Carolina sought to move forward with its water supply plan, the North Carolina Division of Water Resources sent a questionnaire to "numerous organizations" who responded in favor of implementing the water supply planning program (Wallace, 2001). Implementation can also empower local decision makers (RRBC, 2002). The implementation section of the RRBC guiding principles states:

> The shared vision planning model that has been adopted as the framework for development of planning techniques and tools has generated a substantial level of interest by local water suppliers and state and federal agencies; it provides a continuing means to maintain an interactive, cooperative approach to serve in place of the adversarial relationship often seen among levels of government relating to water supply management. This environment provides more guidance and greater certainty for water suppliers as they plan for the satisfaction of future water supply needs. (2002, 4)

The next section in the template is the **Financial Plan**. The field of water supply planning often overlooks financial planning. Many water supply utilities do not meet the typical definition of a "primary business activity" and consequently are poorly managed and lack budgeting or a financial plan (Keuhl, Randolph, &Younos, 1999). A financial water system plan should contain internal costs such as capital, operations, and maintenance costs, as well as external costs such as those imposed to deal with project environmental impacts (AWWA, 2001). Plan implementation and financial planning are connected by including financing strategies for needed improvements, and a system for monitoring or evaluating the attainment of plan objectives (APA, 2002).

The Financial Plan in the template includes management utility responsibilities. The responsibilities include creation of a business plan, preparation of the budget, restructuring of rates, and making sure the rate structures and prices for water are compatible with long-term interests and goals of the regional water plan.

One of the most important aspects of the financial plan is the rate structure. A detailed rate structure helps consumers to know the actual price of water. The Metropolitan Water District of Southern California (MWD) chose rate restructuring as a long-term planning strategy at the beginning of the region's strategic water supply planning process to clarify the actual cost of water for southern California consumers. The MWD rate restructuring process sought to "unbundle" water costs by separating treatment, power, and delivery costs of water. Through cost separation, the MWD identified the cost components of water rates and more clearly allocated costs across users (Atwater & Blomquist, 2002). The literature on water and other utilities supports unbundling rates, clearly allocating costs, and promotion of conservation through rate restructuring, (Atwater & Blomquist, 2002).

The **Water Supply Plan Adoption** section follows the financial plan section within the template. In order for the water supply plan to work, the plan must be adopted by local, regional, and state governing bodies. All the elements in the template should be included in the plan adoption. Plan adoption allows for plan implementation.

Section 17 guides policy development to support the regional water supply plan. **Supporting Policy** includes initiatives that aid water supply planning, regulations to enforce the plan, or regulations consistent with the plan. Policies created to support the plan will be evaluated during the periodic plan evaluation.

The **Management Utility Guidelines** section is the final section in the integrated plan template. As the title implies, this section outlines possible goals and duties of a regional management utility. The first section of the guidelines dictates the basic structure of the utility, the second section presents goal examples, and the third outlines the responsibilities of the utility. Several researchers find that creating a regional utility to manage the regional plan proves more effective than other management structures. Okun, 1977, 325, states, that

> For any strategies to be effective there must be an improvement in the management of our water resources, which now suffers from the fragmentation that results when each small community is charged with providing its own water supply and ridding itself of its own wastewaters. Effective utilization of the available supplies and effective surveillance, treatment, and reuse depends upon greater regionalization of water management.

Additionally, regional leadership is necessary when integrating resources and managing water for a large population (Atwater & Blomquist, 1201, 2002, Stickel & Fiske, 325, 1996)
Of the 18 sections, some are more useful during the planning process, others help to frame the water supply plan, and still others aid in the implementation of the plan. Each covers an individual idea, but most sections can serve more than one purpose.

Chapter 4: The Integrated Plan Template in the Planning Process

The Integrated Plan Template holds the ability to function as a planning tool in three ways. First, by incorporating various sources and elements into the document, the template presents a condensing of information that is usable as a resource independent of other documents. Second, the template functions as an integrated guide to the planning process. Third, the template can be used to frame the elements of a water supply plan. This chapter explains possible uses of the template in the planning process.

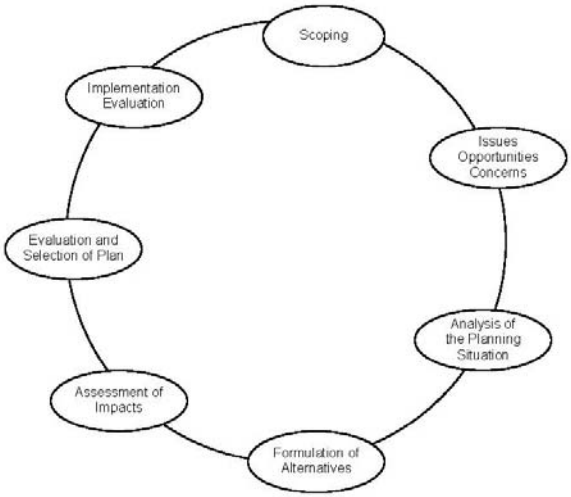
The Planning Process

There are two basic approaches to planning; blueprint planning and process planning. Blueprint planning focuses on "the plan" as the central feature of planning. The "plan" consists of one or more goal statements that are reduced to more specific policies, programs, and projects, spaced out over a limited period of time, related to sets or priorities, standards and financial arrangements (Faludi, 1973). A blueprint planning program includes thinking in advance of implementation so that no uncertainties remain and the desired effects are achieved (Faludi, 1973). In situations related to engineering, blueprint planning proves applicable. When performing environmental planning, the type of planning most often used for water supply planning, conditions are less favorable for blueprint planning and most approaches tend to be process oriented.

Process planning is an approach whereby planning programs are adapted during their implementation and again as incoming information requires changes (Faludi, 1973). The plan document is a guide and the process becomes an approach where strategic information and feedback impinge directly on action, leading to incremental adjustments in the direction of the process (Faludi, 1973). In process planning, any action taken usually forms part of a longer-term policy which is subject to review in the light of new information (Faludi, 1973).

Using the integrated plan template in process planning allows the water supply planner to conduct some analysis at the beginning of the process in the scoping stage and throughout the process as new information is obtained. The template guides the planner to possible sources of new information to include in the process, helping the planner make adjustments throughout the process.

Figure 2. The Environmental Planning Process



The planning process used for water supply planning, shown in Figure 2, is generally an environmental planning process. Environmental planning commonly requires a rational-comprehensive and participatory process, with elements of adaptive, incremental and advocacy planning as appropriate (Randolph, 2004). A rational-comprehensive approach is based on the scientific method and has five basic steps of objectives, information, alternatives, impact assessment, and evaluation (Randolph, 2004). A participatory approach deals with diverse

stakeholder perspectives and conflicting values, aiming to inform and involve the public in the planning process (Randolph, 2004). An adaptive and incremental approach is the essence of process planning and focuses on short-term goals and objectives and small sequential actions (Randolph, 2004). Advocacy planning recognizes that interested stakeholders often fight for special interests, requiring advocacy of underrepresented groups in the process (Randolph, 2004). The four approaches come together to create a synergistic planning process for environmental planning. Randolph, 19, 2004, cites seven steps in the environmental planning process:

0. Scoping
1. Identification of Issues, Opportunities, Concerns, Objectives, Criteria and Uncertainties
2. Analysis of the Planning Situation
3. Formulation of Alternatives
4. Assessment of Impacts
5. Evaluation and Selection of Plan
6. Implementation, Monitoring, Evaluation, and Modification

Step 0: Scoping

The planning process begins with scoping. Scoping involves the identification of stakeholders and development of a work plan (Randolph, 2004). This initial phase seeks to define the critical parameters of potential impacts associated with a proposed development, policy, plan, program, or project (Mulvihill & Jacobs, 1998). The scoping step is the point at which concerns and issues about the process are identified and study boundaries are set (Mulvihill, 2003).

Using the integrated template during the scoping step of the process can create a more informed water supply planning process. The template breaks down aspects of planning into categories that frame the potential impacts and needs of the water supply plan. For example, the introduction section in the template presents items that can structure the scoping step. The introduction section suggests defining a purpose, a vision, a study area, and summarizing land uses in the area. Figure 3 shows the introduction section of the template.

Figure 3. The Introduction Section of the Template

SECTION 1. Introduction
Definition: *Planning refers to a regional provider's role in developing a coordinated overall approach to water development and management.*
A. Purpose
B. Vision
1. Definition: *Vision is a broad statement for a plan, an overarching goal.*
2. Examples
a. A vision can be the protection of all water resources.
b. A vision can provide policy guidance.
c. A vision could be integrated resource management.
d. The creation of a hybrid vision may include elements characteristic to those of a regional provider, contractor, and/or shareholder.
e. A vision should promote regionalization.
f. Regionalization will minimize duplication or inefficiencies from separate supply ownership and management of supplies, and can also increase security, and the amount of adequate, safe, reliable water supplies.
C. Study Area Section and Maps
1. Location information
2. Size
3. Climate
4. Demographics
D. Summary of past and current land uses in the area.

The template links to the scoping step by outlining categories that would be part of a water supply plan. Many water supply plans contain a purpose, a vision, and location information among other items mentioned in the template. The template describes potential contents of a water supply plan, allowing a region to consider how those contents will be structured to reflect the needs of the region. Highlighting the needs of the region and the contents of the plan in the scoping phase of the planning process, allows the region to understand its overall water picture.

If a region chose to use the template during the scoping step, the region could look at the introduction section to determine what to include in its plan. If the region chose to include a vision as part of its plan, the template suggests several frameworks on which to model or structure the vision statement. The possible frameworks for the vision statement are one example of how the template can be used as a guide during the planning process.

In addition to the introduction section, other sections of the template inform the scoping step. The planning criteria, goals and objectives, supply and demand, alternatives, implementation, and supplemental plan sections all provide guidance to the scoping step of the planning process.

Use of the template during the scoping step elicits several strategic questions to help the regional effort. Use of the template may give rise to questions such as what is the overall purpose of water provision in the region? What are the goals of the region or plan? What agreements need to be considered? What are the existing supplies? What are the existing demands? What does the region need to successfully use supplies to meet demands?

Step 1: Identification of Issues, Opportunities, Concerns

The identification step highlights key issues and objectives for the plan, and recognizes potential hurdles that the planning team may face during the process. The step of the process seeks to determine the direction the process will take and the possible barriers to accomplishing tasks and projects.

The integrated plan template can aid the process during the identification step by presenting opportunities or issues common to many other water supply planning processes. The compilation of information in the template provides a range of problems and solutions from existing water supply plans that other planning processes can draw from to determine what opportunities or challenges the water supply planning process may present. The goals and objectives section of the template as well as the existing supplies and demands sections present ideas from existing plans that may help define the objectives or criteria for new plans. Existing water supply plans can also benefit from the template by comparing plan documents with template sections for alternative solutions or new insights to old problems.

The template links to the identification step of the process by presenting categories and situations that may be present in a region. By including many categories, a region could review the template and may find a situation in the template that is familiar to the region. For example, many regions are looking to groundwater as an additional or emergency water source. The existing supplies section lists several factors relating to groundwater that may better prepare a region for using groundwater as an additional or emergency source. The groundwater references in the section bring forward questions that a region would need to answer before utilizing ground water as a supply source. Some of the groundwater considerations listed in the existing supplies section of the template include:

- Description of groundwater sources
- Consideration of access to or availability of groundwater supplies
- Reliability of groundwater supplies
- Description of groundwater storage facilities
- Estimation of groundwater capability to be used as a supply source
- Evaluation of the existing safe yield from a groundwater source
- Description of the vulnerability of groundwater supplies to natural or manmade threats
- Water quality information of groundwater

Using the template to draw out possible solutions to problems, or clarify the direction of the process during step 1, helps to highlight some strategic questions. What are the primary issues the region is facing during the water supply planning process? How can the issues be resolved? How have other localities resolved similar issues? What are the community's greatest assets to meet the challenged of the process?

Step 2: Analysis of the Planning Situation

Step two of the planning process gathers information about the community and surrounding geography. A water supply plan requires knowledge of community issues, as well as knowledge about the physical constraints and opportunities. This step in the process compiles the necessary information.

Figure 4. Excerpt from the Comparison of Existing Supplies and Demands Section of the Integrated Plan Template

SECTION 6. Comparison of Existing Supplies and Demands

Items to be included in the section

1. Inventory of existing facilities, production characteristics and water use.
2. Overview of conditions that might affect the water system and supply planning.
3. Study and compare past water supply and use trends.
4. Compare water use history and water supply history.
5. Do current supplies meet current demands?
6. Evaluate the quantities of waters supplied and demanded. Are supplies excessive or short? Are demands excessive or realistic?
7. Develop a water system profile.
8. Determine if existing supplies are being used to capacity.
9. Evaluate ground water management.
10. Determine if there is a water supply deficit.
11. Examine the effects of system operation.
12. Evaluate the need for added water supplies to meet current demand.
13. Use a model to estimate the current safe yield for ground water and surface waters.
14. Determine if demand exceeds the safe yield.
15. Examine effects of seasonal shortages.
16. Evaluate the effects of stormwater management on supply and demand.
17. Examine the limitations in imported water during drought events.
18. Evaluate capital improvements needed to meet current supplies and demands.
19. Determine the adequacy of water use monitoring and water supply data collection.

The integrated plan template aids the process by listing items that the community would need to research to gain information for the water supply plan. Topics listed in the existing supplies and demands sections and the comparison sections guide a community to the type of information it would need to uncover. For example, the comparison of existing supplies and demands section helps the community to determine if current supplies are being used to capacity, or if current demand is greater than existing water supply. An excerpt of the section is shown in Figure 4.

The template lists the inclusion of information such as annual precipitation information, a map showing the location of existing supplies and populations served, and a comparison of water use currently to water use previously, to help the region gather necessary information for the water supply plan. By suggesting items to include in the plan, the template acts as a planning tool, allowing the region to find information that will enable it to evaluate the regional water picture. By listing the items for the plan, the template presents an avenue for the region to gather information and assemble it into a useful format for the planning process.

Questions that inform the planning process also arise from using the template during step two. What data does the region have about its water resources? What data does the region need? What information needs to be clarified? Which groups in the community can contribute to this part of the planning process?

Step 3: Formulation of Alternatives
This step of the process generates ideas for alternative water supply as well as alternative demand reduction. Step three of the process brings together the interested parties, issues, concerns, and existing data, to formulate an overall picture of water supply and demand in the region.

The template aids this step by presenting alternatives for the region to consider in the comparison sections as well as the alternatives section. The alternatives section of the template suggests a variety of techniques to better utilize supplies, or decrease regional demands. The ideas include: protection of existing sources, optimization of current systems, establishment of a water reuse plan, establishment of a storm water control plan, creating a ground water recharge plan, conservation options, establishment of conservation pricing, and short-term demand management.

The template presents a direct link to this step in the planning process by dedicating two sections to the formulation of alternatives. The alternatives step is often where regions focus on problems and find solutions. For example, if a region possesses very little water and experiences generally dry, frequent drought, or desert conditions, the region needs to consider how best to use its finite supply of water sources. Source protection or water reuse may be alternatives for the region. The identification of alternatives section in the template outlines 13 ideas on source protection that may be helpful to the region. The source protection ideas include:

- Identify protected sources of water, develop them where necessary and secure them where not yet needed
- Delineate the area around a water source
- Inventory land use activities in the delineated area to identify possible sources of regulated and unregulated contaminants to the source
- Determine the susceptibility of the source water to the potential contaminants in the delineated area
- Use of protected sources for potable water, other sources for non-potable needs
- Where the protected sources are inadequate for all public supply needs, they can be restricted to the highest quality uses by substituting adequately treated wastewaters or polluted river waters for many of the non-potable uses to which urban supplies are put
- Include a chart or outline of hierarchy of land use or land use requirements for land located near sensitive resources.

In addition to outlining information for source protection, the template includes a section on water reuse to help solve problems that a dry region may face. The reuse suggestions include:

- Establish a water reuse plan
- Use rainwater capture as reuse source
- Use gray water capture as reuse source
- Use storm water runoff as a reused water source
- Determine uses of waste water
- Describe type, place, and quantity of recycled water
- Describe technical and economic feasibility of recycled water to serve entire or portion of the water public
- Present opportunities for exchange or transfer of reused water in the short and long term
- Coordinate the water reuse plan with the storm water management plan

Questions that the template helps generate during this part of the process include: what can the region do to reduce leaks and optimize existing supplies, what programs can the region implement to conserve water, what programs are contradictory to the regions goals or to each other, and where can the region generate water savings or more efficient water use? Questions in this phase of the process build upon the prior steps in the process and are informed by the template as well as ideas from the community and other stakeholders.

Step 4: Assessment of Impacts

Step four reviews the alternatives and needs of the region to evaluate possible impacts. Each alternative generated in previous steps is evaluated for its economic, environmental, and social costs and benefits. The planning constraints, political situation, community desires, and potential environmental consequences for each alternative or combination of alternatives are considered during this step.

The template provides a section on evaluation of alternatives to help guide planners through step four of the process. The evaluation of alternatives section highlights issues that a region may want to consider before selecting an alternative to increase supply or reduce demand. For example, the alternatives evaluation section suggests using a computer model to assess the odds or probability of certain outcomes by evaluating alternatives based upon costs, reliability, vulnerability, legal or regulatory constraints, regional considerations, institutional arrangements, and coordination with existing documents. Again, the template is directly applicable to the planning process by presenting a section dedicated to this step in the process.

The evaluation of alternatives section in the template provides methods with which to evaluate alternatives produced by the region to solve its water supply problems. For example, if a region decides to increase water supply to a dry area through the use of a water transfer, the template suggests that the region analyze the impacts to natural water supplies in the area, the impacts on existing and required legal and institutional arrangements as well as the roles and responsibilities of appropriate levels of government to carry out a water transfer agreement. This type of analysis would force the region to look outside its boundaries for impacts on the natural systems in the area, the water supplier, and its constituents when evaluating whether the transfer is appropriate for the region.

Use of the template during the assessment of impacts step in the planning process gives rise to several strategic questions including: which alternatives are feasible, which alternatives can be combined, what are the consequences of choosing a particular alternative, and what does the region need to do to mitigate potential impacts of an alternative?

Step 5: Evaluation and Selection of Plan

The "resource mix" for the region is determined during step 5 of the planning process. The evaluation and selection of plans organizes the elements and alternatives that will be part of the water supply plan and outlines how the plan will be further evaluated through public approval. Planning in this step addresses any remaining conflicts in the process and how the conflicts can be resolved to achieve the regional plan.

Figure 5. Excerpt from the Recommendations Section of the Integrated Plan Template

A. Current
1. Recommendations for the alternatives to be implemented to solve existing and current supply or demand issues.
2. Summarize, prioritize, and organize information from the previous sections to determine the best resource mix that will meet the needs of the region.
3. Water availability, economics, and environmental concerns will dictate which combination of strategies is best suited to meet a particular need.
4. A combination of various strategies is used in most regions, often after conservation and reuse measures are implemented, or major new water supply development is required to meet current needs.

B. Future
1. Available ground water supplies are declining and the trend toward partial or full conversion to surface water will continue.
2. Use a variety of approaches and techniques to identify emerging water policy issues.
3. Describe planned facilities to provide the resource mix.
4. An example of a recommendation could be reduction objectives for the governing body as a whole.

C. Forecast Modification
1. Modify water demand and supply capacity forecasts to reflect the anticipated effects of the recommendations.
2. Include an integration of supplies in the modified forecasts.
3. Discuss the effects of actions on planned water purchases, improvements, and additions.
4. Discuss the effects of planned actions on water utility revenues.

The recommendations section of the integrated plan template informs this step. The template's recommendations section provides the planning process with three ways to evaluate the alternatives chosen for the region. The template evaluates the resource mix by reviewing current and future implications, and adds a final step of modifying any forecast used to reflect the recommendations of the regional plan. Figure 5 shows an excerpt of the text from the recommendations section of the integrated plan template.

The recommendations section shown in Figure 5 aids the process by suggesting different approaches to evaluate the alternatives and the resource mix. The template section also provides a framework to organize the evaluations and recommendations of the process, by breaking the recommendations into current, future, and forecast modification aspects.

The template links to the process by providing a specific section dedicated to evaluation and selection of plan characteristics. A region could use the template during the evaluation and selection step of the process by selecting the elements that will be part of the plan and using the template to structure those elements. For example, if a region decides to increase supply by reducing demand and instituting water reuse measures, the recommendations section of the template suggests that the option should be part of recommendations for current use. The region would then need to consider what it will do to accomplish further increases in supply to accommodate future growth. In this way, the template highlights objectives a water supply plan might chose to accomplish, and leads the region to the next logical step for its future. Utilizing the recommendations section of the template during the process raises questions of how best to implement alternatives, how to resolve remaining conflicts, how and when to phase in new supply sources or demand reduction programs, and what effects the recommendations will have on the region and it's water supplies. Questions resolved during step 5 facilitate the implementation of the plan during step 6 of the process.

Step 6: Implementation, Monitoring, Evaluation, and Modification
The final step in the planning process determines the timing of the plan, and eventual monitoring of the plan. Monitoring or plan evaluation will help the plan to be adaptive and flexible for future needs. Plan evaluation will help the plan to improve upon elements that did not work as intended or modify other plan elements as necessary.

The integrated plan template contains at least three sections that contribute to the planning process at this step: the plan evaluation section, plan adoption section and supporting water policy section. Using the template in this step allows the process to structure eventual plan evaluation and monitoring.

For example, if the template is used by a region to help the region monitor the progress of its water supply plan, the region would institute a water management utility to be responsible for the implementation of the plan. The template suggests that the management utility review progress on the plan and consistency with the plan. Through that mechanism the template describes how the region, through the management utility, can monitor the progress of the plan. If the region does not choose to install a management utility, the template also suggests that a plan evaluation be included in the initial writing of the plan.

Inclusion of a mandatory plan evaluation would help assure that the plan implementation occurs and an evaluation would serve as a method of plan monitoring. Plan evaluation and monitoring help to keep a water supply plan current for the needs and changing ideas of the region. The plan adoption section of the template guides the process to plan implementation. The template suggests including supporting water policy to enforce and monitor the plan after implementation. Each section of the template that is useful during step six helps transform the plan from a planning and vision document to a set of actions with tangible outcomes.

Use of the template raises questions of who performs the actions outlined in the plan, within what period will objectives be achieved, when will the plan be updated to meet community needs, and what support does the plan need from other areas of government and policy?

Further Application of the Integrated Plan Template
The integrated plan template proves useful in all seven steps of the planning process but it does not have to be applied in the manner outlined in this thesis. The template can be used in every step or only during some of the steps. The template is a tool to inform the water supply planning process, to aid community learning, and the template can be useful as a guide during the process. There is no specific method to use the template. Each region or community can mold the template, use pieces of it, or reference the template as it sees fit.

One use of the template is as a comparison tool. For a demonstration of how to use the template, this thesis performs a plan comparison of the template content to the plan content of four existing regional water supply plans. The template compares the content of regional plans to see which elements of the template are contained in the plan. Plan comparison shows how a region can use the template to review an existing water supply plan. Plan review can demonstrate if a plan is meeting the needs of the region, or the comparison may provide the region with ideas from the template that can be incorporated into the existing plan. Determining additional elements to use in regional water supply planning could improve the existing use of supplies in a region. Chapter five summarizes the plan and template comparison completed by this thesis.

Chapter 5: Application of the Template

Thus far, this thesis has demonstrated the use of the integrated plan template to create a new regional water supply plan through the planning process. This thesis further seeks to demonstrate how the template can be used in conjunction with an existing regional water supply plan. Some regions that have an existing water supply plan may want to update or revise the plan. If a region is interested in adding new or additional information, the integrated plan template acts as a source for that information. By comparing the template to an existing plan, a region can determine if it is interested in adding information from the template to supplement its existing plan.

This chapter demonstrates a comparison of the template to four regional plans, presents the results of those comparisons, and highlights areas where regional plans and the template differ in content. If a region was to perform a similar comparison, that region could determine if the content in the template is suitable to include, or if the existing plan is acceptable as it stands.

A comparison to the template allows the regional plan a method to measure its content against an objective source. The template offers a general approach to the structure and content of a regional water supply plan. A region could attempt to measure an existing plan against another existing plan to determine if the comparison plan has content which is superior or would be useful in the regions own plan; however, that type of comparison may not be accurate as there are general differences between regions. Differences that may limit a peer plan comparison include geographic distinctions, regulatory constraints, and water regimes. By comparing a regional plan to the more general template, a region can gauge the contents of its plan in comparison to current concepts in water supply planning, without having to weigh the variables and differences inherent in a comparison with another regional plan. The purpose of the plan comparison is to demonstrate how a region can use the template in a comparison with its own plan to determine if the region should amend its current regional plan, and if so, what elements to add and how to add them.

Regional Plan Selection

One objective of this thesis is to compare the template to four regional plans. The four regional plans selected for comparison are:

1. The Regional Water Supply Plan for the Portland Metropolitan Area
2. The Regional Water Facilities Master Plan of the San Diego County Water Authority
3. The Watershed Regional Water Plan of Chester County Pennsylvania Water Resources Authority
4. The Lower East Coast Water Supply Plan of the South Florida Water Management District.

The four plans are "regional" based upon an adapted definition of a metropolitan area from the U.S. Census Bureau (2004).

> Region-A core area with a population nucleus, together with adjacent communities that have a high degree of economic and social integration with that core. The region can be designated by one or more counties or by a group of cities and towns.

Four criteria determine regional plan selection: 1) currency, 2) geographic location, 3) plan scale, and 4) scope of information. A comparison of criteria for each regional plan is in Table 2.

1. Currency
Recently adopted plans are determined to be "current". The American Water Works Association Water Supply Planning: Manual of Water Supply Practices (2001) labels the four regional plans as "recent plans" due to plan adoption within the last ten years. The Portland plan was adopted in 1996, the San Diego plan was adopted in 2000, the Chester County plan was adopted in 2002, and the Lower East Coast plan was adopted in 2000.

2. Geographic Location
Each plan is located in a distinct geographic region to illustrate the differences in water supply planning by region. Due to the different amounts of rainfall, types of rainfall, climatic features, jurisdictional agreements, state mandates, and other features unique to different regions, the plans represent a spectrum of conditions under which water supply planning occurs.

3. Plan Scale
The plans serve populations varying from about 1 million to about 6 million people. Table 2 shows a comparison of the general attributes of each plan, including plan populations and service areas.

4. Scope of Information
Each regional plan contains information about the region's water supplies and the plan's scope of achievement. All plans contain geographic and demographic information. Table 2 summarizes the scope of each plan.

Table 2. Regional Water Supply Plans- General Attributes

	Currency	Geographic Location		Plan Scale		Scope of Information
Plan Title	Year Adopted	Geographic Location	Specific Location	Population	Area Covered	Amount and type of items contained in the plan
Regional Water Supply Plan	1996	Northwest United States	Portland, Oregon Metropolitan Area	1.1 Million	3 counties, 24 cities	12 chapters, 69 plan elements, 7 appendices, 277 pages
Regional Water Facilities Master Plan	2000	Southwest United States	San Diego County, California	2.7 Million	23 member agencies (different jurisdictions), 908, 959 Acres or 1,420 square miles	6 chapters, 65 plan elements, 5 appendices, 100 pages
Watersheds Regional Water Plan	2002	Northeast United States	Chester County, Pennsylvania	1.4 Million	160 municipalities in 8 counties, 3 states, 21 watersheds, 1,408 square miles	10 chapters, 83 plan elements, 1 appendix, 240 pages
Lower East Coast Water Supply Plan	2000	Southeast United States	Southern Florida, Miami-Dade County, Broward County, Palm Beach County, portions of Monroe, Hendry, Collier, Martin, Okeechobee, Glades, and Lee Counties, Florida	6.3 Million	Portions of 10 counties, 1,200 square miles	6 chapters, 53 plan elements, 10 appendices, 358 pages

Limitations
There are two main limitations to the regional plan selection: time allowed for completion and scope of literature. First, the scope of this thesis does not include a comparison of every existing regional plan, nor was there enough time during the entire process of this thesis to compare every existing regional plan with the template. Other regional plans may have been found that are more appropriate standards of excellence in the field. Second, this thesis did not review all available literature on regional planning. The plans selected for this thesis fit criteria outlined by the reviewed literature. However, different literature may well recommend other regional plans as a standard of accomplishment.

Regional Plan Comparison Method
Regional plan comparison is the process of reviewing plan document content as it relates to the 18 elements in the template. A review of the text and intent of each regional plan provides the comparison of the regional plan elements to the template elements. Plan comparison is a demonstration of how a region could use the template to evaluate its own plan to determine if any part of the plan should be revised. The plan comparison process uses the Comparison Checklist. Appendix C contains the Comparison Checklist used for this phase of the research.

Limitations to the Comparison Checklist Method
One limitation to the methodology presented in this thesis, is that the methodology has not yet been evaluated by peer review. Peer review would highlight improvements that could be made to the methodology that would improve the comparison checklist as a planning tool.

Second, the methodology inherently includes the perceptions and biases. The bias for this research leans toward regional, integrated water supply planning. The template and checklist reflect that bias. Additionally, the comparison method includes concepts from the literature reviewed. The literature search allowed a variety, but most likely not every possible element to be included in the template and comparison method. Other literature may present information contradictory to the methodology presented in this thesis.

Third, the comparison methodology is based on one methodology. Other methodologies may exist that are more appropriate than those utilized for the methodology in this thesis.

Fourth, the comparison checklist methodology has only been applied in this thesis and has not been applied to more than four regional plans. With additional application, the comparison method could be improved.

Rationale
One rationale for using the comparison checklist is that it is uncomplicated. The checklist provides a simple method to compare a regional plan to the template so a region can determine which, if any, of the template elements should be added to the existing regional plan. The method is fast and provides a summary review of a regional plan.

A second rationale is that the checklist is grounded in the integrated plan template. The template stems from literature and current practice in the field of planning. The currency of the template makes it and the checklist relevant to the field of water supply planning. Comparison of an existing regional plan to the template with the checklist gives the planner an opportunity to determine if a regional plan is current and relevant, or if there are aspects from the field of water supply planning that are missing from the existing plan.

Regional Plan Comparison Results

Regional Plan comparison consisted of reviewing regional plan document contents to determine if portions of a template element or an entire template element are part of the existing plan. Table 3 shows the results of comparisons between the four plans and the template elements. A key to the shaded portions of the table is at the bottom of the table. Plan comparison considered the intent and wording of the document to determine if the regional plans contain any part of or all of a template element. Appendix D holds regional plan comparison sheets.

Table 3. Regional Plan Comparison Results

	Lower East Coast Regional Water Supply Plan, Southern Florida	Regional Water Supply Plan, Portland Oregon Metropolitan Area	Urban Water Management Plan- San Diego California	Watersheds Regional Water Plan, Chester County Pennsylvania
Template Elements				
Introduction				
Planning Criteria				
Goals and Objectives				
Existing Supplies				
Existing Demands				
Comparison of Existing Supplies & Demands				
Comparison of Future Supplies and Demands				
Identification of Alternatives				
Evaluation of Alternatives				
Recommendations				
Water Shortage Contingency Plan				
Emergency Response Plan				
Water Supply Plan Evaluation				
Water Supply Plan Implementation				
Financial Plan				
Water Supply Plan Adoption				
Supporting Water Supply Policy				
Management Utility Guidelines				

Key:	Plan **contains** the entire template element	Plan **partially contains** the template element	Plan **does not contain** the template element

Lower East Coast Regional Water Supply Plan- Southeast Florida
The Lower East Coast Regional Water Supply Plan contains 13 whole template elements. Four template elements are partially present in the Florida plan, one template element is missing in it's entirety in the plan.

Missing Elements
The missing elements from the Lower East Coast Regional Water Supply Plan (LEC) are community goals and objectives, community input, emergency response plan examples and contents, water supply plan adoption, and management utility goals and responsibilities. The LEC plan mentions public participation and plan review performed by civic groups. However, the plan gives no indication of public contributions to the plan or to plan goals.

The LEC plan includes a discussion of emergency response in scenarios used to generate supply mix options for the region. The plan does not list specific actions, recommendations, goals or other elements pertaining to an emergency response situation.

The reader can assume that the LEC plan is adopted in the region and by the state of Florida, but the LEC plan does not present a written indication of plan adoption. The plan does include a discussion of the integration of other adopted plans and regulations pertaining to water planning in the state of Florida. Similarly, the reader can assume that the LEC Water District provides water to the region. The LEC plan includes general information about the LEC water district but the plan does not contain information about the role of the LEC in service provision.

Regional Water Supply Plan- Portland, Oregon Metropolitan Area
The Regional Water Supply Plan of Portland Oregon contains 16 template elements in their entirety, and 2 partially complete template elements. The regional plan is not wholly missing any template elements.

Missing Elements
The Portland regional plan lacks two portions of template elements, emergency response, and financial plan content. Priorities in the plan mention both emergency response planning and financial planning as goals for region. However, action plans or wording about emergency response and financial planning is missing in the Regional Plan.

Urban Water Management Plan- San Diego County, California
The Urban Water Management Plan contains 14 template elements in their entirety. The plan contains two partially complete template elements and the plan is missing two template elements in their entirety.

Missing Elements
In all, five sections are missing from the Urban Water Management Plan, community goals and objectives, forecast modification, water supply plan evaluation and water supply plan adoption. The Urban Water Management plan includes public and community input for the identification of supply and demand alternatives; however; the plan does not mention obtaining community input for any other section of the plan. The plan does not indicate any use of forecasting for the urban water management plan. The plan includes information on supply and demand options and comparisons of supplies and demand; however; the plan gives no indication about the

method for the comparisons. Additionally the plan does not indicate plan adoption or evaluation. The plan does contain information about the regulations governing water supply planning and the reader can assume that the plan has been adopted.

Watersheds-Chester County, Pennsylvania
Watersheds contains 14 template elements in their entirety. The plan contains two partially complete template sections and the plan is missing two template sections in their entirety.

Missing Elements
Watersheds lacks an assessment of economic, environmental, and social costs and benefits for supply alternatives, forecasting and forecast modification based upon the supply mix for the region, a water shortage contingency plan, and a financial plan. Watersheds lists many goals, plans and objectives for the region, but indicates no monetary costs associated with the water supply plan or any supply or demand alternatives. Similarly, Watersheds considers water shortage as a variable during the water planning process, but does not indicate an action plan for the region during a water shortage. Watersheds does not mention regional forecasting as part of the plan; however, the plan provides some indication that forecasting may be part of the regional planning process in the future.

Plan Comparison Discussion
The regional plan comparison process gave rise to observations about comparison methods and about regional water planning. The following section presents aspects of the comparison process that are not captured by the checklist or plan content to template element comparison.

Lower East Coast Regional Water Supply Plan- Southeast Florida
The Lower East Coast Regional Water Supply Plan (LEC) created by the South Florida Water Management District, includes four interesting elements that stand out upon review: 1) the boundaries of the plan, 2) the approach to regional water supply, 3) performance measures, and 4) the use of computer modeling.

This plan, similar to the three others evaluated, begins with an introduction section. The introduction section includes two elements from the template, the introduction and planning criteria elements. This section provides a foundation for the plan by establishing the legal basis for the plan and the relationships between this plan and other plans and programs. Especially interesting is the outline of the boundaries of the plan. The plan coverage area includes existing service areas and the drainage areas of the Caloosahatchee and St. Lucie river basins. Drainage areas dictate the boundaries of the plan as opposed to jurisdictional lines as plan boundaries. The plan boundary intersects several counties, includes several service areas, two national parks and one national preserve. The plan also evaluates areas outside the plan boundary that have relationships with the LEC and Lower East Coast planning process.

Though jurisdictional boundaries dictate most regional plans, the template suggests that regional plans follow an example similar to the LEC plan for boundary determination. The concept of planning along natural boundaries in the LEC plan demonstrates how a region can implement water supply planning across jurisdictional lines. The inclusion of this concept strengthens the argument presented by the integrated plan template for regional planning along watershed or other natural boundaries.

Similarities exist between many elements in the LEC plan and those listed in the integrated plan template. The similarities include a planning horizon or time frame for the plan, overall goals and objectives for the plan, and plan evaluation.

The LEC also approaches regional water supply in an interesting way. The plan acknowledges that enough water is available to meet demands on a regional scale; however, local conditions and circumstances may make it impossible or impractical to deliver regional water to particular individual supply systems. To address this issue, the plan presents regional water supply development projects, as well as a menu of strategies and local options that are available for more localized water supply development projects (South Florida Water Management District, 2000).

In comparison to the template, the LEC approach to meeting demand presents a different option than some of the options in the template. The template suggests that solutions to water supply problems be found and focused on regionally; however, the template does not indicate that localized projects are the primary option for solving water supply problems. The inclusion of localizing water supply projects as a demand reduction alternative, presents an additional alternative that could be included in the template.

Third, the LEC includes performance measures for the regional planning district. Performance measures are the method of plan evaluation for the LEC. "The performance measures are used as indicators of the degree to which the water supply objectives are being met" (South Florida Water Management District, 2000). The measures indicate how the options and alternatives are likely to meet the goals and objectives of the plan (South Florida Water Management District, 2000). The performance measures summarize the overall performance of the alternatives.

The template suggests several methods for plan evaluation but it does not include performance measures. The use of performance measures presents an additional option for plan evaluation that could be included in the template. The template is designed to be general and useable for most regions, so some may not find performance measures useful. However, the method should probably be included in the template to give regions different options to choose from when designing a water supply plan.

Finally, the LEC relies heavily on the use of computer models. The LEC plan uses computer models to produce comparisons of existing and future supplies, alternative identification, alternative evaluation, cost analysis, plan evaluation, and recommendations. The LEC uses multiple computer models to create the plan, and describes how the models work and what they contribute to the plan.

The use of computer modeling in the LEC plan sets the plan apart from the other regional plans. The computer modeling section presents extensive detailed and technical information about the plans' computer models and modeling process. Though technically useful, the computer modeling section is difficult to read and comprehend. The section might lose or confuse readers from audiences outside the scope of water planning or computer modeling. An improvement for this section might include writing in a style more appropriate for a less well-informed public, or adding a general overview of the models and their use instead of an in-depth description of modeling.

The general use of computer models is stated in the template as an option to consider, but the concept is not presented in as much detail as is it described in the LEC plan. As the template is used by more regional planning efforts, inclusion of computer modeling may become a larger part of the template. The LEC plan highlights the usefulness of computer modeling, and including the option to use a successful tool of water planning is within the scope of the template.

Regional Water Supply Plan- Portland, Oregon Metropolitan Area

The Regional Water Supply Plan (Regional Plan) created by the Water Providers of the Portland Metropolitan Area begins with an introduction section. The section contains an overview of the plan that is very similar to the outline of the integrated plan template. The section also includes a diagram of the water planning process. The diagram provides a useful representation of the actions involved in water supply planning.

The first part of the Regional Plan that stands out is the Public Involvement section. The Public Involvement section outlines the purpose for public involvement, methods of public involvement, and how the plan incorporates public input. Public involvement is mentioned in the template and the use of public involvement in this plan highlights the critical nature of this planning tool. The demonstration of public involvement in the regional plan suggests that the template should incorporate more ideas that utilize public involvement.

In addition to a focus on public involvement, the Portland Regional Plan demonstrates connections to natural resources throughout the bulk of the plan. The Regional Plans' source options section lists connections to wetlands, wildlife, terrestrial threatened and endangered species, forest management, fish, environmental impacts, and catastrophic events. The water availability impacts section also reviews the connections with geotechnical hazards, hazardous materials, and land use. Throughout the document, the Regional Plan evaluates the impacts of catastrophic events and includes cost estimates and tables; further exploring the connections between water supplies and other regional elements.

The Regional Plan includes several in-depth, integrated sections. Some examples of those sections are the analyses of source options, regional transmission, and conservation options. The conservation options section connects rate and pricing structures with the effects of rate structures on regional demand. The supply strategy section integrates analysis, action strategies, and costs for various supplies for the base case and for water shortage.

The Portland Regional Plan and the LEC plan are similar because both plans use computer modeling and scenario generation; however, the Regional Plan differs from the LEC in the description of modeling tools. The Regional Plan section provides an overview of modeling, but leaves out unnecessarily confusing and technical information.

The Portland Regional plan provides a good example of what the integrated plan template tries to convey. The plan reiterates connections and integrations throughout the document, and it addresses a range of issues for every item considered in the plan. The plan shows an active process of integrated planning for water supply and planning for issues connected to water supplies.

Urban Water Management Plan- San Diego County, California
The San Diego County Water Authority created the Urban Water Management Plan, (Urban Plan). The Urban Plan includes several interesting elements, 1) a separation of different demand types into use categories, 2) a summary of demand management 3) integration of regional management issues, 4) consideration of environmental impacts in states that supply water to San Diego.

By separating types of demand into different categories, the Urban Plan gives a more complete picture of water use in the region. The region currently implements demand management. The demand management plan allows the region to summarize the effects of demand management on supplies more accurately. The demand management plan provides a summary of best management practices, conservation programs, connections to revenue and impacts, as well as savings from water conservation. Demand elements demonstrate connections and integration in that aspect of water supply planning. Similarly, by addressing regional management issues for supply and demand management throughout the plan, the Urban Plan seeks management solutions and attempts to solve existing problems while planning for the future.

The integrated template presents the importance of separating types of demand, and the Urban Plan is an example of success with this concept. The plan demonstrates a practical method of use separation that is complementary to the template, and that demonstration upholds the applicability and usefulness of the template in water supply planning.

Imported water makes up 83% of water used in San Diego County. The Urban Plan relies heavily on imported water and therefore has an extensive section in the plan on imported supplies. The plan demonstrates integration by including a discussion on the effects of San Diego County's water importation on the environment of the states providing water. Additionally, the Urban Plan considers impacts on fish, water quality, and salinity in evaluating the region's water usage.

Watersheds-Chester County, Pennsylvania
"Watersheds: An Integrated Water Resources Plan for Chester County, Pennsylvania and its watersheds" (Watersheds) was created by the Chester County Water Resources Authority. Watersheds outlines the setting, problems, opportunities, planning issues, and planning framework. The plan includes impacts from land use on water supplies in a specific section and the plan includes best management practices for alternatives to meet supply and demand.

Watersheds includes three elements that stand out. First, the plan establishes an implementation schedule for projects. The implementation schedule gives the plan functionality for on-the-ground work that other plans do not have. The schedule provides a useful quantifiable measure for plan implementation and evaluation. Second, the plan prioritizes projects. Prioritization gives structure to plan implementation. Third, Watersheds includes water budgets. Water budgets are useful when determining the best supply mix for a region.

Watersheds quantitative elements are examples of implementation elements listed in the template. The plan provides an example of what the template is communicating by including measurable outcomes in the regional water supply plan. Measurable outcomes allow for defined progress as well as a clear-cut method to evaluate and monitor the plan.

Watersheds' writing style stands out as the primary difference between Watersheds and the LEC plan. The intention of Watersheds is as a document for use and review by the public. The plan has a high degree of readability and includes many descriptive tables and informative drawings. The best features of Watersheds include the plan orientation for public use and easy-to-read style.

Writing style is one element not specified in the template. Though the template focuses mainly on potential contents of a water supply plan, writing style is often an effective medium to convey that information. A writing style is born out of the region and culture surrounding a water supply plan, and the template should not and cannot dictate information that specific. However, suggestions of plan styles and writing styles from successful or accepted plans may be within the scope of the template and should be considered as an addition to the template in the future.

Watersheds also mentions the "Compendium." The Compendium is a supplemental document that provides supporting policy and specifics related to the plan. The two documents demonstrate coordination in planning and an integrated approach.

Chapter 6: Evaluation and Conclusion

To complete the process for this thesis, an evaluation of the contributions of this thesis is appropriate. Conclusions on the future direction of research are also included in this chapter.

Integrated Plan Template Evaluation

One purpose of the integrated plan template is to provide a summary of elements that can be part of an integrated regional water supply plan. The template includes elements found in the many plans surveyed and reviewed for this thesis. Template elements demonstrate the breadth of information contained in the integrated plan template.

The integrated plan template produced two additional tools, the condensed template, and the comparison checklist. The condensed template provides a fast method for plan comparison. Using the condensed template allows a plan reviewer to have the benefit of the knowledge contained in the integrated template, without having to use the entire template.

The checklist provides a plan reviewer with a method to compare the template to a regional water supply plan. The checklist is an easy-to-use, quick look at a regional water supply plan, providing a great deal of information to the user. The checklist quickly highlights what template elements are contained in a water supply plan, as well as elements that are missing.

Use of the integrated plan template in plan comparison demonstrates characteristics which may require revision if research is to continue on this subject. One aspect of the template that may need revision is the template's usability. The template is cumbersome to use as a plan comparison tool. The primary method of plan review is comparison of information in the template to information in the regional plan. The act of finding the information in the template is difficult due to the amount of information in the template.

Additionally, the template does not clearly define terminology and broad interpretation occurs. The inclusion of information from many sources and many areas leads to the creation of an integrated template; however; the varied terminology from different sources causes a broad categorization of terms in the template. Due to the broad categorization in terms, the plan reviewer has difficulty determining if a term in a regional plan meets the specifications of the term in the integrated template. Though broad categorization leads to unclear term qualification, the template is better able to accommodate various terminologies contained in regional plans during the plan and template comparison processes.

Overall, three template revisions could occur to make the template more user friendly. First, the template could guide the plan comparison process more effectively if template sections included additional categories. The current categories within template sections are too broad and list too many specific items. Generalized categories would clarify the purpose and intent of each template section, and allow the template more flexibility for plan comparison.

Second, future template use would be aided by the inclusion of sections on computer modeling and public involvement. The regional plan comparison demonstrated the usefulness of computer modeling and public involvement in water supply planning. Though both topics are mentioned in the integrated plan template, the template does not list enough information about either to gain the value of each topic.

Third, terms identified in the template should be defined more thoroughly. The template does not currently demonstrate the intent of the terminology well enough to make the template useful on a larger scale. Clarification of terminology and intent would ensure consistent template performance for regional water supply plan comparison.

Additionally, all template elements may not be applicable to every regional plan. One purpose of the template is to be flexible, adjustable, and adaptable to the different needs of different regions. Regional planners, with help from stakeholders and the public, should use the template as a guide for the water supply planning process. Regional planners, through discussions with stakeholders and the public, should determine the elements of the template best suited to meet the needs of the region, and include those elements in the regional water supply plan.

Finally, the integrated plan template will remain current if it is evaluated and revised as new information is added to the field of water supply planning. The template is not meant to remain constant or static. In fact, the template is more useful if it is modified and adjusted for each individual planning process.

Though the integrated plan template may require some revisions, the template has several strengths as well. First, the template is a summary of current literature and active water supply planning documents. The compilation of information in the field is a valuable and useful resource to any region seeking to plan for water supply or update an existing plan.

Second, the template gives a region a place to start when tackling the complexities of water supply planning. A regional water planning effort will most likely be time consuming and costly, so most regions would want to end up with a product that is useful and informative for the future. The template allows a region to consider many options to increase supply, reduce demand, integrate with other plans, implement the water plan, and follow up after the initial planning process is complete. The template as a tool is useful in a variety of ways. The template can be built upon as the region goes through a planning process and beyond.

The various uses of the template are really its strengths.

- The template can be used in the scoping phase of the planning process to bring out concepts and ideas to consider for the rest of the process.
- The template can be used in any stage of the process to gain ideas, knowledge, or content.
- The template is useful as a comparison tool to evaluate if an existing plan should be or could be updated.
- The template presents ideas and methods to include if a regional plan does need to be updated.
- Additionally, the template gives examples and provides methods for how to integrate the water supply plan with other existing or proposed planning efforts that a region may be experiencing.

Discussion

The use of the integrated plan template, the condensed plan template, and the comparison checklist during the application of the template gave rise to an additional area of analysis. The comparison of plans to the template was primarily a quantitative exercise. Though quantitative comparison is useful, qualitative comparison of the content of a regional plan to a template or other measure would enhance the planning process.

The checklist provides the planning process with a quantitative element and a comparison technique. An element missing from the process is a method to review the quality of content within a regional plan. The comparison method measures only the existence of elements in a regional plan, not the depth of information. Measuring the depth and quality of content of the regional plan is a qualitative measure, a measure not covered by the scope of this thesis. The integrated plan template includes aspects of qualitative evaluation; however, the template is cumbersome to use. Qualitative plan comparison could occur with the creation of another method. A new comparison method could work in conjunction with the comparison checklist to provide an enhanced planning process. The integrated plan template could be redefined to provide a framework for the qualitative comparison method.

Conclusion

This thesis provides the field of water supply planning with a survey of literature and practice, culminating in the tools of an integrated plan template and comparison checklist to support the water supply planning process. These tools inform community learning, encourage public participation, and guide the planning process. The three tools of 1) the integrated plan template, 2) the condensed template and 3) the comparison checklist, can be used as a resource for integrated regional planning. The tools can be used in each step of the planning process from scoping to comparison of existing plans with the template. The template and comparison checklist help to determine what elements of the template are included in an existing plan and also which template elements could be included in a revision of a regional plan.

The template in its current format represents an initial attempt in an evolving process of research and integrated planning for water supply. The scope of this thesis is to provide an integrated template. Further research challenges the plan reviewer to create a template that is less cumbersome to use. The next step in integrated water supply planning is to revise the template to include more general sub-categories within the large categories. Additional regional plan content could be compared to the template to determine appropriate sub-categories to add into the template. Existing sub-categories in the template could be broken out and better defined to increase the use of the template as a tool. Additional implementation and evaluation of the template is necessary to further the goals of this research.

Water supply planning is complex at any level. Planning regionally for water can be cumbersome, but regional planning can also be a method to solve many similar problems at once. Often localities share water supplies and have similar issues relating to lack of supplies or too much demand. To undergo a water planning process, a planner needs a place to start. The integrated plan template offers one starting point, one method for water supply planning. The template is adaptable and flexible. The entire template can be integrated into a new plan, or pieces of it can be included in an existing plan.

However the process evolves, the ideas presented for plan integration with natural features, types of land use, and existing plans are the primary contribution of the template. Water supplies often connect uses, areas, features, or other separations. Because of the connective properties of water, it is essential for a planner to consider crucial associations to land uses, human uses, natural uses, and sustainable uses when planning for the use of water in any manner. Water supply planning has the ability to integrate other plans and initiatives to create a successful, sustainable system. Every water planner has an option and, more accurately, a responsibility to work within the natural and human systems that affect water supplies and uses. To create a plan and system for water delivery and use that integrates many types of other uses and concerns is not only feasible, it is sound and responsible planning.

Bibliography

American Planning Association. (2002, April 15). *Policy Guide on Water Resources Management* [Electronic Version]. Retrieved November 18, 2003, from http://www.planning.org/policyguides/waterresources.htm.

American Water Works Association. (2001) *Water Supply Planning: Manual of Water Supply Practices*. (American Water Works Association, M50, First Edition). Denver, CO: Author.

Ashworth, J. (2002). Water treatment and supply- new direction in Texas water management planning. *Public Works*, Vol. 133, Issue 7, p.22-24.

Atwater, R. & Blomquist, W. (October 2002). Rates, rights, and regional planning in the metropolitan water district of southern California. *Journal of the American Water Resources Association*: *American Water Resources Association*, Vol. 38, No. 5, p. 1195-1205.

Baer, W.C. (Summer 1997). General plan evaluation criteria: An approach to making better plans. *Journal of the American Planning Association:* American Planning Association, Vol. 63, No. 3, p. 329-344.

Bagwell, T., & Personett, M. (1997). State and regional water planning in Texas. *American Water Works Association Journal*, Vol. 89, No. 11, p. 65-72.

Burson, J.M. (2000). Middle Rio Grande regional water supply planning: The pitfalls and the promises. *Natural Resources Journal*, Vol. 40, Summer 2000, p. 533-567.

California Department of Water Resources. (1994, October*). California water plan update: Executive Summary* (Bulletin 160-93). [Electronic Version]. Retrieved February 28, 2004, from http://rubicon.water.ca.gov/esindex.html.

California Department of Water Resources. (1995). *Urban water management plan review summary*. Sacramento, California: Author.

Castaic Lake Water Agency. (2000, December 20) *Urban Water Management Plan*. California Department of Water Resources. [Electronic Version]. Retrieved December 3, 2003, from http://clwa.org/urban_water_plan.htm

Chester County Water Resources Authority. (2002, September). *Watersheds: An integrated water resources plan for Chester County, Pennsylvania and its watersheds*. A functional element of Landscapes Chester County Comprehensive Plan. Chester County Water Resources Authority, West Chester, Pennsylvania: Author.

Code of Virginia. (2003). *Chapter 780: Local and regional water supply planning*. Richmond, VA: on file with author.

Commonwealth of Virginia. (2003). *Tentative outline of state plan*. Richmond, VA: on file with author.

Cox, W. E. (2003). *Measuring safe yield: Issues associated with assessing water supply capacity*. Unpublished manuscript, on file with author.

Cuthbert, R.W. & Lemoine, P.R. (1996). Conservation-oriented water rates. *Journal of the American Water Works Association*, Vol. 88, No. 11, p. 68- 78.

Dzurik, A.A. (2003). *Water resources planning*. Lanham, Maryland: Rowman & Littlefield Publishers, Inc.

Emerson, H., & Lahlou, M., (1998). Conservation: It's the future of water. *On Tap*, Vol. 7, Issue 4, p. 1-28.

Environmental Protection Agency. (1999, December). *Understanding the safe drinking water act* (EPA 810-F-99-008). Washington, DC: Author.

Eugene Water & Electric Board. (1998, December). *Water supply plan*. Eugene, Oregon: Author.

Faludi, A. (1973). *Planning theory*. Oxford, England: Pergamon Press Ltd.

Fiske, G.S., & Sirois, B. (1998). Integrated supply planning in Eugene, Oregon: The water supply plan of the Eugene water and electric board. *Proceedings of American Water Works Association*, p. 571-579.

Grigg, N & Vlachos, E. (1993). Drought and water supply management: Roles and responsibilities. *Journal of Water Resources Planning and Management,* Vol. 119, No. 5, p. 531-541.

HDPE pipeline helps transport stored groundwater. (2002, March). *Public Works*, Vol. 133, Issue 3, p. 52-56

Jercich, S.A. (1997). California's 1995 water bank program: Purchasing water supply options. *Journal of Water Resources Planning and Management,* Vol. 123, No. 1, p. 59-65.

Keuhl, D., Randolph, J. & Younos, T. (1999). *The Virginia small water systems survey: An assessment of public health performance appraisals* (Special Report SR16-1999). Blacksburg, Virginia: Virginia Tech, Virginia Water Resources Research Center.

Kirshen, P & Fennessey, N. (1995). Possible climate change impacts on water supply of metropolitan Boston. *Journal of Water Resources Planning and Management*, Vol. 121, No. 1, p. 61-69.

Kuhner, J., deLucia, R., & Shapiro, M. (1977). Assessment of existing methodologies for evaluation and control of watershed land use in drinking water supply systems. In R.B. Pojasek (Ed.), *Drinking water quality enhancement through source protection* (pp. 345-373). Ann Arbor, MI: Ann Arbor Science.

Lane, M.B. (2001). Affirming new directions in planning theory: Comanagement of protected areas. *Society and Natural Resources,* Vol. 14, p. 657-671.

Lamp, L. Andrews, H., & Kisinger, K. (1996). 10 issues in urban stormwater pollution control. *American City and County*, Vol. 111, Issue 10, p.36-43.

LoGrande, M.A., Corwin, R.P., & Hopkins, T.J. (1995). Integration of watershed protection and regional planning: Experience with New York's central Pine Barrens initiative. *Proceedings of American Water Works Association,* p. 149-158.

Luecke, D.F. (1993). Interaction of water supply planning and environmental protection. *HortScience*, Vol. 28, No. 4, p. 285-286.

Luketina, D. & Bender, M. (2002). Incorporating long-term trends in water availability in water supply planning. *Water Science and Technology*, Vol. 46, No. 6-7, p. 113-120.

Lund, J. & Israel, M. (1995). Optimization of transfers in urban water supply planning. *Journal of Water Resources Planning and Management*, Vol. 121, No. 1, p. 41-50.

Mace, R.E., Mullican, W.F., & Williams, C.R. (2002). Groundwater supplies and availability in Texas: Results from regional water planning. *Transactions- Gulf Coast Association of Geological Societies*, Vol. 52, p. 681-694.

Maddaus, W., Gleason, G., & Darmody, J. (1996). Integrating conservation into water supply planning. *American Water Works Association Journal*, Vol. 88, No. 11, p. 57-67.

McNeil, J., McNeil, T., & Rothstein, F. (2001). *Smart growth strategies, protecting water resources: Local government roles and options for the Rocky Mountains and northern Great Plains* (National Association of Counties No. X-82738701).Washington, DC: National Association of Counties, U.S. Environmental Protection Agency.

Mulvihill, P.R. (2003). Expanding the scoping community. *Environmental Impact Assessment Review,* Vol. 23, p. 39-49.

Mulvihill, P.R. & Jacobs, P. (1998). Using scoping as a design process. *Environmental Impact Assessment Review,* Vol. 18, p. 351-369.

National Drinking Water Clearinghouse. (1998). *EPA publishes conservation guidelines: Contents of a comprehensive water conservation plan* (On Tap Vol. 7 Issue 4). Morgantown, West Virginia: West Virginia University, National Drinking Water Clearinghouse: Author.

National Research Council. (1997). *Safe water from every tap: Improving water service to small communities*. (1st ed.). Washington, D.C.: National Academy Press.

New Mexico Office of the State Engineer. (2003, December 17). *State Water Plan*. New Mexico Office of the State Engineer, Interstate Stream Commission. [Electronic Version]. Retrieved February 19, 2004, from http://www.ose.state.nm.us/water-info/NMWaterPlanning/state-water-plan.html.

North Carolina Department of Environment and Natural Resources, Division of Water Resources. (2001, January). *State Water Supply Plan: Executive Summary* [Electronic Version]. Retrieved February 24 2004, from http://www.ncwater.org/Reports_and_Publications/swsp/swsp_jan2001/final_pdfs/0000ExecSummary.pdf

Okun, D. A. (1977). Drinking water quality through enhancement of source protection. In R.B. Pojasek (Ed.), *Drinking water quality enhancement through source protection* (pp. 345-373). An Arbor, MI: Ann Arbor Science.

Pieroni, C.C., Jacoby, B., & Pekelney, D.M. (1998). The "program design tool": A regional approach to conservation reporting. *Proceedings of American Water Works Association*, p. 287-294.

Piper, S. & Platt, J. (1998). Benefits from including wetland component in water supply projects. *Journal of Water Resources Planning and Management*, Vol. 124, No. 4, p. 230-233.

Poss, N. (2002). Ordinance ties development to water supplies: First of its kind in the east [Electronic version]. *Southeast Watershed Forum* Vol. 5, Issue 2, 1.

Prasifka, D.W. (1994). *Water supply planning*. Malabar, Florida: Krieger Publishing Company.

Randolph, J. (2002). *Environmental land use planning and management.* Draft, Island Press. Unpublished manuscript on file with author.

Randolph, J. (2004). *Environmental land use planning and management.* Washington, D.C.: Island Press.

Rappahannock River Basin Commission. (2002). *Guiding Principles for Water Supply Planning* (Rappahannock River Basin Commission Publication). Fredericksburg, VA: Author.

Raucher, R.S. (1996). Public health and regulatory considerations of the Safe Drinking Water Act. *Annual Review Public Health,* Vol. 17, p. 179-202.

Regional water system offers solutions to water needs. (1996, September). *American City and County*, p. 51.

Safe Drinking Water Act Amendments of 1986. (Enacted June 19, 1986). In E.J. Calabrese, C.E. Gilbert, & H. Pastides (Eds.), (1989), *Safe drinking water act: Amendments, regulations and standards* (Appendix 1, pp. 143-201). Chelsea, MI: Lewis Publishers, Inc.

San Diego County Water Authority. (2000, December). *2000 Urban water management plan*. Water Resources Department, San Diego, California: Author.

Selby, D.A., & Robinson, S.L. (1995). Utilizing integrated supply planning to define a new water supply system for southern Nevada. *Proceedings of American Water Works Association*, p. 481-486.

South Florida Water Management District. (2000, May). *Lower East Coast Regional Water Supply Plan*. Planning Document. Water Supply Planning and Development Department, West Palm Beach, Florida: Author.

Southworth, W.P. (1998). A successful regional wellhead protection program. *New England Water Works Association*, Vol. 112, Issue 3, p. 241-243.

Statewide Planning Program Rhode Island. (1997). *Water supplies policies for Rhode Island* (State Guide Plan Element 721). Providence, Rhode Island: Author.

Stickel, L., & Fiske, G. (1996). Water supply for 21st century: Using integrated resources planning for the Portland, Oregon metropolitan area. *Proceedings of the American Water Works Association*, p. 313-327.

Sudol, F. & Dresdner, A. (1995, March 31). The sustainable city. *American City and County*, p. 6-11

Texas State Water Plan: Drought, Conservation, Development, and Management, Article 1, Section 1.01, Section 16.051, Water Code, (1997).

Toneatti, S., & Stinson, T. (2002). Design and construction of the upper cape regional water supply project. *Journal of the New England Water Works Association*, Vol. 116, Issue 4, p. 248-263.

U.S. Army Corps of Engineers. (1994). *Managing water for drought*. (IWR Report 94-NDS-8). Water Resources Support Center: Institute for Water Resources: Author.

U.S. Census Bureau. (2001, September 20) *Glossary of Basic Geographic and Related Terms*. [Electronic Version]. Retrieved March 29, 2004 from http://www.census.gov/geo/www/tiger/glossary.html#othergeographicentities

Virginia Department of Environmental Quality. (2003). *Report of the water policy technical advisory committee to the general assembly of Virginia*. [Electronic Version] Retrieved January 9, 2004, from http://www.deq.state.va.us/info/pdf/wptacfinal120103.pdf

Virginia Water Central. (1998) *Fitting Drinking Water Amendments into Place.* Virginia Water Central, December 1998, Virginia Water Resources Research Center: Author.

Wallace, T.B. & Cox, W.E. (2001). The *North Carolina water supply planning program (draft)*. On file with author, Virginia Polytechnic Institute and State University.

Water Providers of the Portland Metropolitan Area. (1996). *Regional water supply plan for the Portland metropolitan area* (Final Report). Portland, Oregon: Author.

Wetzel, M. (1990). Water supply or water deficiency? *Water Engineering and Management*, August, p. 137-139.

Wilchfort, O., & Lund, J. (1997). Shortage management modeling for urban water supply systems. *Journal of Water Resources Planning and Management*, Vol. 123, No. 4, p. 250-258.

Whipple, W. (1993). Buffer zones around water supply reservoirs. *Journal of Water Resources Planning and Management*, Vol. 119, No. 4 p. 495-499.

Whipple, W & Werick, W. (1994). Drought and water-supply management: Roles and responsibilities. Discussion. *Journal of Water Resources Planning and Management*, Vol. 120, No. 6 p. 1003-1005.

Wu, R. & Haith, D. (1993). Land use, climate, and water supply. *Journal of Water Resources Planning and Management*, Vol. 119, No.6, p.685-703

Appendix A
Integrated Plan Template

SECTION 1. Introduction

Definition: *Planning refers to a regional provider's role in developing a coordinated overall approach to water development and management.*

A. Purpose

B. Vision

1. Definition: *Vision is a broad statement for a plan, an overarching goal.*
2. Examples
   a. A vision can be the protection of all water resources.
   b. A vision can provide policy guidance.
   c. A vision could be integrated resource management.
   d. The creation of a hybrid vision may include elements characteristic to those of a regional provider, contractor, and/or shareholder.
   e. A vision should promote regionalization.
   f. Regionalization will minimize duplication or inefficiencies from separate supply ownership and management of supplies, and can also increase security, and the amount of adequate, safe, reliable water supplies.

C. Study Area Section and Maps

1. Location information
2. Size
3. Climate
4. Demographics

D. Summary of past and current land uses in the area.

SECTION 2. Planning Criteria (can also be called Guiding Principles for Water Supply Planning)

Definition: *Planning Criteria provides a framework for the planning process, how the planning process will be structured.*

A. Planning criteria should:

1. Be developed for the study area.
2. Be consistent with the Comprehensive Plan.
3. Be coordinated with land use and transportation plans.
4. Include community input and public involvement.
5. Include member agency input.
6. Set priorities among competing interests.
7. Take Federal and State requirements into consideration.
8. Establish regulation to guide planning.
9. Promote regionalization.
10. Honor existing water rights and agreements.
11. Consider water supply strategies in light of:
    a. Cost
    b. Public acceptability.
    c. Quality of life.
    d. Water quality.
    e. Environmental impact.
    f. Local controls.
    g. Flexibility.
    h. Regulatory feasibility.
    i. The probability of not meeting summer demands due to system shortages and reliability.

SECTION 3. Goals and Objectives

Definition: *Goals should be overall intentions of the regional water providers and things the regional water plan should accomplish. Each goal should have at least one corresponding objective.*

Definition: *Objectives are measurable evaluation criteria connected to each goal. Objectives are either completed or not.*

A. Plan Goal and Objective Examples

1. Establish community goals for water supplies in the plan.
   Objective: Solicit five goals from community members.
2. Ensure that the Water Supply Plan is consistent with the comprehensive plan.
   Objective: Set time frame for review and coordination of both plans.
3. Enhance public welfare.
   Objective: reduce number of people being served unacceptable water.
4. Reduce damage caused by floods.
   Objective: Control upstream water to reduce flooding.
5. Provide for the reasonable and sustained development and use of surface and groundwater for municipal, agricultural, recreational, commercial and industrial purposes.
   Objective: Determine how much water is needed to meet future demand.
6. Protect and restore fisheries, wetlands and aquatic habitat.
   Objective: Determine which fisheries to restore and set date for restoration.
7. Protect water quality and instream uses and ensure future availability of flows.
   Objective: Determine amount of flow needed and allow for that amount of flow with water .. planning.
8. Having adequate water supply is often thought of as being able to meet "offstream" water uses, such as municipal, industrial, and agricultural uses. However we need to maintain healthy . .. "instream" uses such as protecting aquatic habitat, maintaining water quality, and providing .... recreation.
   Objective: Determine amount of water necessary to meet instream and offstream uses.
9. Regional leadership is necessary for planning of flood control, wastewater, and water facilities. Regional leadership can save money, avoid duplication and needlessly redundant projects.
   Objective: Establish regional leadership.
10. Balance economic viability of water supplies while protecting environmental resources.
    Objective: Establish scale for economic and environmental comparison.
11. Recommend policies and actions that will ensure an adequate and affordable supply of water to meet needs, based on water use projections in a manner that fosters conservation of .... resources.
    Objective: Date by which policies should be written about provision of adequate water supply.
12. Minimize environmental impacts to natural areas.
    Objective: Determine current environmental impacts and reduce future impacts.
13. Maximize conservation of natural areas.
    Objective: Determine acres to be conserved, institute plan to conserve those areas.
14. Minimize vulnerability to catastrophic events.
    Objective: Determine areas susceptible to catastrophic events and improve resilience in those areas.
15. Maximize flexibility of water system.
    Objective: Determine ranges of services to be provided.
16. Get sufficient public input to generate broad support for the plan.
    Objective: Attain input from a target percentage of the population.
17. Identify the cost of effective, environmentally sensitive, water supply strategies to meet .... .. current and future water needs.
    Objective: Conduct an assessment of economic, environmental, and social costs and benefits of water supply strategies by a certain date.

18. Some forms of water and waste pollution will no longer be tolerated.
    Objective: Remove ability to pollute from plans and policies.
19. Flood control is a crucial part of the water supply plan.
    Objective: Implement flood control measures by a certain date.
20. Develop accurate and sufficient information concerning water supply sources, ground water and surface water.
    Objective: Have GIS coverage of a certain percentage of the region covered.
21. Establish contingency management plans and strategies that effectively address the current .. and future water needs
    Objective: Draft a contingency management plan.
22. The water supply plan should provide policy guidance.
    Objective: Outline policies that support the water supply plan.
23. Incorporate land use planning and water supply planning.
    Objective: Review comprehensive plan to assure coordination with water supply plan.
24. Land use decisions should be consistent with available water supplies.
    Objective: Review water supply plan before making a land use decision.
25. Land use decisions should not impact water supplies.
    Objective: determine impacts of land use decisions before they are finalized.
26. Promote the efficient use of water and protection of water quality in all new development.
    Objective: Require water protection and water quality plan with new development plans.
27. Coordinate source protection with land use and transportation plans to integrate water supply protection into those plans.
    Objective: link documents by pages, phrasing, require consultation of all documents on .... permits, etc.
28. Use GIS as foundation for future water systems and planning.
    Objective: Integrate and use GIS.
29. Present a more justifiable and balanced approach to development of water supplies.
    Objective: Clarify and justify all actions relating to water supply.
30. Create reduction objectives for the governing body as a whole.
    Objective: Set measurable reduction thresholds and time frame of evaluation, sequential .... .. actions if reduction is met or not met.
31. Achieve a balance between capacity expansion and conservation.
    Objective: Add one conservation option for every capacity expansion option.
32. Coordinate the operation of facilities to reduce costs or improve the reliability of providing . adequate supplies.
    Objective: Implement plan to coordinate the operation of all member utility facilities.
33. Promote development of alternatives.
    Objective: Set date for completion of alternative development.
34. Encourage energy conservation strategies as they relate to water, to reduce negative impacts on the environment and avoid wasting valuable energy resources.
    Objective: Create and implement energy conservation strategies related to water resources.
35. Use a variety of approaches and techniques to identify emerging water policy issues.
    Objectives: Identify a set number of emerging water policy issues.
36. New supply uses shall be cost effective, efficient.
    Objective: Supplies and demands may be subjected to performance standards.
37. The water management utility shall be effective and efficient.
    Objective: The utility may be subjected to performance standards.
38. Assess the long range water supply needs and the adequacy of planning efforts to meet those needs.
    Objective: Determine a needs list and evaluate the needs met at the end of the process.
39. Constantly prepare for drought to mitigate drought in the long run.

Objective: Implement daily conservation and drought preparedness.

40. There should be an ongoing process of preparing and periodically updating the plan. That . .. process provides the greatest benefit to the citizens.

Objective: Outline plan evaluation and update program.

41. Consider including technology lines- broadband or fiber optic with new water lines to reduce the duplication of digging efforts and further economic development and accessibility to ... .. internet.

Objective: Coordinate technology line construction and water line construction.

B. Community Goals

Definition: *Each community should outline individual goals and needs over a consistent time frame to incorporate ..... all the goals and needs into the regional plan.*

SECTION 4. Existing Supplies

A. Goal Examples

1. Maintain all existing supplies

Objective: outline plan for supply maintenance.

2. Determine amount of all existing supplies.

Objective: Set date for completion of amount survey.

3. Assess measures to improve water resource quantifications by the private sector to better .... .. address site-specific water availability and quality issues.

Objective: Review and revise existing measures of quantification.

4. Improve water efficiency as an alternative to traditional water supply development.

Objective: Set goals for water efficiency improvement and meet them before initiating .... traditional supply alternatives.

5. Protect against water supply shortages.

Objective: Determine the amount of water necessary to protect against supply shortage and .. store that amount of water.

6. Supplies should only be used to their safe yield, and safe yield should be determined on all . .. supplies.

Objective: Determine safe yield for each supply source.

B. Items to be included in section

1. Map showing location of existing supplies.
2. Description of surface waters.
3. Description of ground waters.
4. Status of existing facilities, condition of water supply facilities in each member utility.
5. Summary of production, treatment, and distribution infrastructure.
6. Identify sources of water supplies for each member agency.
7. For each source dictate how current water is supplied, through a single agency, or regional . .. agency etc.
8. Past and current trends in climate changes.
9. Annual precipitation information.
10. Water supply history.
11. Evaluate water supply availability.
12. Determine the availability of emergency and seasonal supplies.
13. Describe reliability of water supplies.
14. Describe any plans to replace inconsistent water sources.
15. Describe surface and ground water storage opportunities.
16. Describe the limitations of water storage to offset annual water supply variability.
17. Estimate ground water supply capability.
18. Evaluate of existing safe yield from ground water and surface water sources.

Definition: *Safe Yield has been defined as the maximum output that a system can maintain for the duration of the most restrictive condition of supply.*

Definition: *Supplies should only be used to their safe yield, and safe yield should be determined on all supplies.*

19. Describe vulnerability of water supplies. (To natural or manmade threats)
20. Summarize of current local water recycling practices.
21. Summary of current conservation practices.
22. Summary of current desalination practices.
23. Water quality information inventory.
24. Analysis of water quality and pollution sources.
25. Identify key system design parameters such as flow rates, storage capacity, main sizing, ... routing, and expected pressures at each connection point.
26. Capacity of all systems should be summarized including current capacity, total capacity, and excess capacity.
27. Determine current system standards.
28. Determine the most effective methods for delivering water.
29. Describe wastewater collection and treatment systems
    a. Quantity of wastewater collected/treated.
    b. Methods of wastewater disposal
30. Include a summary of regional and wholesale agreements.
31. Include a summary of regulatory constraints.

SECTION 5. Existing Demands

A. Goal Examples
1. Categorize current water demands
   Objective: Create and assign water use categories.
2. Determine the average water use per day for each category.
   Objective: Define and determine averages.

B. Items to be included in section
1. Current population.
2. Current number of connections.
3. Water use amounts by category.
   a. Residential
   b. Commercial
   c. Industrial
   d. Public and Semipublic
   e. Wholesale Customers
   f. Regional Customers
4. Water use history.
5. Average water consumption rates.
6. Evaluation of the maximum day and average day demand ratios per service consumption.
7. Peak day water use statistics.
8. Amount of water used monthly in a "million gallons per day" unit.
9. Amount of water used annually in the planning area.
10. Water use statistics for emergency and seasonal demand.
11. Summary of unaccounted for losses.
12. Water sales to other systems.
13. Evaluate current uses of water as allowed in comprehensive plan, zoning ordinances, as .... .. demands on water supply. (i.e. Allowed water for landscaping)

Definition: *Maximum day demand includes ground water supplies, treatment facilities, pumping equipment and transmission water mains.*

SECTION 6. Comparison of Existing Supplies and Demands

A. Goal Examples

1. Existing supplies should meet demands
   Objective: Directly compare numbers to determine deficit or surplus.
2. Consistency in related information.
   Objective: Compare item for item that projections and information is consistent.

B. Items to be included in the section

1. Inventory of existing facilities, production characteristics and water use.
2. Overview of conditions that might affect the water system and supply planning.
3. Study and compare past water supply and use trends.
4. Compare water use history and water supply history.
5. Do current supplies meet current demands?
6. Evaluate the quantities of waters supplied and demanded. Are supplies excessive or short? Are demands excessive or realistic?
7. Develop a water system profile.
8. Determine if existing supplies are being used to capacity.
9. Evaluate ground water management.
10. Determine if there is a water supply deficit.
11. Examine the effects of system operation.
12. Evaluate the need for added water supplies to meet current demand.
13. Use a model to estimate the current safe yield for ground water and surface waters.
14. Determine if demand exceeds the safe yield.
15. Examine effects of seasonal shortages.
16. Evaluate the effects of stormwater management on supply and demand.
17. Examine the limitations in imported water during drought events.
18. Evaluate capital improvements needed to meet current supplies and demands.
19. Determine the adequacy of water use monitoring and water supply data collection.

SECTION 7. Comparison of Future Supplies and Demands

A. Goal Examples

1. Future demands should not exceed future supplies.
   Objective: Determine level of supply and demands that should not be exceeded.
2. Measures should be taken to assure that future demands can be met.
   Objective: Determine and implement measures to assure supplies meet demands.
3. Project future water needs for various water use categories.
   Objective: Establish water use categories and future projections for each.

B. Items to be included in the section

1. Water supply needs and service areas should be based on sound comprehensive planning .... .. principles.
2. Evaluate all comparisons, supplies demands etc., over a designated planning horizon, between 20-50 years.
3. Determine a water supply forecast.
4. Determine demand forecasts for each use classification.
   a. Forecast anticipated water demand for future time periods.
   b. Adjustments to demand based on known and measurable factors.
   c. Discussion of uncertainties and “what if” analysis.
5. Include current demands and supply allocation in future forecasts.
6. Use population demand forecasts to help assess future needs.
7. Collect both historical and forecasted demographic information to understand the service area thoroughly.
8. Develop a baseline projection of water use with and without alternatives.

9. Projections should cover each key customer category and cover indoor and outdoor use.
10. Quantify projected future demand.
11. Compare future water supply demands to the availability of supplies to meet those needs.
12. Determine if existing supplies are being used to capacity.
13. Evaluate ground water management options.
14. Create reduction objectives for the governing body as a whole.
15. Factor conservation measures into demand scenarios.
16. Forecast average dry-weather conditions expected versus advanced water conservation .... measures.
17. Dry and drought year scenarios should be based on most likely water demand forecasts as .. well as water supply availability.
18. Anticipate using existing and projected ground water and surface water supplies.
19. Data should be analyzed with pertinent climate data to develop weather normalized water use factors that account for weather effects on water use.
20. Evaluate the need for added water supplies.
21. Evaluate plans for future facilities.
22. Propose water supply projects to meet projected demand.
23. Present a preliminary forecast of total installed water capacity over the planning horizon ... .. based on anticipated improvements and additions.
24. Compare reduced demand costs with new supply costs.
25. Evaluate potential water quality impacts.
26. Evaluate potential treatment needs.
27. Review impact analyses for the effects of new developments on local water supplies.
28. Determine probable construction costs of new facilities, treatments, etc.
29. Plan for capital improvements necessary to meet future supplies and demands.
30. Compare costs, savings and other benefits to all member utilities.
31. Determine if member utilities costs and benefits can be applied regionally to even out .... resource costs or savings across the region.
32. Include a non-household use allowable water plan to coordinate the water supply plan, comprehensive plan, transportation plan, zoning ordinance, and subdivision ordinance. This . would assure coordination of the plans and assign a demand to water uses for landscaping, car .. washing, median watering etc.
33. Develop a future water system profile.

SECTION 8. Identification of Alternatives

A. Include cost estimates with each alternative option.
1. Estimate total cost.
2. Estimate annualized cost.
3. Estimate unit cost (per gallon).
4. All alternatives should be evaluated based upon design criteria including:
   a. Soundness of engineering and operation considerations.
   b. System installation and start up costs.
   c. Operations and maintenance costs.
   d. System flexibility and growth potential evaluation.

B. Include community input to help determine alternatives, increase participation and help toward future approval of alternatives and plan.

C. Goals for future alternatives
1. Protect future supply areas.
   Objective: List future supply areas and list measures to protect them.
2. Promote management of existing resources including leak detection and water conservation.
   Objective: Determine the amount of water lost to leaks.

3. Continuous monitoring of source protection areas.
Objective: Hire inspectors and set up a schedule.
4. Capture and conserve precipitation and storm flow.
Objective: Measure the amount of previously uncaptured water forms that have been captured for use.
5. Implement aggressive control of urban and stormwater runoff.
Objective: Determine amount of runoff, decrease amount of runoff.
6. Examine how to meet future water needs and allocate water during shortages.
Objective: Measure current water needs and future water needs and balance supply numbers to meet demand needs.
7. Set measurable water quality goals.
Objective: Determine water quality thresholds.

D. Supply Alternatives

1. Identify options for existing supplies.
2. Expand use of existing supplies.

Definition: *Source protection integrates land conservation into water supply planning. Source protection is an effort to prevent or control pollution at the source.*

3. Protect existing sources.
a. Determine who will identify, develop and protect sources.
b. Use protected sources for potable water, other sources for non-potable needs.
c. Delineate the area around a water source that could affect water quality.
d. Inventory land use activities in the delineated area to identify possible sources of regulated and unregulated contaminants that may threaten public health.
e. Determine the susceptibility of the source water to the potential contaminants in the .... delineated area
f. Emphasize that water protection reduces the need for treatment
g. Identify protected sources of water, develop them where necessary and where not yet .... .. needed, protect them from industrial and urban encroachment so that they can be preserved for .... .. public water supply for the future.
h. Where the protected sources are inadequate for all public supply needs, they can be .... restricted to the highest quality uses by substituting adequately treated wastewaters or .... polluted river waters for many of the non-potable uses to which urban supplies are put.
i. Educate the public on source water protection.
j. Create of use a handbook for "Best Management Practices" for dealing with source waters, should be linked to comp. plan, coordinated with other documents.
k. Include a chart or outline of hierarchy of land use or land use requirements for land located near sensitive resources.
l. Secure ground water sources for secondary sources during times of drought and they can be used for primary sources if protected.
m. Control non-point source pollution.
4. Identify institutional changes that can increase supply.
5. Identify water treatment changes that can increase supply.
6. Identify storage management changes that can increase supply.
7. Identify water transfer changes that can increase supply.
8. Identify improvements and additions to system of facilities.
9. Optimize current supply systems.
10. Describe any plans to replace inconsistent water sources
11. Consider water conservation as a potential new supply to accommodate demand.
12. Create a plan to minimize leakage.
a. Through reduced pipe length.

b. Reduced number of connections- i.e. infill and limiting sprawl, encouraging cluster .... development.

c. Improve efficiency of existing systems.

d. Leak detection programs can reduce water supply requirements.

13. Establish a water reuse plan

a. Direct reuse and use of return flows as supply sources when appropriate.

b. Rainwater capture as reuse source.

c. Gray water capture as reuse source.

d. Storm water runoff as a reused water source.

e. Waste water reuse.

f. Describe type, place, and quantity of recycled water.

g. Describe technical and economic feasibility of recycled water to serve entire or portion of the water public.

h. Present opportunities for exchange or transfer of reused water in the short and long term.

i. Coordinate the water reuse plan with the storm water management plan.

14. Establish a Storm Water Management and Erosion Control plan.

a. Gather information on the types and magnitudes of pollutants carried in urban runoff.

b. Determine the options available for stormwater management and their associated costs.

c. Determine the relationships between the management options raw water quality

d. Demonstrate that storm water can be treated to drinking water.

e. Use natural systems of urban drainage, with control for increased flows.

f. Controlling stormwater may reduce water treated and free up that money for upgrades at .. treatment facilities.

g. Include a flood plain management element addressing the on-site prevention, retention and treatment of stormwater runoff.

15. Establish a Natural Resources Protection plan.

a. Include protection of habitat and watershed health for water protection.

b. Water quality as related to natural resources, macro-invertebrates.

c. Recharge levels for natural water systems.

d. Use natural systems of urban drainage, with control for increased flows.

e. Protect environmentally sensitive areas, especially riparian areas and adjacent wetland ... .. which are critical to watershed health.

f. Promote restoration of natural systems.

g. Promote habitat restoration efforts to areas critical to watershed health and integrity.

h. Evaluate of surface and ground water resource impacts

i. Determine actions necessary to maintain the ecological, recreation, and navigational .... functions of the water resources.

16. Create a well program or well head protection plan, possibly as part of the source protection plan.

That plan would include:

a. Identification of an area's public water supply wells

b. Assessment of potential risks around those wells

c. Implementation measures to manage those risks.

d. Phasing out of individual wells.

e. Monitoring continued water quality and use of existing wells.

f. Abandonment procedures.

g. Well efficiency tests should be performed to determine if well cleaning and redeveloping . will significantly improve yield.

h. Recharge amount back to groundwater instead of all water going to surface water systems.

i. Encourage low impact development to increase groundwater recharge into areas with wells.

17. Ground water recharge programs.

18. Establish a Water Quality plan.
    a. Include objective measures for how the regional provider will meet water quality standards and quantities.
    b. Identify water quality enhancement projects.
    c. Determine the relationships between storm water management options and raw water .... .. quality.
19. Impose cost effective water technologies.
20. Eliminate or reduce existing impervious surfaces.
21. Support or create plan for Brownfield redevelopment.
22. Describe planned facilities.
23. Identify new sources.
    a. Ground water
    b. Surface water
    c. Purchase
    d. Reuse
    e. Transfer
    f. Other
24. Include a location map of all new supply alternatives.
25. Short term alternatives to water supply deficits include:
    a. Yield evaluation.
    b. Leak detection and repair.
    c. Water conservation programs.
    d. Connections with adjoining water systems.
    e. Voluntary or mandatory water use restrictions.
26. Incorporate water transfers to increase system reliability.
27. Evaluate the potential for inter-basin transfers.
28. Evaluate the option of large reservoir construction.

E. Demand Alternatives

1. Conservation options
    a. Review conservation measures that have been implemented or that are planned for .... implementation.
    b. Discuss legal or other barriers to implementing recommended measures.
    c. Specify conservation planning goals.
    d. Use conservation measures to delay the construction of new supply sources.
    e. Identify non-structural alternatives.
    f. Identify conservation opportunities.
    g. Identify reclamation opportunities.
    h. Identify exchange transfer opportunities.
    i. Provide incentives for xeriscaping.
    j. Implement design guidelines for conservation
    k. Implement conservation programs
2. Implement conservation pricing of water, block or seasonal.
3. Implement an Efficiency program including:
    a. Continuous public education.
    b. Continuous evaluation of meters.
    c. Continuous leak detection programs.
    d. Reduction of peak outdoor use.
    e. Investigation of water policies with financial implications.
    f. Residential retrofit programs.
    g. Water audit programs.
4. Demand management

a. Always prepare for drought to mitigate drought in the long run. Implement daily .... conservation and drought preparedness.

b. Modify consumption patterns.

c. Education about demand management.

d. Mandate low volume water fixtures.

e. Tiered water pricing.

f. Controlling landscaping.

g. Minimize "lost" or non-accounted for water.

h. Make information available to consumers about demand and supply management.

i. Reduce household and commercial demand through education.

j. Reduce peak demands.

k. Select water saving hardware and software.

l. Complete water audits- evaluate landscape water requirements and irrigation leakage .... potential in new large residential or commercial developments.

5. Short-term demand management

a. Water rationing.

6. Examine effects of uncertainties associated with hydrology, water demands, environmental .. requirements and regulations, availability of supplies.

7. Achieve a balance between capacity expansion and conservation.

8. Evaluate water withdrawal considerations.

a. Evaluate a receiver's ability to withdraw water based upon monitoring of water levels.

b. Evaluate allowing the withdrawal of water after considering safe yield levels and recharge rates.

F. Assessment of Economic, Environmental, and Social Benefits and Costs

1. Evaluate costs of supply alternatives.

2. Include evaluations of monetary, environmental, social and other costs for supply alternatives.

3. Evaluate costs of demand alternatives.

4. Include evaluations of monetary, environmental, social and other costs for demand alternatives.

5. Evaluate the benefits of the supply alternatives.

6. Include evaluations of extraneous social, environmental or other benefits, not just increased .. physical water supply.

7. Evaluate the benefits of the demand alternatives.

8. Include evaluations of extraneous social, environmental or other benefits of decreasing .... demand.

SECTION 9. Evaluation of Alternatives

A. Goal Examples

1. Determine the best resource mix for the region.

Objective: Create a plan with varied solutions.

2. Include all costs and benefits of each alternative.

Objective: Create a detailed assessment of economic, environmental and social costs and .. .. benefits.

B. Items to be included in the section

1. Evaluate and compare the costs and benefits of the supply and demand alternatives to create .. the best resource mix.

2. Evaluate conventional and innovative water management options for:

a. Technical feasibility.

b. Cost.

c. Environmental considerations.

d. Public acceptability

3. Use a computer model to assess the odds or probability of certain outcomes and evaluate .... .. options based upon:

a. Costs
b. Reliability
c. Vulnerability
d. Legal/Regulatory Constraints
e. Regional Considerations
f. Institutional Arrangements
g. Coordination with existing documents

4. Data should be analyzed with pertinent climate data to develop weather normalized water use factors that account for weather effects on water use.

5. Evaluations should consider protection of watersheds and evaluation of surface and ground .. water supply impacts and actions necessary to maintain the ecological, recreation, and .... navigational functions of the water resources.

6. Water supply should be obtained from the most desirable sources which are feasible. Efforts . should be made to prevent or control pollution of those sources.

7. Develop a baseline projection of water use with and without alternatives.

8. Estimate total implementation costs and anticipated water savings.

9. Estimate the cost effectiveness assessment for recommended measures.

10. Compare implementation costs to avoided costs

11. Estimate reducing peak day water use versus savings with alternatives.

12. Projections should cover each key customer category and cover indoor and outdoor use.

13. Use figures and information from the Identification of Alternatives section, the Comparison of Future Supplies and Demands section and the Comparison of Existing Supplies and .... Demands section.

14. Include community input to help evaluate alternatives.

15. Identify of alternatives that require further analysis.

16. Review alternative solutions that may involve coordination between entities in charge of .. .. water supply, flood control, hydroelectric power, navigation and irrigation.

17. Analyze existing and required legal and institutional arrangements and roles and .... responsibilities of appropriate levels of government in carrying out the alternatives including . .. intergovernmental or interstate agreements.

18. Determine subsequent actions based on the model outcomes.

19. Include action plans for alternatives and plan implementation.

20. Estimate implementation costs.

21. Identify water, wastewater flow and energy benefits to customers and utilities

22. Create a method to equalize local resources and conservation savings and regional supplies . and demands. This would assure that all resources and savings would be regional resources .... .. and savings.

SECTION 10. Recommendations

A. Current

1. This section will include recommendations for the alternatives to be implemented to solve .. .. existing and current supply or demand issues.

2. The recommendations will summarize, prioritize, and organize information from the previous sections to determine the best resource mix that will meet the needs of the region currently.

3. Water availability, economics, and environmental concerns will dictate which combination of strategies is best suited to meet a particular need.

4. A combination of various strategies is used in most regions, often after conservation and reuse measures are implemented, or major new water supply development is required to meet .... current needs.

5. Available ground water supplies are declining and the trend toward partial or full conversion to surface water will continue.
6. Use a variety of approaches and techniques to identify emerging water policy issues.
7. Describe planned facilities to provide the resource mix.
8. An example of a recommendation could be reduction objectives for the governing body as a .. whole.

B. Future

1. This section will include recommendations for the alternatives to be implemented to solve .. .. future supply or demand issues.
2. The recommendations will summarize, prioritize, and organize information from the previous sections to determine the best resource mix that will meet the needs of the region in the future.
3. Water availability, economics, and environmental concerns will dictate which combination of strategies is best suited to meet a particular need.
4. A combination of various strategies is used in most regions, often after conservation and reuse measures are implemented, or major new water supply development is required to meet future needs.
5. Available ground water supplies are declining and the trend toward partial or full conversion to surface water will continue.
6. Use a variety of approaches and techniques to identify emerging water policy issues.
7. Describe planned facilities to provide the resource mix.
8. An example of a recommendation could be reduction objectives for the governing body as a .. whole.
9. Recommendations can also include suggestions for performance standards.

C. Forecast Modification

1. Modify water demand and supply capacity forecasts to reflect the anticipated effects of the recommendations.
2. Include an integration of supplies in the modified forecasts.
3. Discuss the effects of actions on planned water purchases, improvements, and additions.
4. Discuss the effects of planned actions on water utility revenues.

D. Establish a Water Management Utility to control regional water supplies and be in charge of the regional water supply plan.

SECTION 11. Water Shortage Contingency Plan

Definition: *The Water Shortage Contingency Plan will plan for enough water for normal times and for a reserve to guard against drought or other problems. It will then have a contingency plan for dealing with shortfalls, usually based on demand management. The emphasis of this plan will be on drought preparedness.*

A. Goals and Objectives

1. The purpose of the plan will be to plan for the causes and manage the shortages.

B. The section will include

1. A Supply Deficit Evaluation and Risk Assessment based upon information from the .... Comparison of Future Supplies and Demands section and the Comparison of Existing .... Supplies and Demands section.
2. Identify the supply situation in relation to drought using information from the Comparison of Existing Supplies and Demands section.
3. A three-year worst case supply projection, using information from the Existing Supplies .... section.
4. Consideration of past shortages in conjunction with future water demand, using the information from the Comparison of Future Supplies and Demands section.
5. Describe average, single dry and multiple dry year water data using information from the ... .. Comparison of Existing Supplies and Demands section.

6. Assessment of the reliability of water supplies during average, single dry and multiple dry .. .. years, using
information from the Comparison of Existing Supplies and Demands section.
7. Assessment of drought mitigation options.
8. Assessment methods for expected water supply deficits.
9. A determination of the causes of shortages. Could include:
a. Dry weather.
b. Substantial residential and commercial growth.
c. Contamination of public water supply.
d. Increased regulation of new supplies.
e. Or something else.
10. Uncertainty scenarios and forecasts.
11. Monitoring mechanisms to determine when drought occurs or when the region is nearing .. .. triggering levels.
12. Establish triggering levels.

Definition: A *Triggering Level* *is the level at which water supplies are low enough to call an event a drought.*

13. Drought alert procedures.
14. An emergency or short term demand reduction program including:
a. Consumption limits.
b. Flow restrictions.
c. Per capita allotment.
d. Percentage reduction.
e. Reduction of pressure in lines.
f. Restriction on building permits.
g. An additional charge for excessive use.
h. Water shortage pricing
i. Other applicable items.
15. An emergency or short-term supply augmentation program including:
a. Yield evaluation.
b. Leak detection and repair.
c. Water conservation programs.
d. Connections with adjoining water systems.
e. Voluntary or mandatory water use restrictions.
16. Procedures to estimate potential demand reduction and supply conservation.
17. Methods to determine monetary losses from supply cutbacks.
18. Testing of the regional drought contingency plan.
19. Adoption of this plan before a drought event.
20. A Water shortage contingency plan analysis, including;
a. Will it work?
b. How to do it?
c. Who will do it?

SECTION 12. Emergency Response Plan

Definition: *The Emergency Response Plan will determine the actions taken in regard to water supplies in the event of an emergency other than drought.*

A. Examples of emergencies where the emergency response plan would be used
   1. Hurricane
   2. Flood
   3. Earthquake
   4. Other acts of nature
   5. Emergencies initiated by humans or non-natural events

B. Develop a plan for sequential emergency measures

C. Items that might be included:
   1. Shut down of sources
   2. When to switch to more secure sources
   3. Which sources would be back-up sources?
   4. Which sources would be secure sources?
   5. Which sources would remain on in any event?
   6. Who would make the decisions in an emergency scenario?
   7. Who would determine an emergency?
   8. Who would execute each step in the plan?
   9. What are immediate alternatives if sources are not viable?

D. The plan should contain estimation methods for the costs of emergency procedures and supplies.

SECTION 13. Water Supply Plan Evaluation

Definition: *Plan Evaluation will be the action of evaluating the plan for it's accuracy in representing the needs of the*

region, and also how the plan will be updated and evaluated after its initial acceptance.

A. The plan evaluation will include:
   1. A review of the plan structure.
   2. A program and structure for plan revision.
   3. An evaluation strategy.
   4. An assessment of long range water supply needs and the adequacy of planning efforts to meet those needs.
   5. Does the water supply plan meet the needs of the region?
   6. Create a needs list and evaluate the plan on how it meets the needs.
   7. Analysis of the adequacy of water use monitoring and water resource data collection.
   8. Analysis of existing and required legal and institutional arrangements and roles and .... responsibilities of appropriate levels of government in carrying out the plan, including .... intergovernmental or interstate agreements.
   9. Periodic evaluation and modification the plan to reflect changing conditions and priorities.
   10. A variety of approaches and techniques to identify emerging water policy issues.

SECTION 14. Water Supply Plan Implementation

A. Present approaches for implementing the regional water supply plan.

B. Present solutions for how future water will be supplied (small agencies, regional agencies etc.)

C. If regional- how and when will small agencies turn over facilities, and water rights.

D. Present actions plans stemming from the plan recommendations.

E. Present deadlines and timelines for projects.

F. Mechanisms should be included to accomplish the goals and track progress.

G. Completion of plan implementation will be evaluated during next plan evaluation session.

SECTION 15. Financial Plan

A. Goals

1. Shift to a conservation oriented rate structure to help manage existing resources and equitably recover costs of new more expensive supplies.
   Objective: Set deadline for full transition to conservation rate structure.
2. Use rates as a utility tool to assess water charges and as an incentive to encourage efficient . .. water use.
   Objective: Set limits for conservation reduction achievements.
3. Use rate structures to convey the message that water is a valuable resource worth conserving . and using wisely.
   Objective: Establish a public education program about water as a valuable resource.
4. Conservation rate structures will be designed to more accurately and efficiently convey true .. pricing signals to customers.
   Objective: Explain why the water is priced at a certain rate.
5. Rate structures will incorporate a low-income assistance element that can help to keep water . bills low for those who use minimum amounts of water.
   Objective: Establish a low-income assistance program in accordance with the rate structure.
6. Develop a set of rates and charges that can allow water transfers in a manner that does not .. .. leave capital costs of those facilities solely to the member agencies.
   Objective: Implement a program for allocating capital costs.
7. Incorporate system capacity constraints and promote conservation by imposing additional .. .. charges for peaking growth of demand.
   Objective: Determine charges for increased demand.
8. Restructure water provision rates.
   Objective: Review and revise current rates into more realistic rates.
9. Address long-term financing needs for an array of water supply and water quality projects.
   Objective: Complete financing plan for resource mix of alternatives.

B. Management Utility financial responsibilities

1. Create a business plan including:
   a. Revenue earned from rates
   b. Debt issued for the sale and delivery of water
   c. Prices to cover the cost of supplies
   d. Other
2. Prepare a capital budget for new source development.
3. Minimize duplication or inefficiencies from separate supply ownership and management of .. supplies.
4. Implement a phased program of water supply development.
5. Structure and restructure rates as necessary.
6. Coordinate water use categories with rate use categories.
7. Implement conservation pricing of water- block or seasonal
8. Assess economic, environmental and social costs and benefits.
9. Align revenue needs with vision.
10. Provide water supply contract opportunities, shortage allocation, and water management price signals that will support regional investments and local resource decisions.
11. Encourage member agencies to plan carefully and avoid substantial variation in annual .... demand on regional water. Create pricing structure for water that reflects this objective; .... otherwise develop local supplies to meet demand contingencies.
12. Plan aggressively but base facilities on achievement of less.
13. Work to increase system reliability.
14. Minimize short term customer costs.
15. Limit risk of over building.

16. Make sure rate structures and prices for water are compatible with long term interests and .. goals of the regional water plan.

C. Aspects of financial plan.

1. Address long-term financing needs for an array of water supply and water quality projects.
2. Capital improvements needed to meet current supply.
3. Capital improvements needed to meet future supply.
4. Financing strategies for needed improvements.
5. Recover sufficient revenue to cover the cost of the system.
6. Operational and maintenance program.
7. Maintenance program costs.
8. Separate identification of treatment and power costs.
9. Phasing of plan and system to minimize costs to customers.
10. Sewer rate information.
11. Water Rate Structure including:
    a. water rate costs
    b. rate structure
    c. Separate rates for each customer billing class
    1. Residential
    2. Commercial
    3. Industrial
    4. Public
    d. Indicate both indoor and outdoor use components
    e. Conservation –oriented rate structures
    f. Implement zone pricing- based on distance or altitude from facility

Rate Structure Definitions

Seasonal rates incorporate two or more different uniform volume charges for different seasons during the year.

Inverted block rates increase rates for units of water consumption at higher levels of use.

Excess use rates define a base water rate as the average use during a certain non-peak period and water is charged at a base rate during a peak period or season. Water use above a percentage of this base level is charged at the base rate plus an excess use rate.

Uniform commodity rates are those in which all water use is charged at the same unit rate.

12. Rate Structure methodology. May include
    a. Setting rates based on a cost-of-service analysis, a two-step process.
    b. The first step is to allocate costs to customer classes based on the types of service provided to each class.
    c. Second, design rates for each class so that each customer on average is paying .... approximately the cost of the level of service received.
    d. Unbundling rates to more clearly identify cost components.
    e. Revenue generation from new rate structure is intended to encourage water conservation .. and recycling.
    f. Increased water supplies would be financed primarily by assessments upon new demands.
13. Cost-of-service program.
    a. Allows the utility greater financial stability by matching revenues with costs incurred in .. providing service.
    b. Second, it sends an accurate pricing signal to the customer.
14. Allocate costs across users more intentionally based on which user behaviors were driving .. which costs.
15. Establish a capacity reservation charge levied upon member agencies to cover capital costs of regional facilities.

16. Impose peaking charges on member agencies exceeding capacity requirements.
17. Plan for financial impacts of water shortages.
18. Compare costs of all supply and demand alternatives on a unit cost basis.
19. Consideration of non-monetary effects such as environmental effects.
20. Penalty charges for excessive use.
21. All member utilities should share in any increase or decrease in services, rates, water supplies, etc.
22. Costs of facility expansions and extensions necessitated by rising demands will be recovered primarily from the member agencies generating those demands.
23. An implementation schedule with budget costs. This will ensure that sufficient time is .... allowed to perform the necessary testing of water supply facilities and obtain regulatory .... approval.

SECTION 16. Water Supply Plan Adoption

A. Present a method for plan approval
B. Coordinate public participation for review before plan adoption
1. Broaden participation to increase effectiveness
2. Public participation will help obtain better consensus of opinion
C. Review draft plan with all member agencies to help achieve consensus.
D. Coordination with public and all member utilities for plan adoption.
E. Make the plan available for inspection before adoption.
F. Present certification or approval of the plan done by the water system's governing body or bodies.

SECTION 17. Supporting Water Supply Policy

Definition: <u>*Supporting Water Supply Policy*</u>*- this section will outline policies that should be adopted by the governing body to support, uphold and work in conjunction with the water supply plan.*

A. Identify nearby jurisdictions, private landowners and other stakeholders to participate in the ... .. policy development and implementation process.
B. Include policy actions that exist or will be done to enforce, encourage, or coordinate goals and .. ideals of the water supply plan.
C. Policy Objectives will be tasks for policy creation. They may include restructuring of policies to allow for continuous work on integrating water supply into all areas of planning.
D. The supporting policy actions will be evaluated in the plan evaluation phase. Were the policies .. implemented? Followed?
E. Goals
1. Establish regulations consistent with the water supply plan.
Objective: Deadline for writing regulations, deadline for passing regulations.
F. Policy Examples
1. Improve cooperation in water policy development and implementation among agencies local . and regional water interests, environmental interests and public.
2. Promote consistent planning, policy, regulation, management and use of water supplies.
3. Minimize conflict in the planning and management of such resources
4. Provide an ongoing, cooperative planning and policy process for orderly and responsible water conservation, development and management.
5. Address complex interdependencies of water supply and demand, water quality, and .... environmental water needs.
6. Address local and regional water supply and infrastructure needs, and provide important data
7. Include policies for resource and habitat restoration such as:
a. development of land use regulations and design criteria that reduce future water .... consumption by limiting landscaping area
b. Requiring or encourage native or drought-tolerant vegetation.

8. Promote use of renewable water supplies.
9. Promote the use of aquifer storage and retrieval projects.
10. Promote policies including water reuse.
11. Promote projects to enhance aquifer recharge.
12. Impose restrictions on domestic well use as a condition of approving development.
13. Restrict the proliferation of domestic wells and septic systems by requiring new developments to utilize existing utilities if the utility is ready, willing and able to serve
14. Protect aquifer water quality by requiring development plans to include centralized .... `wastewater treatment and disposal, or centralized management of de-centralized wastewater . .. systems
15. In rural areas where centralized or centrally managed wastewater treatment and disposal is not feasible, assure adequate lot size and spacing between septic tanks and wells
16. Ensure that unused or abandoned wells are properly plugged and abandoned.
17. Enforce zoning regulations to:
    a. Limit development in hydrologically sensitive areas such as flood plains and recharge areas.
    b. Preserve areas for certain high value water related uses such as agriculture and riparian .. .. habitat.
18. Determine whether subdivisions of a certain size should include a community water system . plan and water rights documentation for approval.
19. Determine whether subdivisions of a certain size should include centralized or centrally .... .. managed wastewater treatment and disposal.
20. Establish a Management Utility.
21. Consider adopting laws to aid water supply planning.
    a. North Carolina has 3 laws in place which aid water supply planning.
    b. The first has the ability to limit capacity in areas where water supply is not adequate to meet current needs.
    c. The second outlines the minimum stream flow required below a dam to maintain surface .. water levels.
    d. The third creates a permitting system for large water transfers between different water ... .. basins to insure adequate supply.

SECTION 18. Management Utility Guidelines

A. Establish a management utility.
B. Outline the structure of the utility. Structure might include:
1. One member from each affiliated member utility appointed to board.
2. The term of each member
3. Customer access to public meetings of the utility
C. Establish the powers of the management utility
D. Examples of powers include:
1. Rate setting
2. Collection of revenues
3. Issue debt
4. Hire staff
5. Enter into agreements
6 Expand as necessary with agreement from all members
7. Contract the sale of water to non-member agencies
E. Establish Goals for the Management Utility.
F. Goal examples
1. To manage water to maximize beneficial reuse and avoid water quality problems.
Objective: Determine water quality before and after the actions of the management utility.
2. Recognize and incorporate the trend toward ever more stringent drinking water standards.

Objective: Adopt more stringent standards than current laws dictate.

3. Ensure reliability, quality, and efficient use of water supplies.

Objective: Establish levels for acceptable water quality, reliability, and management .... efficiency.

4. Ensure that a sufficient supply of water will be collected, treated and delivered to the points of use where it is required.

Objective: Determine amount of water necessary for supply, determine amount of demand, .. compare.

5. Wastewater will be collected from and extended to areas programmed for growth and delivered to points best suited for waste treatment and disposal or reuse.

Objective: Determine areas for growth.

6. Both water and wastewater services shall be monitored and maintained in a manner that strives to maximize the public health, safety and welfare for all while minimizing every .... environmental impact.

Objective: Establish a monitoring program schedule and hire staff to complete the monitoring.

7. Plan for water, sewer and flood control facilities to meet the needs of the region.

Objective: Create facility implementation plans with installation dates.

8. Flood control districts, sanitation districts and water purveyors need to cooperate and integrate capital investment programs to avoid wasteful and competing projects.

Objective: Establish plan for cooperation.

9. Minimize cost of water provision.

Objective: Determine total costs and methods to reduce costs.

10. Maximize reliability of the system.

Objective: Determine current reliability and potential reliability and decrease the difference.

11. Provide safe and adequate supply for both existing and future customers of the water system.

Objective: Determine levels of "safe" and "adequate" supply. Set measures to reach levels.

12. Water supply should have a high level of dependability with a low occurrence of disruption in normal service.

Objective: Determine the acceptable amount of service disruption.

13. Compare costs, savings and other benefits of all member utilities, to determine if costs and .. benefits can be applied regionally to even out resource costs or savings across the region.

Objective: Evaluate numbers of costs and savings of member utilities.

14. Collaborate with federal state and local entities to improve communication, data sharing ... .. development of study programs, and acquire funding for water availability studies.

Objective: Implement programs and measure results.

15. Demonstrate how local development projects will impact local water supplies.

Objective: Require an impact analysis for local development projects.

16. Collaborate with water research entities to develop water supply models.

Objective: Establish and initiate research on water supply models.

17. Minimize duplication or inefficiencies from separate supply ownership and management of . supplies through regionalization. The effects will be increased security, and adequate, safe, ... reliable water supplies.

Objective: Measure security, reliability before and after implementation.

G. Establish the responsibilities of the management utility.

H Utility Responsibility examples

1. Provide and allocate water.
2. Provide safe, secure water supply.
3. Facilitate water supply management.
4. Facilitate water supply development.
5. Facilitate processing of sewerage and wastewater treatment and disposal.
6. Take regulatory actions as necessary, such as restricting water use.

7. Regulate water use and discharge.
8. Meet state and federal water quality standards at the point of delivery.
9. Coordinate the operation of facilities for cost efficiency.
10. Coordinate the operation of facilities to improve reliability of the overall system.
11. Manage development to protect resource health.
12. Restore and maintain the integrity of the waters in the region
13. Manage the use of waters to coordinate with recreation.
14. Enhance and preserve the regions' waters to maintain natural amenity values.
15. Coordinate water supply use with land drainage, flood control, fisheries and navigation
16. Select a water resource mix in accordance with the Evaluation of Alternatives and .... Recommendations sections of the water supply plan.
17. Identify impacts of development on water quality and on the system as a whole.
18. Consider the cumulative impacts of growth management decisions.
19. Coordinate infrastructure investments for flood control, conservation of local storm water, .. water storage and distribution facilities and reclamation and other treatment facilities.
20. Determine who will direct how water supply land under the utilities jurisdiction is used.
21. Determine a plan for investments and long term projects, and the effects of their introduction.
22. Determine who will plan, site, design, build, operate, finance and maintain public water .... .. supply and waste water treatment facilities- whether regional utility or member utility will be .... responsible.
23. Coordinate among competing interests.
24. Identify conflicts and establish conflict resolution for water sources and users.
25. Outline and order the interactions between water users and management bodies.
26. Outline a plan for interactions between the industrial user, public water utility. and .... conservation agency system.
27. Coordinate agency review and input.
28. Coordinate multi-jurisdictional efforts, work with watershed groups, other jurisdictions and . agencies.
29. Determine if creating a stormwater management utility as part of the water authority will help to manage storm water.
30. Control funding and provide technical support for large scale regional water planning .... programs.
31. Determine the options available for stormwater management and its associated costs.
32. Determine the relationships between storm water management options raw water quality.
33. Do preventative maintenance on water supply systems.
34. Pursue information activities including
    a. Data collection and management
    b. Analysis and information
    c. Education
35. Gather and analyze water supply, water use, physiographic, and water source data.
36. Use GIS as foundation for future systems planning.
37. Maintain information on withdrawals from ground water and surface water, precipitation, . .. water use types, connections between water quality and water resources and supplies, and .... population and demand and projections.
38. Keep all information current.
39. Establish stream flow information
40. Collect information on the types and magnitudes of pollutants carried in urban runoff.
41. Development of an information base for monitoring and regulating.
42. Optimize the collection and dissemination of water supply data and information among .... .. federal state and local agencies.
43. Establish baseline environmental indicators for each water plan goal.

44. Use data to modify and refine strategies as circumstances change.
45. Develop and update the water supply plan.
46. Monitor and evaluate progress on the supply plan.
47. Establish a system for monitoring or evaluating the attainment of plan objectives.
48. Recognize when member utility and regional plans have met criteria as they move into implementation of projects and permitting.
49. Track past program performance.
50. Forecast future program activity.
51. Develop population and water demand forecasts.
52. Provide emergency aid.
53. Coordinate emergency response
54. Provide financial assistance
55. Provide technical assistance to member utilities to ensure consistency across region.
56. Serve as a communication tool between member agencies
57. Assess the behavior of water users as an economic indicator for budget determination and rate setting.
58. Facilitate the calculation of water savings.
59. Perform basic cost-effectiveness calculations.
60. Conduct special studies.
61. Conduct ongoing research to examine effects of uncertainties associated with hydrology, ... water demands, environmental requirements and regulations, availability of supplies
62. Coordinate policy development.
63. Analyze policies for their relation to the water supply plan.
64. Add new legislative directives to further enhance and strengthen state and regional water .. .. planning and drought preparedness
65. Support local supply development in accordance with regional plan.
66. Support conservation.
67. Support seasonal storage.

I. Ability to perform duties will be evaluated during the next plan evaluation phase.

J. The management utility should be efficient and effective and may be subject to performance standards.

Appendix B
Condensed Plan Template

Condensed Plan Template

Section 1. **Introduction**
- Purpose
- Vision
- Study Area Section and Maps
- Summary of past and current land uses in the area.

Section 2. **Planning Criteria**
- Contents

Section 3. **Goals and Objectives**
- Plan Goals
- Objectives
- Community Goals
- Objectives

Section 4. **Existing Supplies**
- Goals
- Contents

Section 5. **Existing Demands**
- Goals
- Contents

Section 6. **Comparison of Existing/Current Supplies and Demands**
- Goals
- Contents

Section 7. **Comparison of Future Supplies and Demands**
- Goals
- Contents

Section 8. **Identification of Alternatives**
- General information
- Community Input
- Goals
- Supply Alternatives
- Demand Alternatives
- Assessment of Economic, Environmental, and Social Costs and Benefits

Section 9. **Evaluation of Alternatives**
- Goals
- Contents

Section 10. **Recommendations**

Current
Future
Forecast Modification
General

Section 11. **Water Shortage Contingency Plan**
Goals
Contents

Section 12. **Emergency Response Plan**
Examples
General Information
Contents

Section 13. **Water Supply Plan Evaluation**
Contents

Section 14. **Water Supply Plan Implementation**
Contents

Section 15. **Financial Plan**
Goals
Management Utility Responsibilities
Contents

Section 16. **Water Supply Plan Adoption**
Contents

Section 17. **Supporting Water Supply Policy**
General Information
Goals
Contents

Section 18. **Management Utility Guidelines**
General Information
Goals
Responsibilities

Appendix C
Comparison Checklist

Regional Plan: Title

	Contains Element
1. Introduction	
2.5 Purpose	Yes or No
2.5 Vision	Yes or No
2.5 Study area and maps	Yes or No
2.5 Past and current land use	Yes or No
2. Planning Criteria	
10 Contents	Yes or No
3. Goals and Objectives	
2.5 Plan Goals	Yes or No
2.5 Objectives	Yes or No
2.5 Community Goals	Yes or No
2.5 Objectives	Yes or No
4. Existing Supplies	
5 Goals	Yes or No
5 Contents	Yes or No
5. Existing Demands	
5 Goals	Yes or No
5 Contents	Yes or No
6. Comparison of Existing/Current Supplies and Demands	
5 Goals	Yes or No
5 Contents	Yes or No
7. Comparison of Future Supplies and Demands	
5 Goals	Yes or No
5 Contents	Yes or No
8. Identification of Alternatives	
2 Community Input	Yes or No
2 Goals	Yes or No
2 Supply Alternatives	Yes or No
2 Demand Alternatives	Yes or No
2 Assessment of Economic, Environmental, and Social Costs and Benefits	Yes or No
9. Evaluation of Alternatives	
5 Goals	Yes or No
5 Contents	Yes or No

	Contains Element
10. Recommendations	
2.5 Current	Yes or No
2.5 Future	Yes or No
2.5 Forecast Modification	Yes or No
2.5 General	Yes or No
11. Water Shortage Contingency Plan	
5 Goals	Yes or No
5 Contents	Yes or No
12. Emergency Response Plan	
3.3 Examples	Yes or No
3.3 General Information	Yes or No
3.4 Contents	Yes or No
13. Water Supply Plan Evaluation	
10 Contents	Yes or No
14. Water Supply Plan Implementation	
10 Contents	Yes or No
15. Financial Plan	
3.3 Goals	Yes or No
3.3 Management Utility Responsibilities	Yes or No
3.4 Contents	Yes or No
16. Water Supply Plan Adoption	
10 Contents	Yes or No
17. Supporting Water Supply Policy	
3.3 General Information	Yes or No
3.3 Goals	Yes or No
3.4 Contents	Yes or No
18. Management Utility Guidelines	
3.3 General Information	Yes or No
3.3 Goals	Yes or No
3.4 Responsibilities	Yes or No

Appendix D
Regional Plan Comparison Checklists

Regional Plan: Lower East Coast Regional Water Supply Plan, South Florida Water Management District

	Contains Elements
1. Introduction	
2.5 Purpose	yes
2.5 Vision	yes
2.5 Study area and maps	yes
2.5 Past and current land use	yes
2. Planning Criteria	
10 Contents*	yes
3. Goals and Objectives	
2.5 Plan Goals	yes
2.5 Objectives	yes
2.5 Community Goals	no
2.5 Objectives	no
4. Existing Supplies	
5 Goals	yes
5 Contents	yes
5. Existing Demands	
5 Goals	yes
5 Contents	yes
6. Comparison of Existing/Current Supplies and Demands	
5 Goals	yes
5 Contents	yes
7. Comparison of Future Supplies and Demands	
5 Goals	yes
5 Contents	yes
8. Identification of Alternatives	
2 Community Input	no
2 Goals	yes
2 Supply Alternatives	yes
2 Demand Alternatives	yes
2 Assessment of Economic, Environmental, and Social Costs and Benefits	yes
9. Evaluation of Alternatives	
5 Goals	yes
5 Contents	yes

	Contains Elements
10. Recommendations	
2.5 Current	yes
2.5 Future	yes
2.5 Forecast Modification	yes
2.5 General	yes
11. Water Shortage Contingency Plan	
5 Goals	yes
5 Contents	yes
12. Emergency Response Plan	
3.3 Examples	no
3.3 General Information	yes
3.4 Contents	no
13. Water Supply Plan Evaluation	
10 Contents	yes
14. Water Supply Plan Implementation	
10 Contents	yes
15. Financial Plan	
3.3 Goals	yes
3.3 Management Utility Responsibilities	yes
3.4 Contents	yes
16. Water Supply Plan Adoption	
10 Contents	no
17. Supporting Water Supply Policy	
3.3 General Information	yes
3.3 Goals	yes
3.4 Contents	yes
18. Management Utility Guidelines	
3.3 General Information	yes
3.3 Goals	no
3.4 Responsibilities	no

Regional Plan: Regional Water Supply Plan- prepared by the Water Providers of the Portland Metropolitan Area

	Contains Elements
1. Introduction	
2.5 Purpose	yes
2.5 Vision	yes
2.5 Study area and maps	yes
2.5 Past and current land use	yes
2. Planning Criteria	
10 Contents*	yes
3. Goals and Objectives	
2.5 Plan Goals	yes
2.5 Objectives	yes
2.5 Community Goals	yes
2.5 Objectives	yes
4. Existing Supplies	
5 Goals	yes
5 Contents	yes
5. Existing Demands	
5 Goals	yes
5 Contents	yes
6. Comparison of Existing/Current Supplies and Demands	
5 Goals	yes
5 Contents	yes
7. Comparison of Future Supplies and Demands	
5 Goals	yes
5 Contents	yes
8. Identification of Alternatives	
2 Community Input	yes
2 Goals	yes
2 Supply Alternatives	yes
2 Demand Alternatives	yes
2 Assessment of Economic, Environmental, and Social Costs and Benefits	yes
9. Evaluation of Alternatives	
5 Goals	yes
5 Contents	yes

	Contains Elements
10. Recommendations	
2.5 Current	yes
2.5 Future	yes
2.5 Forecast Modification	yes
2.5 General	yes
11. Water Shortage Contingency Plan	
5 Goals	yes
5 Contents	yes
12. Emergency Response Plan	
3.3 Examples	yes
3.3 General Information	yes
3.4 Contents	no
13. Water Supply Plan Evaluation	
10 Contents	yes
14. Water Supply Plan Implementation	
10 Contents	yes
15. Financial Plan	
3.3 Goals	yes
3.3 Management Utility Responsibilities	yes
3.4 Contents	no
16. Water Supply Plan Adoption	
10 Contents	yes
17. Supporting Water Supply Policy	
3.3 General Information	yes
3.3 Goals	yes
3.4 Contents	yes
18. Management Utility Guidelines	
3.3 General Information	yes
3.3 Goals	yes
3.4 Responsibilities	yes

Regional Plan: 2000 Urban Water Management Plan, San Diego County Water Authority

	Contains Elements
1. Introduction	
2.5 Purpose	yes
2.5 Vision	yes
2.5 Study area and maps	yes
2.5 Past and current land use	yes
2. Planning Criteria	
10 Contents*	yes
3. Goals and Objectives	
2.5 Plan Goals	yes
2.5 Objectives	yes
2.5 Community Goals	no
2.5 Objectives	no
4. Existing Supplies	
5 Goals	yes
5 Contents	yes
5. Existing Demands	
5 Goals	yes
5 Contents	yes
6. Comparison of Existing/Current Supplies and Demands	
5 Goals	yes
5 Contents	yes
7. Comparison of Future Supplies and Demands	
5 Goals	yes
5 Contents	yes
8. Identification of Alternatives	
2 Community Input	yes
2 Goals	yes
2 Supply Alternatives	yes
2 Demand Alternatives	yes
2 Assessment of Economic, Environmental, and Social Costs and Benefits	yes
9. Evaluation of Alternatives	
5 Goals	yes
5 Contents	yes

	Contains Elements
10. Recommendations	
2.5 Current	yes
2.5 Future	yes
2.5 Forecast Modification	no
2.5 General	yes
11. Water Shortage Contingency Plan	
5 Goals	yes
5 Contents	yes
12. Emergency Response Plan	
3.3 Examples	yes
3.3 General Information	yes
3.4 Contents	yes
13. Water Supply Plan Evaluation	
10 Contents	no
14. Water Supply Plan Implementation	
10 Contents	yes
15. Financial Plan	
3.3 Goals	yes
3.3 Management Utility Responsibilities	yes
3.4 Contents	yes
16. Water Supply Plan Adoption	
10 Contents	no
17. Supporting Water Supply Policy	
3.3 General Information	yes
3.3 Goals	yes
3.4 Contents	yes
18. Management Utility Guidelines	
3.3 General Information	yes
3.3 Goals	yes
3.4 Responsibilities	yes

Regional Plan: Watersheds: An Integrated Water Resources Plan for Chester County, Pennsylvania and its Watersheds

	Contains Elements
1. Introduction	
2.5 Purpose	yes
2.5 Vision	yes
2.5 Study area and maps	yes
2.5 Past and current land use	yes
2. Planning Criteria	
10 Contents*	yes
3. Goals and Objectives	
2.5 Plan Goals	yes
2.5 Objectives	yes
2.5 Community Goals	yes
2.5 Objectives	yes
4. Existing Supplies	
5 Goals	yes
5 Contents	yes
5. Existing Demands	
5 Goals	yes
5 Contents	yes
6. Comparison of Existing/Current Supplies and Demands	
5 Goals	yes
5 Contents	yes
7. Comparison of Future Supplies and Demands	
5 Goals	yes
5 Contents	yes
8. Identification of Alternatives	
2 Community Input	yes
2 Goals	yes
2 Supply Alternatives	yes
2 Demand Alternatives	yes
2 Assessment of Economic, Environmental, and Social Costs and Benefits	no
9. Evaluation of Alternatives	
5 Goals	yes
5 Contents	yes

	Contains Elements
10. Recommendations	
2.5 Current	yes
2.5 Future	yes
2.5 Forecast Modification	no
2.5 General	yes
11. Water Shortage Contingency Plan	
5 Goals	no
5 Contents	no
12. Emergency Response Plan	
3.3 Examples	yes
3.3 General Information	yes
3.4 Contents	yes
13. Water Supply Plan Evaluation	
10 Contents	yes
14. Water Supply Plan Implementation	
10 Contents	yes
15. Financial Plan	
3.3 Goals	no
3.3 Management Utility Responsibilities	no
3.4 Contents	no
16. Water Supply Plan Adoption	
10 Contents	yes
17. Supporting Water Supply Policy	
3.3 General Information	yes
3.3 Goals	yes
3.4 Contents	yes
18. Management Utility Guidelines	
3.3 General Information	yes
3.3 Goals	yes
3.4 Responsibilities	yes

MS. T O B Y C. I E U T E R

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EDUCATION &PROFESSIONAL CERTIFICATION

Masters Degree at Virginia Tech in Urban and Regional Planning,
December, 2004.
Certified Arborist MA-4174, International Society of Arboriculture,
September 2001.
Bachelor of Science in Horticulture, University of Wisconsin-Madison,
Turfgrass and Grounds Management, and Ornamental Horticulture. August, 1997.
Semester at Sea through the University of Pittsburgh.
Spring 1995.
21-day trek across England, Coast to Coast a comparison of British and American Planning,
May, 2004.

PROFESSIONAL EXPERIENCE

Park Planner, Project Manager, City of Cheyenne Department of Parks and Recreation,
Cheyenne, Wyoming
Landscape Designer, Christopher Consultants,
Sterling, Virginia
Water Resources Designer, Environmental Quality Resources,
Gaithersburg, Maryland

RELEVANT EXPERIENCE

Graduate Research Assistant, Urban and Regional Planning Department, VPI & SU,
Blacksburg, Virginia
Intern, New River Valley Planning District Commission,
Radford, Virginia
Service Training for Environmental Progress (STEP) Intern, Va. Water Resources Research Center,
Blacksburg, Virginia
Intern, Montgomery County Department of Planning and Inspections,
Christiansburg, Virginia
Intern, New River Land Trust,
Blacksburg, Virginia
Riparian Monitoring Supervisor, Aquatic and Wetland Company,
Boulder, Colorado

RELEVANT PROJECTS

- Land planning and regional watershed development concepts for Tom's Creek Basin, Blacksburg Va.
- Feasibility Study for Berryville, Virginia.
- Initial comprehensive planning for Orange County, Virginia.
- Park master planning as part of comprehensive plan, Cheyenne, Wyoming.
- Ordinance drafting relating to landscaping, xeriscaping, natural and open space areas, Cheyenne, Wy.
- Development of manual for local officials for land development in karst terrain, Blacksburg, Virginia.
- Rock Creek Watershed Restoration Study, Montgomery County, Maryland.
- Cluster development concepts for Historic Selma Estates, Loudoun County Virginia.
- Cluster development and new town concepts for Round Hill, Virginia.
- Project management of historical monument, "Cornerstones of Law and Liberty", Cheyenne, Wy.