STATE GUIDE PLAN ELEMENT 721
REPORT #

RHODE ISLAND WATER 2030

RHODE ISLAND DIVISION OF PLANNING

Rhode Island Department of Administration
Division of Planning
Statewide Planning Program
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FINAL

07.14.12

The **Rhode Island Statewide Planning Program**, Division of Planning. Department of Administration is established by Chapter 42-11 of the Rhode Island General Laws as the central planning agency for state government. The State Planning Council comprised of state, local, and public representatives, and federal and other advisors, guides the work of the Program. The objectives of the Program are:

(1) to prepare strategic and systems plans for the state

(2) to coordinate activities of the public and private sectors within this framework of policies and programs

(3) to assist local governments in management, and

(4) to advise the Governor and others concerned on physical, social, and economic topics.

Further, the Division of Planning is authorized by § 46-15-13 of the RI Gen Law entitled**,** Water supply planning to study and evaluate the needs of the State for current and future water supply and shall have the following powers:

(1) To formulate and maintain a long range guide plan for development of major water resources and transmission systems needed to furnish water to regional or local public water systems as part of the State Guide Plan adopted pursuant to § 42-11-10.

(2) To provide for cooperative development, conservation, and use of water resources by the state, municipal agencies or departments, water resources board, and public water systems, including special water districts and privately owned public water systems.

(3) To review all plans and proposals for construction or installation of facilities for water supply for conformance with the state guide plan in accordance with § 46-15-2 and report its findings to the Water Resources Board.

Abstract

TITLE: Rhode Island Water 2030

SUBJECT: Management of drinking water supply resources in the State of Rhode Island

DATE: June 14, 2012

AGENCY:
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ABSTRACT:

Rhode Island Water 2030 consolidates 5 previous State Guide Plan Elements which examined issues that directly affect the availability of, demand for, management and protection of drinking water, as well as the operation and maintenance of water systems to meet or exceed public health and safety standards, sustain growth and development, and improve the overall quality of life in Rhode Island. This consolidation identifies the previously adopted goals, policies, and recommended actions that are based on sound strategies deemed essential to maintaining existing and protecting future water supplies. When construed and applied in conjunction with Land Use 2025 (State Guide Plan Element 121, 2006) this guidance is intended to advance the effectiveness of public and private stewardship of the state's water supply resources. As an element of the State Guide Plan, this Plan sets forth goals and policies that must, under state law, be reflected in future updates of local comprehensive plans.

State Planning Council

TO BE FILLED IN AFTER ADOPTION

Technical Committee

TO BE FILLED IN AFTER ADOPTION

Water Supply Advisory Committee

The development of this consolidated plan was drafted by Nancy Hess, Supervising Land Use Planner, of the Statewide Planning Program who was guided in her efforts by an Advisory Committee. This plan is the product of the efforts of those hard-working and dedicated individuals who helped define the major issues, presented and debated positions, and eventually formed a consensus on a broad range of water supply topics. This was not an easy task. It required time, energy, patience, many long hours of deliberation, and a strong interest on a personal and professional level to come to a consensus. It could not have been done without the following individuals who contributed numerous hours and provided technical and editorial review of the Plan as it developed through its various draft stages.

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Part 1: Rhode Island's Potable Water Setting

Key Points:

- Precipitation provides all the drinking water we use.
- The State's waters are shared, interconnected natural resources.
- Rhode Island's primary sources of potable water are surface water and groundwater resources.
- Economic prosperity in the State has historically been and will be tied to our water resources.
- Multiple state agencies along with several federal agencies, municipalities, public suppliers and citizens manage the use of drinking water in the State.
- Rhode Island has a total of 490 public water supply systems which vary widely from small rural restaurants to 28 large suppliers.
- Areas of significance to the water supply of the State are the Scituate Reservoir Complex, the Big River Area, and 4 groundwater aquifer systems that have been classified as "Sole-Source Aquifers" by the United States Environmental Protection Agency (EPA)
- This Plan is intended to serve as the foundation of potable water supply policies for future water management decisions to be made across multiple jurisdictional levels.

Introduction

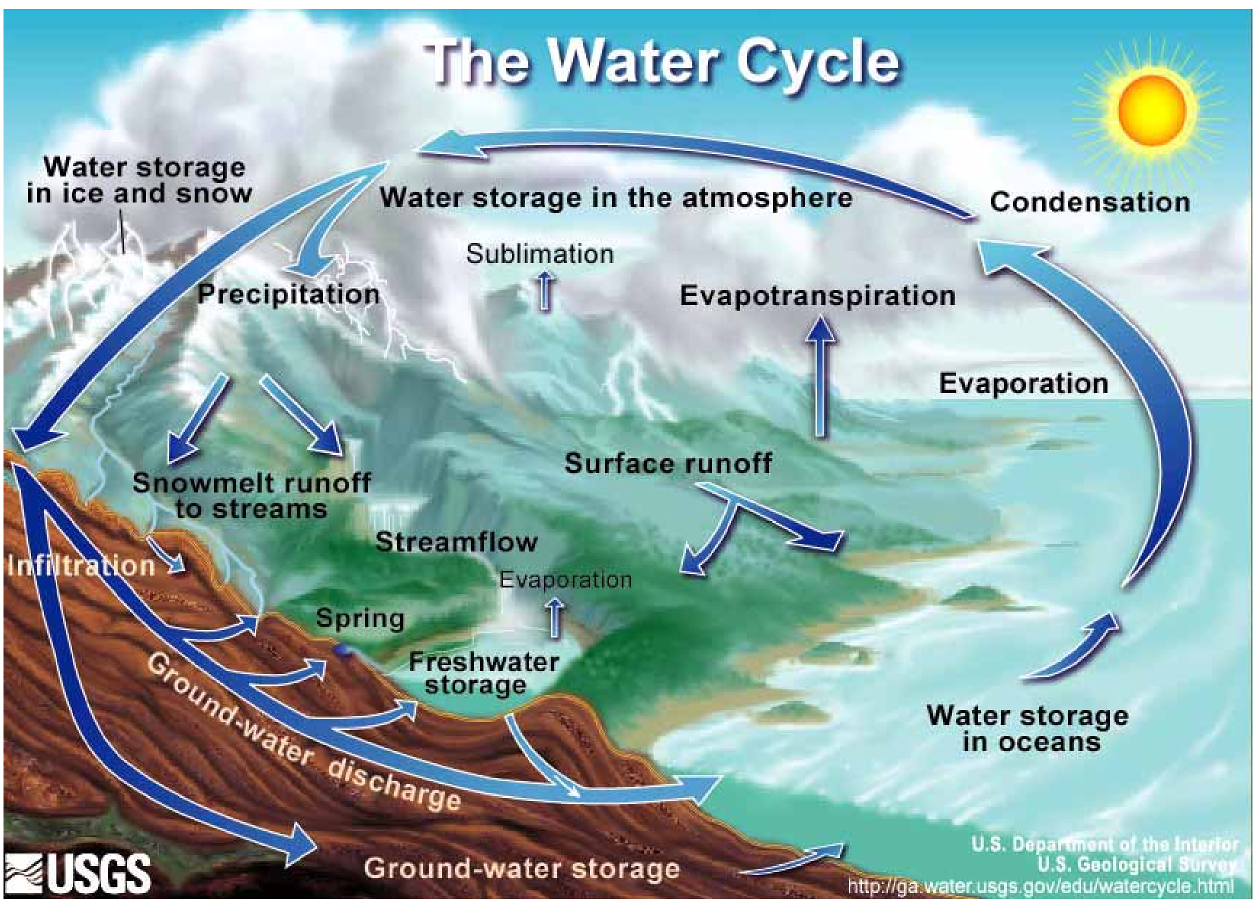
Water is the most important natural resource to the future of our state. This Plan is about drinking water also known as potable water – where we get it, how we get it, how we use it and the relationship of its use on our economy and the environment. Drinking water or potable water is water which is fit for consumption by humans. This Plan describes the potable water resources of the State, and sets goals and policies for the management of issues pertaining to them. The State Guide Plan (SGP) has been the planning tool to coordinate and identify potable water supply issues in Rhode Island for more than 40 years. The 1st SGP water supply element (SGP 721) was adopted in 1969. Later this Element was rewritten and adopted in 1988 and 1991. Subsequently the following potable supply related SGP were adopted:

- 1993 *Rhode Island Emergency Water Supply Management Plan* (723)
- 1997 *Water Supply Policies for Rhode Island* (722)
- 2002 *Rhode Island Drought Management Plan* (724).

This Plan focuses on critical policy and emerging trends for potable water policy and sets the goals and policy foundations for potable water management. Aspects related to the natural resource functions of water resources and water quality protection for other purposes will be addressed in other State Guide Plan Elements. More specific actions and capital planning efforts for the Water Resources Board to address will be defined through more their agency specific strategic planning processes. This Plan is intended to serve as the foundation of potable water supply policies which will provide a guide for future drinking water management decisions to be made within those more specific strategic planning processes. This revised State Guide Plan Element 721 consolidates and replaces 5 previous potable water policy plans. It is a consolidation of all prior elements into one unified element. It is not intended that water planning in RI will be stagnant. Policy issues and strategies to address them will be added or modified as needed. Strategic planning for the various State agencies involved with water supply will address implementation of the identified issues through individual work programs. Small text boxes will appear throughout the text of Parts 2 & 3 to correlate the key policies of the Plan to the strategies of the Implementation Matrix.

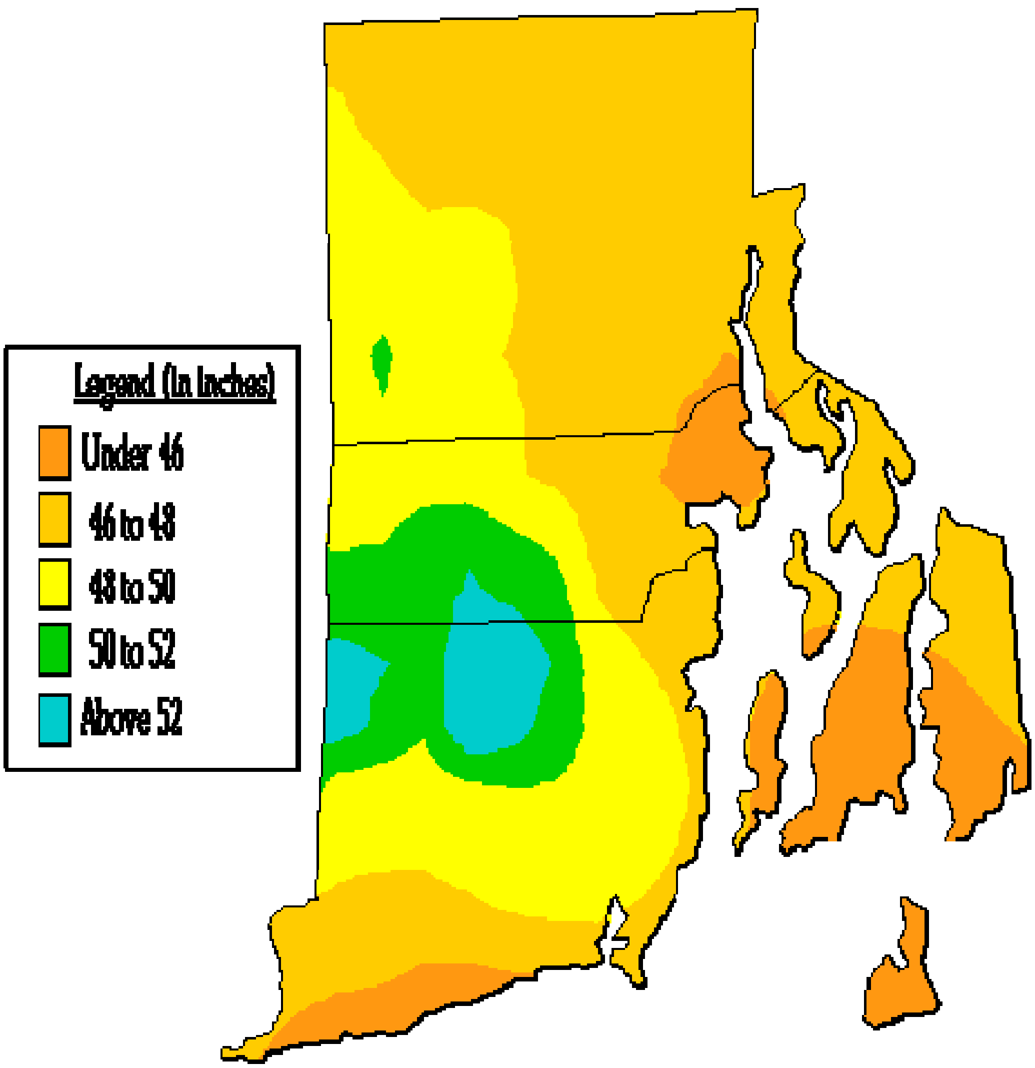
Where Does Our Potable Water Come From?

The water cycle that is as old as the earth itself provides our water. The basic underlying principle is simple: All water is recycled. There is no new water. The hydrologic cycle is depicted below. As we use water from a particular phase of the cycle we impact the other phases. Just as surface water withdrawals impact groundwater, withdrawals from groundwater influence surface water. Water that is consumed or is re-introduced with added pollutants can have an impact on the quality of the resource at different phases of the cycle. Specific emphasis on a particular use of water must still allow for consideration of the potential effects on availability and quality for other uses, as well as its future condition for that the same use. The wise use and management of potable water is critical to support the state's economy, to protect public health, and to maintain healthy natural systems.



On average, between 39 and 54 inches of precipitation (2.7 billion gallons a day) falls across the State and is spread fairly evenly over the 12 months of the year. See Figure 1, Rhode Island Average Annual Precipitation. Precipitation provides all the fresh water we use. Rhode Island has a freshwater resource inventory that includes 14 major watersheds with 140 freshwater lakes and ponds and 22 groundwater aquifers. Of these numerous lakes and ponds, only a small percentage is committed to water supply as a primary function. Surface drinking water reservoirs supply 85% of public water in Rhode Island. Groundwater wells supply the rest. This plan will focus on the potable supply and infrastructure issues for the State and not on the many and diverse issues of the ecological values of fresh water ecosystems.

Figure 1, Rhode Island Average Annual Precipitation



Source: http://www.worldatlas.com/webimage/countrys/namerica/usstates/weathermaps/riprecip.htm

All of the State's waters are shared, interconnected natural resources. Streams, rivers, and aquifers run through many political jurisdictions. The rain that falls in one community in Rhode Island may replenish the aquifers used by other communities many miles away. Fresh water is not an unlimited resource. Not all of the precipitation that falls in any given area is recoverable and usable as a source of potable water. It must be carefully managed to meet long-term water needs.

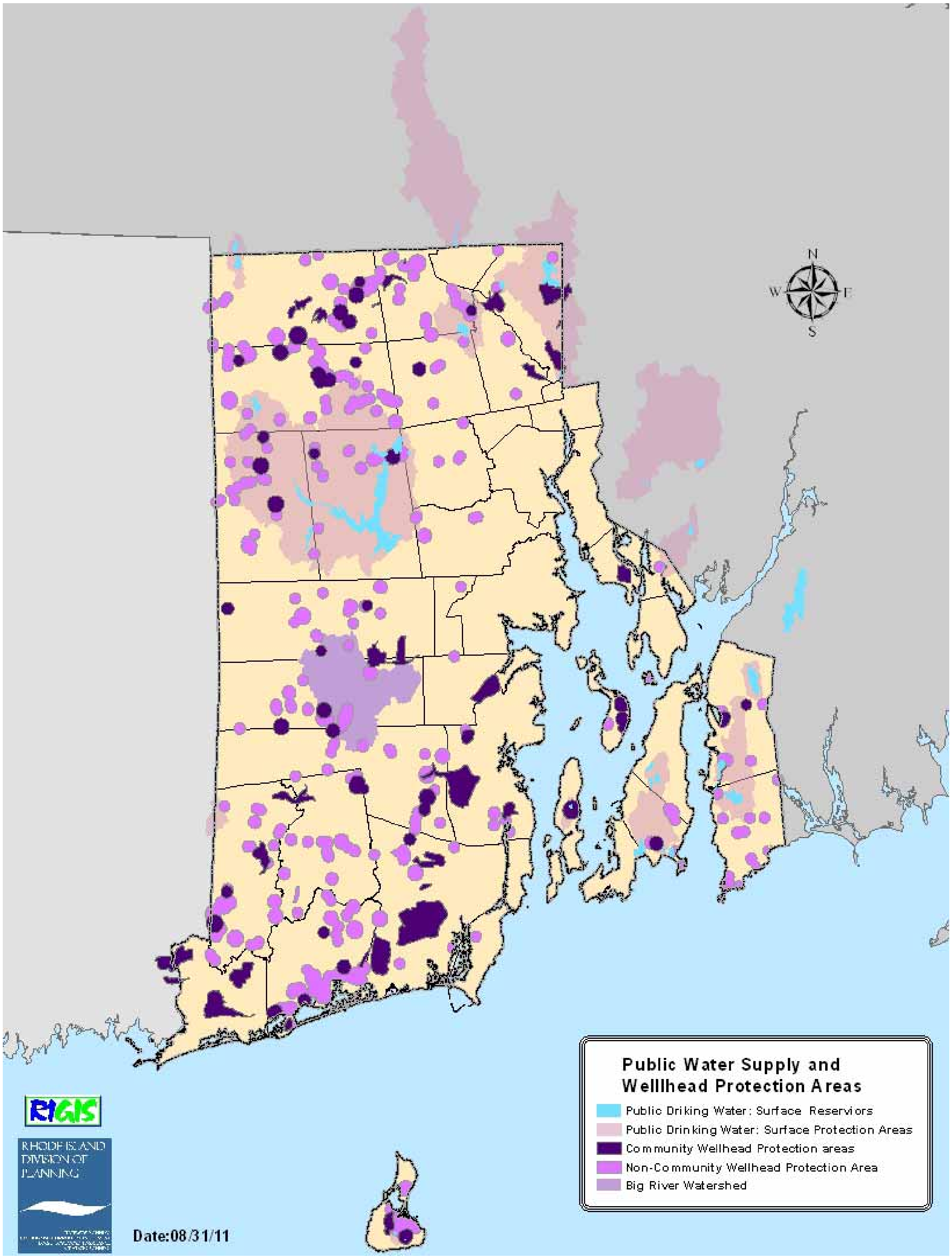
Currently, RI obtains all of its potable water from either surface water and groundwater resources. Figure 2, Rhode Island's Water Supply and Wellhead Protection Areas, shows in a generalized display where sources of surface water supply and wellhead protection areas are located. The figure shows that much of the public drinking water in the central and southern parts of the state comes from wells relying on groundwater aquifers, and that surface water sources supply the majority of water supply for the other regions of the State. Some of the surface water supplies in the north and east come from out of the State as well.

Recycled water needs to be considered as a potential future source for non-potable needs in RI. Research or investigations as to whether recycled water can be used to recharge aquifers has yet to be done in the State. Interest in pursuing the desalination of salt water as a water source has periodically arisen. This as a water source is not currently economically competitive with other water sources. The energy costs for desalination are high, and technical problems have not yet been solved with economic efficiency. In the future, as its use and technology increases in other areas of the Country, it could be studied in greater depth for economic feasibility in RI. In the foreseeable future, however, it does not appear that this source of supply will be able to compete with the current costs of surface and ground water available for use in our State.

Because RI was glaciated, most of the State is covered either with till or outwash. Soil and wind deposits are on top of the till or outwash, but they only account for a couple of inches to a few feet and do not contribute much to water supply. Till is a mix of clay, gravel, stones, rocks, sand, etc. that the glacier left underneath it as it passed. There are few spaces between the particles, so these deposits do not store very much water, and what is there is very difficult to get out. Outwash (also known as "stratified drift") which covers most of the southern part of the State was deposited by melt water streams flowing out under or from the end of the glaciers and is well-sorted by size and usually, with cobbles or large stones. These deposits have relatively large spaces between the particles and can store a lot of water, and water travels easily through these deposits. Most consist of glacial debris so that deposits vary in thickness of up to 200 feet while other areas are mantled by till which is on the average 20 feet thick. Most of the State's groundwater is considered suitable for drinking water use. Approximately 26% of the State's population in 2/3 of the communities depends on groundwater for their water supply.[1]

[1] DEM, State of the State's Waters, 2006, Section 305(b) http://www.dem.ri.gov/pubs/305b/305b2006.pdf

Figure 2, Rhode Island's Water Supply and Wellhead Protection Areas



Economic prosperity in the State has historically been and will continue to be tied to our water resources. We were national leaders in international shipping with our ports and the birthplace of the industrial revolution because of our rivers. As the State's population and economy change, demands on the State's water will grow and change as well. Rhode Island residents need to recognize the limited and vulnerable nature of our water resources, and the importance of that water to public health, the environment, and the economic well being of the State. Cooperation is in everyone's best interest, not only to avert conflict but also to protect the environmental resources on which we depend.

Previous efforts to articulate the State's water supply goals have included utility oriented, capital project developments. The approach of this Plan is more broadly conceived. It emphasizes efficient use of our natural resources, enhanced cooperation between water systems and cooperation with the communities they serve, and coordination of water system planning with community comprehensive plans. Although much of the focus of the plan is toward the major suppliers of potable water, it does contain policies for small water supply systems, government agencies, and municipalities. This view of water resource planning supports the ability of the decision-making process to be flexible to respond to changing current and future conditions and promotes adjustments from the current situation which do not foreclose future resource use options.

This plan is designed to be consistent with Rhode Island's current laws and programs for potable water. All other provisions of our water management systems will remain in place. For example, this plan will not affect state law that provides the Water Resources Board the authority over water system supply management plans for large suppliers. The DOH will continue to monitor water suppliers and to maintain and update information on the status and condition of their systems. Similarly, the plan will not change or replace current statutory provisions for the permitting of wetland impacts overseen by the Department of Environmental Management (DEM).

This Plan builds upon Rhode Island's current statutory framework to create a more integrated potable water management policy for all levels. To the extent the Plan mentions or discusses other statutory or regulatory authority, it does so for informational purposes only. The document does not supersede those statutes or regulations. Neither this document, nor any part of it, is itself a rule or a regulation. It will be implemented in conjunction with existing statutes and programs that guide responses to potable water supply management.

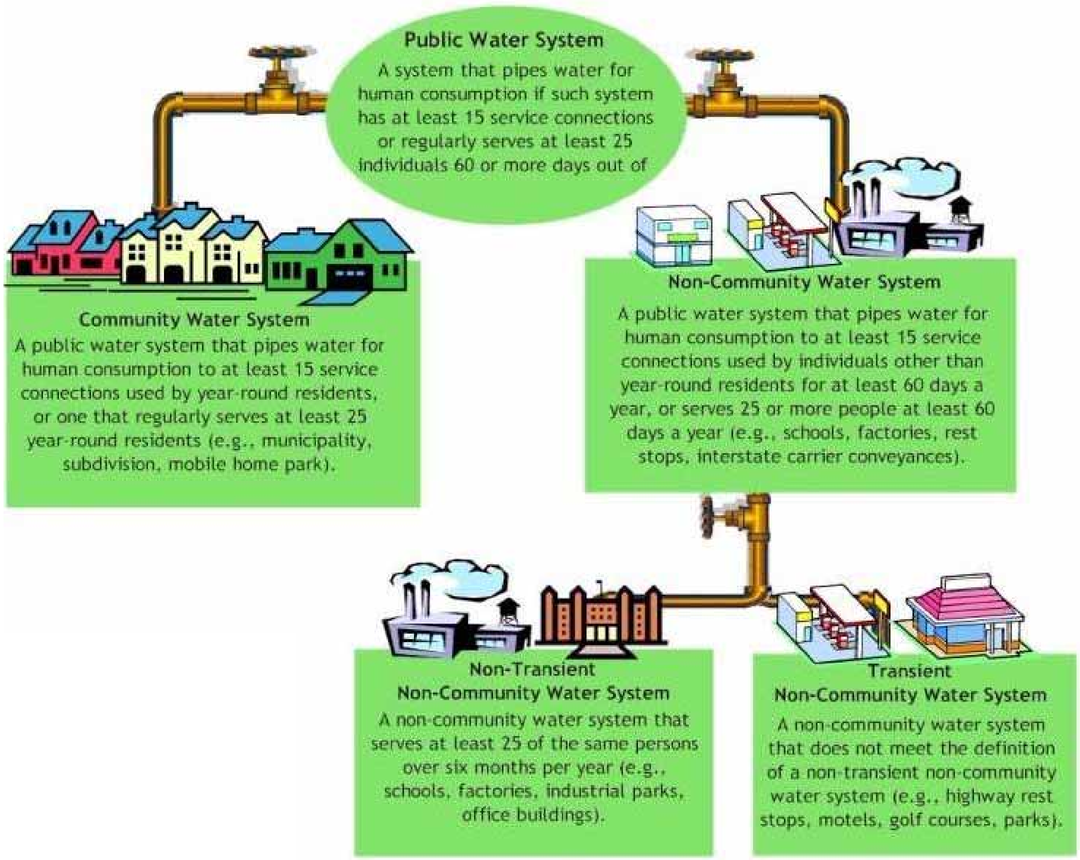
This plan is based upon the following assumptions:

- our ability to understand the interdependencies among natural and social systems is ever evolving;
- most water managers make everyday decisions incrementally to manage the status quo; and
- that all water resource decisions must recognize varying interests of the public and private sectors.

Potable Water Systems in Rhode Island

According to the DOH in 2010, Rhode Island had a total of 490 public water supply systems. The 490 systems vary widely from small rural restaurants to 28 major suppliers. According to the EPA's regulations, a public water supply system may be publicly or privately owned and has fewer than 15 service connections or 25 people per day at least 60 days a year. Public systems are subdivided into two major categories: community and non-community water systems. The division is based on the type of consumer served and the frequency with which the consumer uses water. The basic distinction is that a community system serves a residential population and a non-community system serves a non-residential population. The non-community category is further broken down into non-transient non-community, such as a school or office, and transient non-community water systems such as motels, golf courses, or restaurants. Individual homes and water systems having fewer than 25 people with their own well source are considered private water systems. The graphic below illustrates this.

Types of Water Systems in Rhode Island



Source: http://www.epa.gov/safewater/pws/index.html

Most water systems in Rhode Island originated in the urban areas of the State because of their industrial and commercial development, and population density. Rhode Island has some of the first public water systems to be built in the Country. The Providence system was established in 1866. The systems serving Pawtucket, Newport, Westerly and Woonsocket were established shortly thereafter. These early systems expanded the size and scope of their operations in a manner consistent with the growth of the urban area they served. In many cases municipal and even state boundaries are traversed by these systems. Today it is very difficult and very unlikely that new major community systems will be developed due to evolving source development requirements and dwindling fiscal resources. It is more likely that regionalization or a combination of existing systems into larger units, will eventually serve the State.

The majority of people in Rhode Island get their water from a community system. The 490 public water systems in the State provide direct or retail service to about 1,075,830 people. Most of these public systems (462) serve over 25 but fewer than 3,300 people. Most (56%) are restaurants or food establishments with their own supply wells. They are primarily located in rural areas where infrastructure for drinking water is not available. It is the responsibility of private owners to oversee operations and ensure proper management of small systems. On the other hand, a small number of large public systems serve the largest proportion of the population. Figure 3, Potable Water Sources, shows that 36% of the State's geographic area is served by public water suppliers. These are the largest of the community systems, and they are owned and operated by municipalities, water authorities, fire districts, special districts, and one is a private for-profit company.

Currently there are 31 (28 plus 3 which do not cross the 50 MGY threshold) larger water suppliers in Rhode Island. (See Appendix A, Major Public Water Suppliers by RI City/Town. These water suppliers operate under a variety of organizational frameworks: among them are 14 municipal departments which are an integral part of the municipal government in which they are located; 2 regional water authorities, one serves 3 towns and the other serves 4 towns and parts of 4 other municipalities; 4 quasi-municipal authorities with their own governing boards; a total of 15 special districts created by the General Assembly, some of which have the authority to levy property taxes; and other water suppliers such as the University of Rhode Island and the Quonset Development Corp. and one private supplier: United Water of Rhode Island. Nine major systems rely primarily on groundwater and, with one exception (Quonset), can be characterized as representing the smaller residential customer-based public systems. Of the other major water systems in RI, the remaining majority (21 of 28) rely on their own surface water sources and or purchase water from another surface water system. All but 7 towns are at least partially served by some type of major public system.

Rhode Island Drinking Water Facts[2]

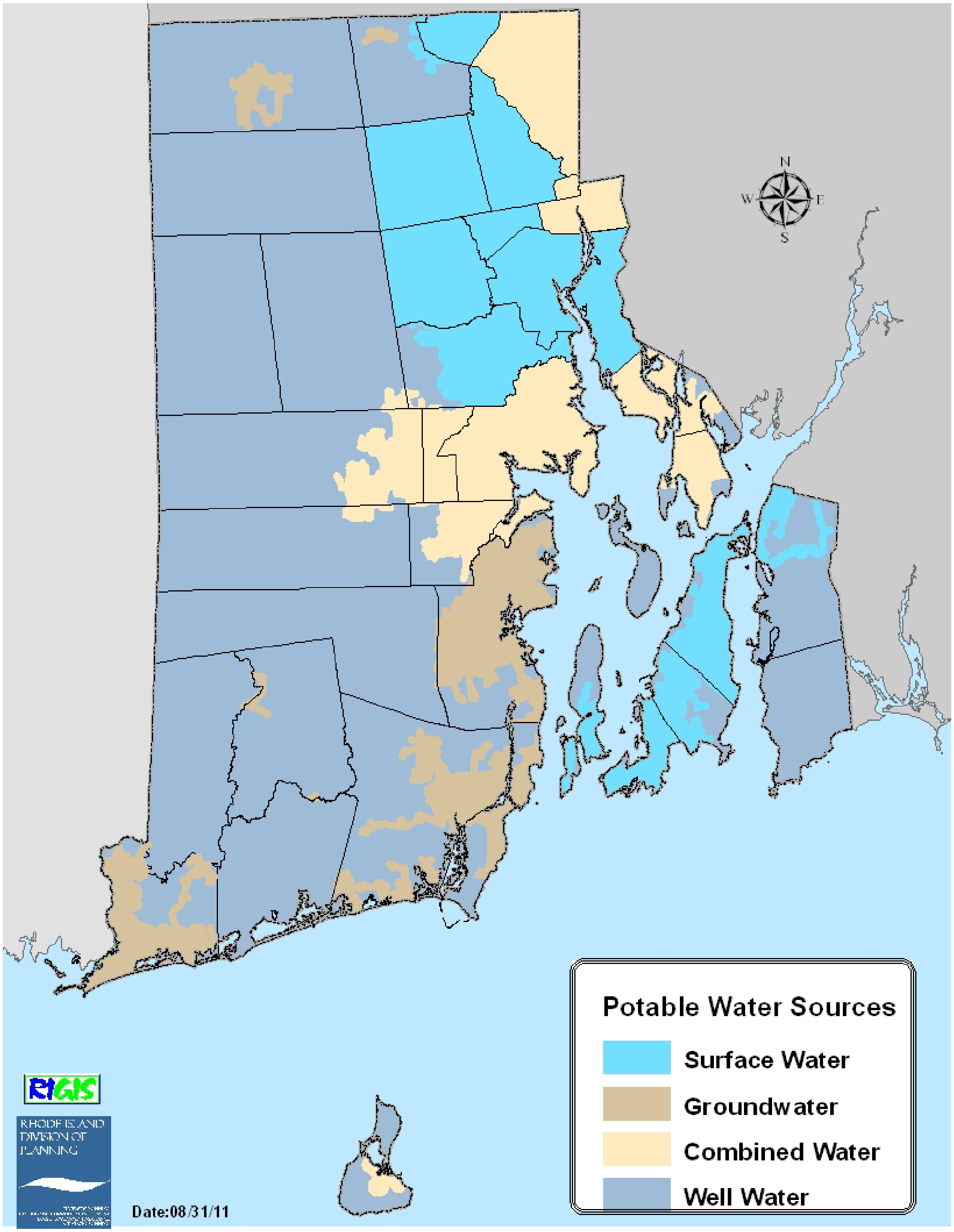
	2008	2010
Persons Served by Public Water In Rhode Island	*1,075,830	*1,074,258
Number of systems using surface water	24	29
Transient Systems	322	317
Non-Transient Systems	80	81
Community Systems	85	89
Number of public water systems in Rhode Island	487	490
Persons served by groundwater systems	*231,679	*224,708
Persons served by surface water systems	*844,151	*849,550
Number of systems using groundwater	**463	**459

*Includes all populations, transient, residential, and workplace. The persons served are actually higher than State total population count.
**Some water systems use both ground and surface water (purchased/non-purchased).

Since the DOH filed their federal compliance report with the EPA in 2008 the total number of persons served by public water in RI has gone down by 1,572 persons in 2010. The number of systems using surface water has increased while the number of systems using groundwater has declined. This is matched by an increase in the number of persons served by surface water systems and a decline in the number of persons served by groundwater systems.

[2] http://www.health.ri.gov/publications/annualreports/2010DrinkingWaterQualityCompliance.pdf

Figure 3, Potable Water Sources by City/Town



Who Does What?

There are numerous federal and state laws related to the use and protection of all Rhode Island's water resources. In order to effectively manage water resources in such a politically complex environment, the resources, the issues and the management needs must be understood. Rhode Island's current approach to potable water management has evolved in a piecemeal fashion over several decades, mainly through reactions to federal mandates and localized water issues such as contamination problems or water shortages. Water management in Rhode Island also grew by opportunity. It still reflects our village culture and history, where private, community-based water supply companies grew out of the fire districts formed in early mill towns. As populations grew, some towns formed their own public water supplies. The development of water systems in the State has encountered problems related to political boundaries, topographical features, inadequacies in the quantities of water available in specific areas, variable water quality, the scarce availability of funds, and lack of coordination among systems.

Some of the traditional ways are changing as agencies seek to maximize dwindling staff and fiscal resources. In 2009, a Memorandum of Understanding (MOU) between the Department of Health, the Department of Environmental Management, the Division of Planning and the Water Resources Board regarding coordination of permitting and considerations for all water withdrawal projects for drinking water supply was signed. The Agencies determined that it is in the public interest that the various departments and agencies with jurisdiction over public water supply systems and the associated water withdrawals coordinate their review and decision making process. The agencies determined that the review and approval of water withdrawal projects - including those projects that will provide a new source of public water supply of greater than 10,000 gallons per day or other water withdrawal projects that may substantially increase withdrawals - would benefit from a coordinated review process among all Parties. The following is a general summary of state agencies that are involved with the stewardship of our drinking water resources. Key water financing programs are highlighted. More specific information on each agency's potable water and other programs can be found on the World Wide Web pages cited.

Also in 2009, the General Assembly passed Budget Article 5 regarding the financial instrument of the Water Resources Board (WR Board), the Water Resources Board Corporate (WRBC). The Article shifted financial control of the WRBC programs to the Clean Water Finance Agency (CWFA). Article 5 prohibits the WRBC from incurring any new debt for water supply projects for the State, and transfers the financial powers and duties of WRBC to the CWFA after existing outstanding bonds are defeased (expected in 2014).

In 2010 the General Assembly through adoption of the State fiscal year 2011 State Budget, Budget Article 11 consolidated the staff of the Water Resources Board with the Division of Planning. The WR Board continues to exist as a public policy body and to conduct its mandated statutory responsibilities. As a result of the Budget approval, the staff of the Board is housed within the Department of Administration's Division of Planning. The staff operate as a functional unit within the Division focusing on water supply and report to the Associate Director of Planning. For purposes of this Plan, references to the Water Resources Board primarily mean the staff within the Division of Planning except for where specific responsibilities of the Board itself have been assigned by RI General Law.

WR Board will be used to distinguish between the staff of the Board (**WRB staff**) and the Board itself (WR Board).

Bay, Rivers, Watershed Coordination Team - Conducts strategic interagency planning, fosters coordination of government programs and partnerships, and makes targeted investments in science, monitoring, and policy analysis related to the water resources of the State.

Citizens – Everyone manages water when using it

Department of Administration, Division of Planning:

- **Statewide Planning Program (SPP) Staff and State Planning Council -** Creates long range policy plans to guide future land use, transportation and use of natural resources of the State http://www.planning.ri.gov/default.htm

- **Water Resources Board (WRB) Staff -** Identifies sources of and assists with the management of potable water resources and provides information on water resources and supplies for people, municipalities, suppliers and businesses http://www.wrb.ri.gov/

Department of Environmental Management (DEM)

Regulates the state's freshwater resources under state and federal laws such as the Clean Water Act to protect the environment http://www.dem.ri.gov/

Department of Health (DOH)

Protects and regulates drinking water quality and regulates public suppliers under state and federal laws such as the Clean Water Act. http://www.health.ri.gov/

Federal Agencies

U. S. Geological Survey (USGS) - assesses and maps water and geological resources. http://www.wrb.ri.gov/waterdata.htm

United States Environmental Protection Agency (EPA) - establishes rules under the federal Safe Drinking Water Act for the provision of and protection of drinking water http://water.epa.gov/drink/

Municipalities

Develop comprehensive plans and ordinances that determine what happens to land use and water resources http://www.muni-info.state.ri.us/municipalities/

Public Utilities Commission (PUC)

Regulates rates charged by water suppliers who sell to areas outside their service district and privately owned water companies http://www.ripuc.org/

Rhode Island Clean Water Finance Agency (RICWFA)

Administers the Drinking Water State Revolving loan fund (DWSRF) http://www.ricwfa.com/About.html

Water Resources Board (WRB Board) & Water Resources Board Corporate (WRBC)
Oversees the identification of potential sources, certain financial programs, and the central management and use of potable water resources

Water Suppliers

There are 490 public water supply systems which range from the small well supplying a rural restaurant to the 28 large systems that provide potable water http://www.health.ri.gov/drinkingwaterquality/

Financing Drinking Water Programs

Federal

The United States Department of Agriculture Rural Development Program administers loan and grant programs to improve water supply in rural America. This assistance is available through Rural Development's Rural Utilities programs. Program assistance is provided in many ways, including direct or guaranteed loans, grants, technical assistance, research and educational materials. The programs of relevance to drinking water financing are the Water and Environmental Programs. The WEP provide loans, grants and loan guarantees only for drinking water facilities in rural areas and towns of 10,000 or less in population. Public bodies, non-profit organizations and recognized Indian tribes may also qualify for assistance. The following are highlights of the programs concerning improving water supply in rural areas which qualifying RI suppliers may use:

- Direct loans and grants are provided to develop water systems in rural areas.
- Guaranteed Loans - Loan guarantees are provided for the construction or improvement of water projects serving the financially needy communities in rural areas. This purpose is achieved through bolstering the existing private credit structure through the guarantee of quality loans which will provide lasting benefits.
- Emergency Community Water Assistance Grants – Grants are provided to assist a rural community that have experienced a significant decline in quantity or quality of drinking water due to an emergency, or in which such decline is considered imminent, to obtain or maintain adequate quantities of water that meets the standards set by the Safe Drinking Water Act. This emergency is considered an occurrence of an incident such as, but not limited to, a drought, earthquake, flood, tornado, hurricane, disease outbreak or chemical spill, leakage or seepage.
- Pre-development Planning Grants - Predevelopment planning grants may be available, if needed, to assist in paying costs associated with developing a complete application for a proposed project.

More information may be obtained from the web page for the WEP at: http://www.rurdev.usda.gov/UWEP_HomePage.html

Rhode Island

The State has a water use surcharge established by RI General Law 46-15.3.5 that is required to be collected by water suppliers. The funds collected are deposited in various water quality protection accounts overseen by the WR Board and the Providence Water Supply Board (PWSB). They are used for protection of drinking water sources. The charge is based upon water sales of every major supplier of public drinking water and collected through water bills at the rate of $.0292 per one 100 gallons of water used.

- All suppliers, other than the City of Providence acting through the PWSB, or suppliers purchasing water from the PWSB, remit to the Treasurer of the WR Board 36.1% of the fees billed each month.
- For suppliers purchasing water from the PWSB for the portion furnished from the PWSB, the suppliers remit to the PWSB, 36.1% of the amount billed each month. For that portion of water furnished from sources other than the PWSB, 36.1% of the amount billed each month is remitted to the Treasurer of the WR Board.

- For all suppliers, including the PWSB, 57.0% of the surcharge amount billed each month is remitted by the WR Board to the General Treasurer of the State of Rhode Island and is deposited as general revenues.

- All suppliers collecting the surcharge may retain 6.9% of the charges collected as an administrative charge.

The water quality protection charge is separated into three water quality protection accounts. The first two consist of any amounts as the State or the PSWB may from time to time appropriate and all water quality protection charges other than the 6.9% administrative charge. One account is administered by Treasurer of the WR Board. The WRBC borrows money and issues notes and bonds by pledging or assigning, in whole or in part, the revenues and other monies held or to be deposited in this fund. The second account is administered by the PWSB. A third account is administered by the General Treasurer of the State. It is a general revenue receipt account known as the "water resources operating fund". The general revenue appropriations made available from the general revenue receipts credited to "Water Resources Operating Fund" are supposed to be used for the administration and support of the WR Board and staff.

Clean Water Finance Agency (CWFA)

The CWFA was established in 1989 by the General Assembly. It was created to administer certain federal and state financial programs relating to municipal or community wastewater and drinking water infrastructure projects. The Agency's operating expenses are funded solely from loan service fees generated from managing its programs. Relevant to water supply, the Agency administers the Drinking Water State Revolving Loan Fund (DWSRF).

The DWSRF was created in 1996 by the federal Safe Drinking Water Act Amendments to finance public drinking water projects. The DWSRF provides low-interest loans to local government units and publicly and privately organized water suppliers. Projects relate to the planning, design and construction of safe drinking water supply, treatment and transmission infrastructure for existing systems. The DOH prepares a Project Priority List to rank potential projects according to several health and economic criteria prior to eligibility for DWSRF financing. The focus of the program, as mandated by the federal law, is small water suppliers and disadvantaged systems. According to EPA, small water systems are supposed to receive higher priority over larger systems in use of the SRF funds. A small water supplier is defined as one serving fewer than 10,000 persons. A disadvantaged system is defined as one whose system improvements would dramatically increase water rates paid by consumers as it relates to median household income. And as also mandated by the federal government, it is not funding to pay for growth or extensions of water systems to service new growth.

CWFA funds are used to:

- Assist small systems in preparing applications for revolving fund assistance.
- Assist all public water supply systems in maintaining financial, managerial and technical abilities and maintain compliance with the Safe Drinking Water Act Amendments of 1996.
- Assist small systems in meeting compliance with the Safe Drinking Water Act.

The DWSRF receives federal funding in the form of capitalization grants from EPA with the state providing a 20% state match. Initially, the program provided direct loans with an interest rate subsidy of 25% off a water suppliers' market rate of borrowing. As the frequency of loan applications and loan amounts have increased, the Agency has used a leveraged financial structure since 2004 so as to maximize the dollar amount available for loans.

Water Supply System Management Plans (WSSMP)

Planning for large drinking water systems in Rhode Island is addressed through the Water Supply System Management Plan process. The Public Drinking water Supply System Protection Act was adopted in 1987 (R.I. Gen. Law 46-15.3) and was later revised in 1997. The Act acknowledged the importance of water supply planning and requires that all large suppliers who sell or distribute drinking water prepare a WSSMP. A large supplier is defined as one that supplies, sells or distributes more than 50 million gallons of drinking water per year. There are a total of 28 drinking water suppliers that exceed this threshold. These large suppliers serve 30 of the 39 cities and towns in Rhode Island.

Adopted by Public Law Chapter 484, WSSMP are required by Section 46-15.3-5.1 of RI General Law. The 1st submission process for plans was administered by the DEM in 1994. The process is now overseen by the WR Board and its staff. The WSSMP requirements were a response to a series of water supply failures and shortages by several major water suppliers in the State in the early 1990's. The Plans are intended to have the 28 largest suppliers in the State address ongoing management for operating water systems. Specific items that the law requires suppliers to focus on are maintaining capacity and capability, protecting source and potable water quality, resource conservation, and emergency situations. The WSSMP process calls for planning to be done for the protection of water sources, anticipating future demands, reducing peak demands and identifying potential future service areas. Most suppliers have finished a 2nd edition of WSSMP and some a 3rd for their system since the process started in 1994. The plans are required by the law to be revised once every 5 years.

The DOP is mandated by this law to participate in an interagency review along with DEM, the PUC, and DOH. This review provides the WR Board with recommendations on the compliance of the WSSMP with each agency's existing water related goals, policies and programs. This review also helps DOP to fulfill its mission of planning for the physical, economic, and social development of the State by assuring that there is coordination between the water suppliers, state agencies and municipalities. DOP advises water suppliers, municipalities and the WR Board on compliance with existing water resource policies that are part of the State Guide Plan (SGP). Further, DOP helps identify drinking water resources issues in community comprehensive plans (CCP) for the suppliers to address in the WSSMP. In each review the DOP provides an advisory assessment of whether the WSSMP achieved the objectives of the appropriate CCP related to water supply. In prior DOP reviews, each supplier was directed to obtain consistency letters from the appropriate municipal planning officials that the WSSMP complied with the community comprehensive plans where

SGP policy items in WSSMP

- Consistency with the goals of the SGP
- Supply management policies
  - Non-account water percentage
- Demand management policies
  - Anticipated future demand
  - Water reuse or recycling
  - Non-potable water
  - Conservation / public education programs
  - Technical assistance to major users
  - Type of rate structures
- Water quality protection measures
- Emergency management planning
  - Updated interconnection /assistance agreements
  - Drought planning
- Coordination with community comprehensive plan(s)

appropriate. Areas which required greater attention and consistency between the SGP and the WSSMPs were;

- The lack of updated supply and emergency assistance agreements between adjacent suppliers. An extreme case of this was during the groundwater contamination crisis suffered by the Pascoag Utility District System in 2001. Pascoag turned to the neighboring Harrisville system for help and found it difficult to obtain water as the emergency agreement had lapsed between the two suppliers.

- Preventing non-account water loss through upgrading meters on a regular basis, improving inspections and conducting leak detection on a frequent basis. By 2010, most suppliers reduced the overall non-account water percentage to at or below the SGP goal of 15 % through such measures. In 2009, the Water Use and Efficiency Act (discussed in further detail in Part 2) set a new goal of not more than 10% for non-account water.

> **Non-account water** is the system wide loss of water through leaks, under registering meters, or other reasons not accounted for. (Now is called non-billed water by RI General Law 46-15.3-4.)

The first WSSMP completed in 1994 was a good start for suppliers to begin thinking comprehensively about their systems. During subsequent reviews of WSSMPs, DOP pushed suppliers to take system-wide approaches in looking at anticipated future demands predicted by local CCPs for their systems. In general, the insertion of SGP policy in the WSSMP has improved in the later rounds but the specific areas concerning the use of non-potable water, water reuse and recycling, increased and better public education, and the use of more technological advanced water conservation measures still need more attention by suppliers.

DOP has encouraged suppliers look comprehensively to work more closely with the municipal governments they serve. The WSSMPs have valuable technical information on water resources issues that municipal governments can use to assist in the revision of community comprehensive plans concerning future land use and water supply where appropriate. Information is present for planners to consider in formulating future land use allocations and density limitations.. Coordinating the WSSMP will be enhanced by the Water Use and Efficiency Act requirements but challenging to complete with current staff reductions at the WR Board. Periodically, the WRB staff evaluates the submission requirements and review process and recommends revisions to the WR Board to ensure that contemporary water supply issues are addressed by the WSSMPs. The next program revision will be to add the demand management programs and reporting requirements mandated by the Water Use and Efficiency Act which is described in more detail in Part 2. A comprehensive analysis of the full program and its results will be done when the WRB staffing levels permit.

Private Wells

According to DEM, over 150,000 Rhode Islanders drink groundwater supplied by a private well on their property. These wells are primarily residential wells that do not serve enough people to be considered a public water system. DEM estimates that approximately 500-1000 new and replacement private wells are installed annually in Rhode Island. The 2008 economic downturn of the State's economy may have affected this annual average somewhat. DEM regulates the distance a private well should be from potential contamination sources. Until 2008, Rhode Island did not require any testing of private wells. Individual well owners are responsible for the quality of their water. Individual well owners do not benefit from the public health safeguards provided by a regulated public water supply system. The DOH Office of Drinking Water Quality can assist private well owners with water quality concerns, but responsibility for wellhead protection, adequate well maintenance and water testing falls mainly on the owner.

Regulations were adopted by the DOH in 2008 that require quality testing at the time of a real estate transfer for existing wells and at the issuance of the certificate of occupancy for new private wells. The regulations define a private-drinking-water system as a system that extracts groundwater from a well or well field, provides potable water for human consumption, and does not meet the requirements to be classified as a public water system. These systems include commercial – mixed use, multi-family residential, single/duplex residential, and individual private systems. Additionally, these rules and regulations provide direction for municipal officials regarding enforcement on the data reporting requirements. As of 2011 the regulations are undergoing a staged implementation and Building Officials have been trained on the regulations and what required testing needs to be completed and results submitted as part of the Certificate of Occupancy process. Reviews are underway for applications for samplers to become a licensed sampler and issuance of licenses should occur in 2011. Training for real estate, lending, and legal partners regarding implementation of the regulations has begun. A private well testing internet viewer is being developed which will allow certified analytical labs to post sample results on publically accessible web pages.

Resources of State Significance

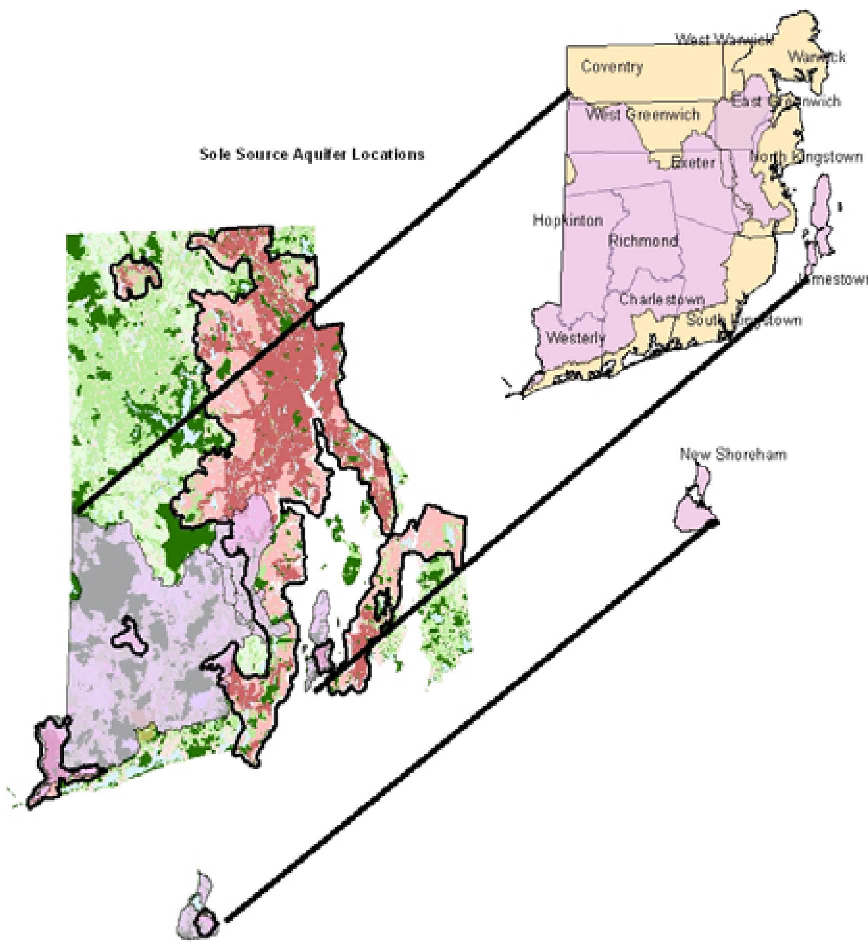
This Section will focus on several areas indentified by the Advisory Committee to be of significance to potable water supply of the State;

- sole source aquifers,
- the surface water reservoir serving the largest portion of the State population, the Scituate Reservoir, and
- an area designated for supplementing existing supplies and augmenting future water supply, the Big River Watershed Area

Sole Source Aquifers

Four groundwater aquifer systems of the State have been classified as "Sole-Source Aquifers" by the United States Environmental Protection Agency (EPA). The program was established under Section 1424(e) of the Safe Drinking Water Act of 1974.

A sole source aquifer is a groundwater aquifer which has been designated as the "sole or principal" source of drinking water for an area. EPA says that currently no other water supplies are available except for the groundwater in the aquifers when applying this definition.

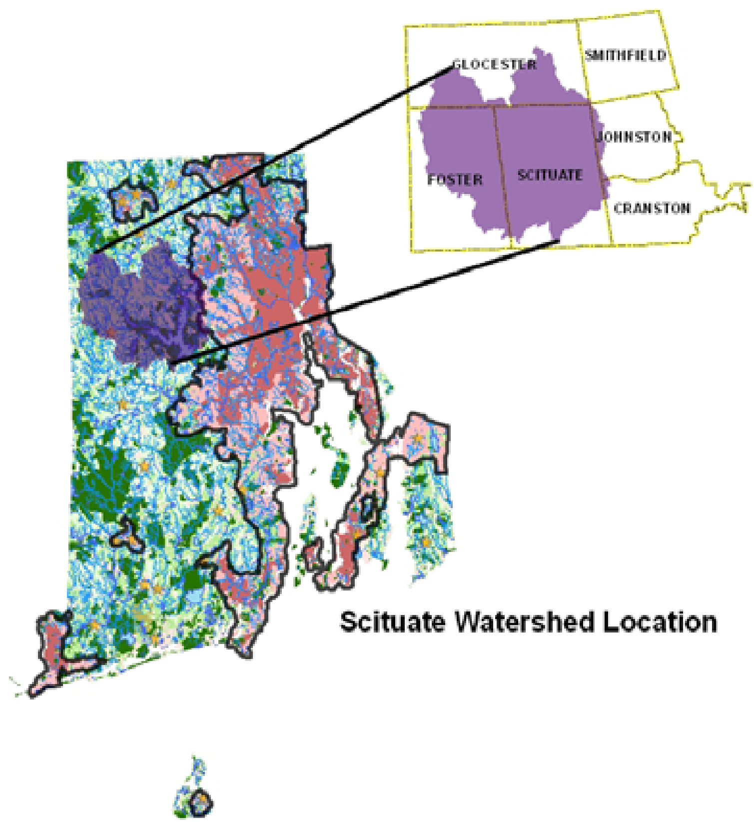


The 4 aquifers are the Block Island, Hunt-Annaquatucket-Pettaqumascutt, the Jamestown, and the Wood-Pawcatuck aquifer complexes. The Block Island Aquifer is located on the island of New Shoreham. The Jamestown Aquifer is located on the island of Conanicut. The other 2 aquifers are located in the southern mainland interior of the State overlapping 11 communities.

Scituate Watershed

The Scituate Reservoir of the Providence Water Supply Board (PWSB) water system accounts for almost 50% of the total surface withdrawals in the State. Several large public water suppliers which formerly relied upon their own or other sources of water have switched to entirely or partially relying upon the PWSB as a supply source. This has been due to increasing problems with contamination and in some cases, anticipation of degradation of groundwater supplies from encroachment of intensive land use activities. This tendency to rely on the largest public water system in the State, which has the most widespread and sophisticated distribution, points out the paradox of water supply issues in the State; the overall perceived abundance of the water resource is a false measure of its adequacy. The Scituate was never designed to be the single source of supply for the State but it has no backup supplies. This was one of the several factors considered in the State's purchase of the Big River Area. The issues facing our potable water systems will be discussed in greater depth in Part 2: Potable Water Issues Today.

The Scituate Watershed is located in the north central part of Rhode Island. The watershed is comprised of portions of 6 communities; Scituate, Foster, Glocester, Johnston, Cranston, and Smithfield. The watershed is the source of the largest public water supplier in the State, the Providence Water Supply Board (PWSB). This system provides water to the metropolitan areas of the State and about 600,000 persons (about 60% of State's residents). It consists of the main (Scituate) Reservoir and its five tributary reservoirs and accounts for more than 80% of freshwater surface storage capacity in the State.

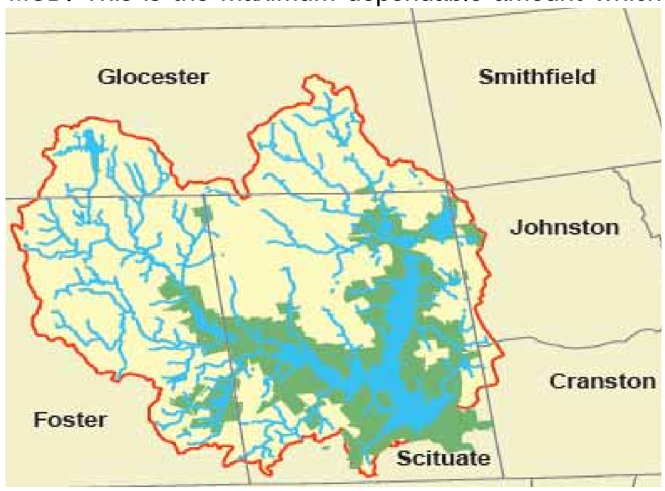


Scituate Watershed Location

The PWSB system is one of the oldest water systems in the country. It was started in 1866 with an Act from the RI General Assembly. The original supply was obtained from the Pawtuxet River in Cranston. Several years following the start of the system, the Pawtuxet was reported to have almost run dry in dry weather periods as consumption exceeded the natural flow of the river. Source water quality concerns, providing a dependable water supply for businesses, and adequate fire protection drove the Providence City Council in 1913 to vote to develop a new water supply system to respond to these concerns. The menace of a possible water shortage led to the adoption of the state legislation under which the present supply system was built.

The legislation authorized the construction of the reservoir and treatment plant on the north branch of the Pawtuxet River in the Town of Scituate. Title to the property needed for the Reservoir was taken by eminent domain in 1916. The main reservoir was formed by the construction of Gainer Dam across the Pawtuxet River. The dam is about 3,200 feet long and 109 feet high. The top of the dam is about 35 feet wide and occupied by Route 12 which is a 2-lane highway. Water storage in the reservoir began in 1925.

The PWSB is required by RI General Law and the US Army Corps of Engineers to release a minimum of 9 MGD to maintain sufficient flow for downstream uses including providing assimilative capacity for wastewater treatment facility discharges on the Pawtuxet River. World War I delayed construction. The aqueduct from the dam to the Phillip J. Holton treatment plant was placed in operation in 1926. The treatment plant has undergone several major expansions and renovations since then. The Plant has a maximum treatment capacity of 144 MGD and still remains the largest treatment facility in New England. However this quantity of water cannot always be counted on being available. The System has a safe yield of 83 MGD. This is the maximum dependable amount which can be made continually from the water supply source during a period of extended drought. The average daily flow from the treatment plant in 2007 was 68.14 MGD or more than 24 billion gallons a year.



The transmission and distribution system consists of approximately 4 miles of concrete lined tunnel, 10 miles of concrete aqueducts, 102 miles of transmission piping (16-66 inches) and 835 miles of distribution piping (6-12 inches). There are 5 constructed water storage reservoirs in the system.

The watershed covers nearly 60,000 acres (about 93 square miles) of mostly rural and forested land. This represents about 9% of the total land area of the State and is 5 times the land area of Providence. The watershed reservoirs and surface water bodies are connected by about 141 miles of streams and brooks. The Ponagansett River is the largest river in the surface water system, draining 15% of the watershed. Other major tributaries include Peeptoad, Winsor, Shippee, Westconnaug and Wilbur Hollow Brooks, which drain an additional 20% of the watershed.

The Scituate Watershed comprises portions of 6 communities:

Scituate	84%
Foster	55%
Glocester	31%
Johnston	8%
Cranston	2%
Smithfield	0.1%

According to 2003-04 land use /land cover data from the RI Geographic Information System (RIGIS), the watershed is largely undeveloped. Only 2% of the watershed is classified as high-density residential, commercial or industrial land use. The major land use/ cover is forestland. Development in the watershed is primarily concentrated along major transportation corridors (Routes 6, 101 and 116). Land use, development and construction activities in the watershed are governed through a combination of federal, state, and municipal regulations. The watershed is subject to development pressure due to its proximity to Providence. The watershed is within a 10-mile radius from Providence City Hall. Nearly 17,000 acres or 28% of the watershed is controlled by the PWSB.[3] This area includes the reservoir, the tributary reservoirs and land adjacent to most of these water bodies. The PWSB works to acquire critical parcels of land and buffer zones within the watershed to ensure

[3] Providence Water Supply System Management Plan, Providence Water Supply Board, April 2010

critical watershed resources are protected. Most lands owned by the PWSB are within a ½ mile of the reservoirs.

Total Maximum Dailey Load (TMDL)

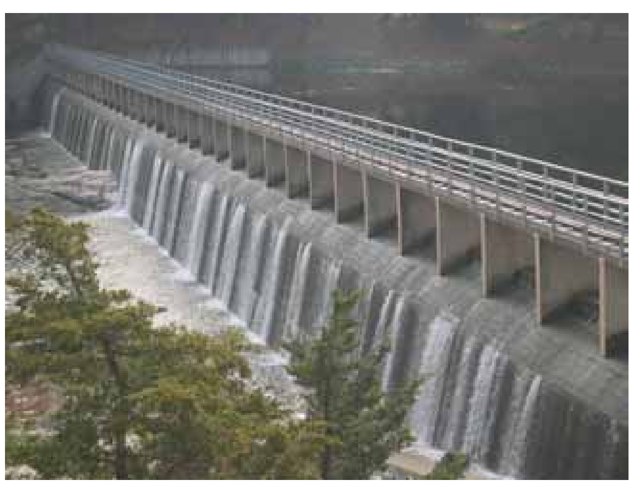
According to DEM a TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. TMDLs are based on the relationship between pollution sources in the watershed and instream water quality conditions. A TMDL addresses a single pollutant or stressor for each waterbody or waterbody segment.

In general, the water quality in the watershed is good. The PWSB and the municipalities work cooperatively together to protect the existing high water quality of the watershed. Only one water body in the watershed, The Moswansicut Stream, is listed on the Rhode Island 2006 303(d) list of impaired waters published by DEM. A total maximum daily load (TMDL) is scheduled to be completed by the DEM for this water body in 2012.

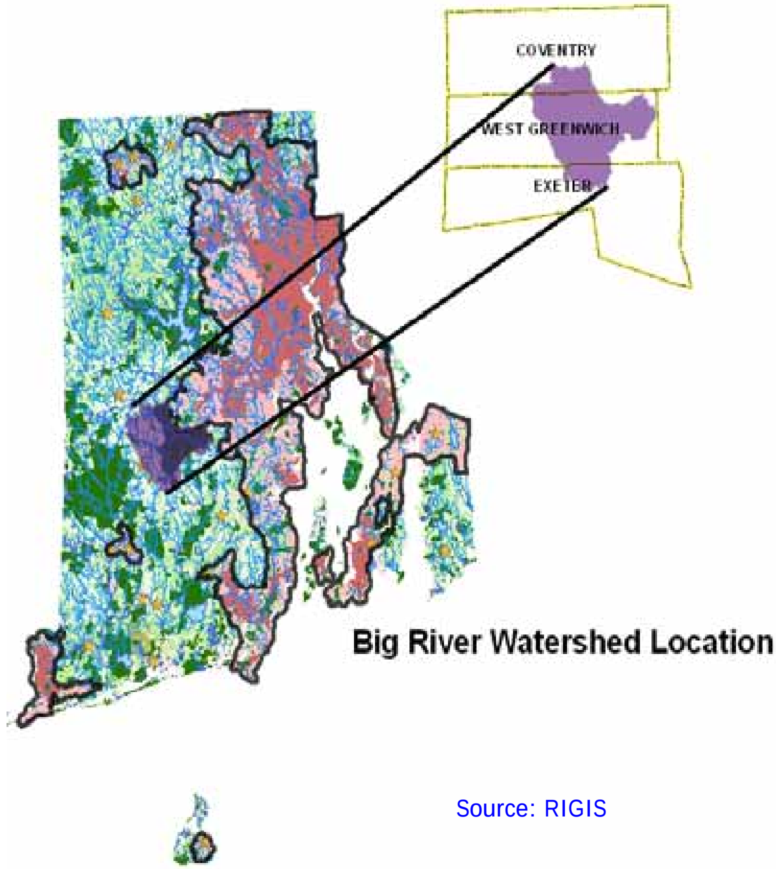
The six reservoirs of the watershed cover a surface area of 4,563 acres and have a combined gross capacity of 41.268 billion gallons. Unusable storage is 1,522,000,000 gallons leaving a total of available storage of 39,746,000,000 gallons. The area of the reservoir is larger than the northern area of Narragansett Bay that includes the Seekonk and Providence Rivers, north of Pawtuxet Neck. To put this amount in visible terms; the amount of water stored in the reservoir would cover the entire area of the City of Providence to a depth of 10 feet.

A 2001 USGS report on the glacial geology and aquifer characteristics of the watershed studied changes in water quality over time in the watershed. This study concluded that a link exists between land development and water quality impacts. The concentration of water quality constituents such as alkalinity, color, iron, pH, turbidity, chloride, bacteria, and nitrate, were shown to have generally increased in developed sub-basins of the watershed over the last 50 years compared to predominately forested sub-basins of the watershed. Today there are about 12,000 acres of managed forestland in the watershed. The USGS study also indicated that water quality impacts are closely related to the presence of urban runoff, onsite septic systems, and wetland biogeochemical processes. Statistical trend analysis was performed on the water quality sampling that suggests the quality of water resources in the watershed may be slowly degrading as a result of urban development. Current policies for use of the watershed will be described in Part 3, Assuring There's Water for Tomorrow.

Scituate Reservoir Spillway



Big River Watershed



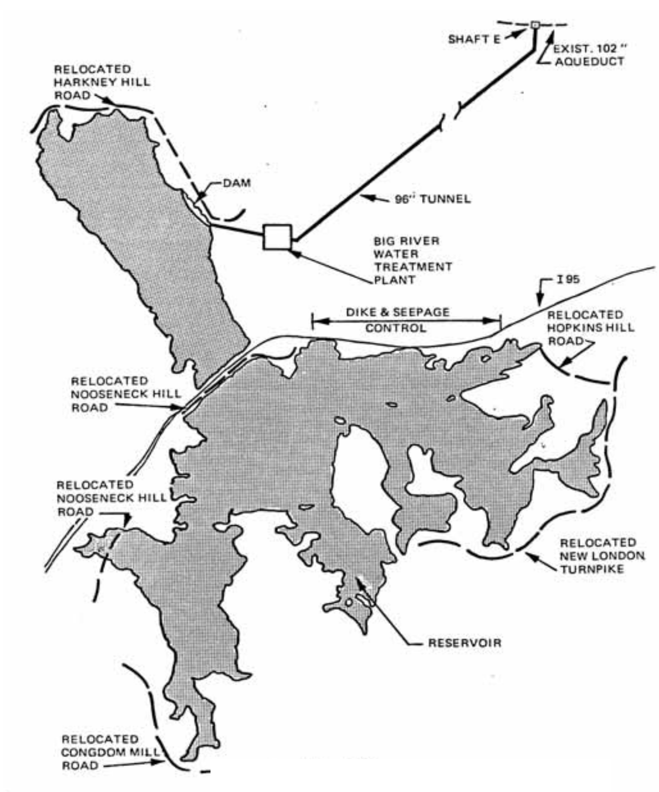
Source: RIGIS

The Big River Watershed is located in the south central portion of the State. The watershed covers 29.7 square miles and is comprised of portions of 3 communities; Coventry, West Greenwich, and Exeter. It is not yet used for water supply. The Big River is formed in West Greenwich by the confluence of the Congdon, Carr, and Nooseneck Rivers. From there, it flows due north through West Greenwich and Coventry to its confluence with the Flat River, in the area now flooded by the Flat River Reservoir, to form the South Branch of the Pawtuxet River. It flows approximately 6 miles. There are no dams along the river's length. The topography in this region consists of rolling hills intertwined by relatively flat gradient streams containing small ponds and swamps. The watershed is comprised of an irregular topographic surface with relatively low to moderate size hills in the western section gradually decreasing in relief toward the east. The valley of the Big River is physiographically located within the drainage area of the Pawtuxet River Basin. The Pawtuxet River Basin is the largest river basin in RI and located entirely within central RI,

In 1964-66 the State experienced what is called the “drought of record”. The area was acquired by the State through the use of its eminent domain powers in 1964, under the Big River-Wood River Acquisition Act, for the purposes of constructing surface drinking water supply reservoirs. The construction of the Big River Reservoir has been proposed many times since 1952 and much site investigation has been done in the area. The first comprehensive study on building supplemental water resources in RI was made in 1952 and several reservoir sites including the Big River were proposed to supplement the supply source for the Providence area. The Northeastern United States Water Supply Study by the Army Corps of Engineers (1969) proposed the development of Big River Reservoir and flood skimming from the Flat River Reservoir. A report of the Southeastern New England study by the New England River Basins Commission (1976) recommended construction of the Big River Reservoir. A study of water supply alternatives for the Pawcatuck River and Narragansett Bay drainage basins was done by the Army Corps of Engineers (1979) recommended development of the Big River Reservoir. A Big River Feasibility study was completed in 1981 by the Army Corps of Engineers.

The State obtained a total of 8,400 acres from 351 owners at a cost of $7.5 million. Originally 200 single-family dwellings and several businesses were located there. The Water Resources Coordinating Board was established in 1964 to acquire and protect the land for the proposed Big River Reservoir. During 1967 the agency was renamed the Rhode Island Water Resources Board. In

1970, the Legislature created the Rhode Island Water Resources Board Corporate as the infrastructure financing arm of the WR Board. A bond issue to begin the reservoir engineering was not passed until 1980. In 2011, the WR Board maintains leases on 17 residential properties, a 9-hole golf course, 2 commercial properties and a portion of Maple Root Corporation, and a 79 unit mobile home park.



Engineering investigations for the purpose of water supply purposes continued through the 1970s and 80s. The proposed project entailed building a dam for a 3,400 acre reservoir to be used for potable water supply. In 1978, having failed to secure funding to complete engineering studies, Rhode Island asked the US Army Corps of Engineers to construct the reservoir as a federal flood control project. A dam was proposed for the Big River. The proposed 70 foot high dam would have been located in West Greenwich adjacent to Interstate 95 to create the 3,400 acre reservoir with an average depth of 25 feet. Additionally, the Reservoir needed a subsurface liner to prevent the proposed stored water from leaking through the natural glacial deposits. It was estimated that the reservoir would have provided approximately 20 - 25 million gallons of water a day. This design output was about one quarter the size of the Scituate output but would have covered about the same size land area of the Scituate. A plant for water treatment and a 6 mile transmission main would have been built to transport the water into the existing adjacent Kent County Water Authority (KCWA) water system. The preliminary strategic planning efforts of the WRB staff have provided draft estimates that range from 514 to 537 million dollars[4] to construct the reservoir and necessary transmission lines today.

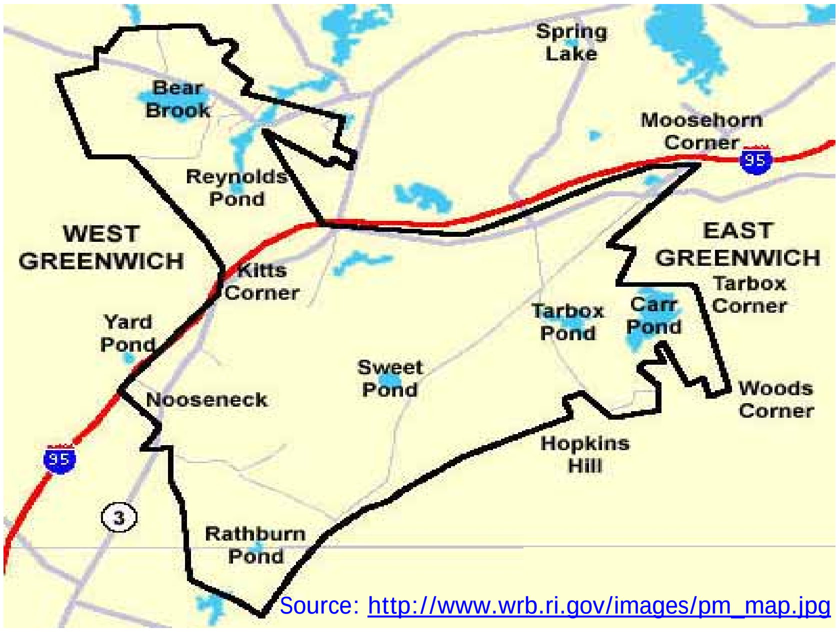
Source:http://www.wrb.ri.gov/reports/WaterSupply_Mariscal_091707.ppt#390,26,Slide 26

In March of 1990, the EPA Assistant Administrator for Water issued a final determination under Section 404(c) of the Clean Water Act that the fill resulting from the proposed project would cause serious environmental damage. EPA based its decision on anticipated negative environmental effects and a failure by all parties to explore other water supply alternatives. The EPA decision outlined that it would have destroyed 575

[4] In 2011 dollars

acres of valuable wetlands, eliminated 17 miles of streams, many containing cold water fisheries, would worsen downstream water quality causing failure to meet state water quality standards, and would cause substantial adverse impacts to the recreational values of the site. It also was seen as threatening to the viability of an additional 800 acres of wetlands by depriving them of groundwater and surface water. EPA said that an alternative, or combination of alternatives (demand management and conservation), could be used to satisfy the water needs of the State.

Many groups opposed to the reservoir's creation. The primary concern was for building it on wetlands and damaging a pristine wetland environment. The EPA and several environmental groups cited inaccuracies in the methodology of the study used to justify the creation of a reservoir. Questions were raised surrounding the study's population growth and demand assumptions and its characterization of industry water needs. Some of the opposition to these embedded assumptions proved warranted. For instance, the study predicted a 17.7 million gallon per day increase in water demand between 1975 and 1987; while water demand has risen since 1989, this predicted increase never materialized.



Source: http://www.wrb.ri.gov/images/pm_map.jpg

Due to the opposition to the reservoir by the EPA and environmental organizations, the State halted the project in 1990 and no further action has taken place to advance the surface water reservoir project. In 1993, the RI General Assembly passed legislation (§ 37-20-1, Big River Reservoir Moratorium). This Act required that all land acquired by the State for the development of the "Big River Reservoir" shall not be sold nor shall the land be developed in any way. The General Assembly stated that State shall not allow any future development or continued development on that property, and the property shall be designated "open space" as defined in § 45-36-1(1)–(7). This open space legislation was amended in 1999 to allow for the development of wells and wells sites together with any necessary infrastructure for the treatment, transmission, storage and distribution of drinking water. Per RI Gen. Law 46-15.1-19.1 the area remains under the control of the WR Board. Strategic Planning by the WR Board will continue to evaluate the optimum use of the area for supplemental water supply. The current policies of the WR Board for use of the watershed will be described in more detail in Part 3, Assuring There's Water for Tomorrow.

RI Water Supply Planning Actions Since 1990

- WSSMPs
- Source Water Projection Plans (SWAP)
- Wellhead Protection Plans (WHPA)
- Addressing water supply planning in municipal comprehensive plans
- Clean Water Infrastructure Plans
- 2009 Water Use and Efficiency Act

Part 2 will discuss in more depth that water demand in Rhode Island is changing. The WR Board is concerned that adequate supplies may not be available for some groundwater dependent areas when they are needed. Nearly all of the potable groundwater supplies identified in Rhode Island are found in shallow, river-dominated valley-fill aquifer systems, such as the Big River Watershed. There are concerns about the potential effects of groundwater withdrawals on the hydrology of streams and wetlands in the watershed. These concerns have created the need for a better understanding of the interaction between groundwater and surface water.

The WR Board in conjunction with the USGS selected the Big River area as a case study to examine potential field-monitoring and groundwater modeling methods for hydrologic wetland assessments. The regional groundwater conditions reflect the glacial history of the area. The entire watershed has been mantled by glacial debris so that outwash deposits vary in thickness of up to 200 feet while other areas are mantled by till which is on the average 20 feet thick. Previous groundwater investigations by the University of RI and others indicate that the most productive wells would be located in glacial outwash deposits close to streams or ponds. Wells in the glacial till would yield smaller supplies than those in the glacial outwash. The groundwater quality is generally good with the water in the outwash deposits being soft, that in till being hard and quality in bedrock being soft to moderately hard. A cooperative study was initiated in 1995 by the USGS and the WR Board to evaluate ground water as a source of water supply from the stream-aquifer system in the Big River area. The stream-aquifer system is the surficial aquifer and the network of rivers, brooks, lakes, and ponds that overlie and are in hydraulic connection with the aquifer. To date, minimal ground-water withdrawals take place in the Big River Basin, because most of the land is designated as open space and protected from development by State law. Four reports have been published from these recent investigations in order to understand the potential variable and sustainable well pumping levels for groundwater withdrawals in the watershed.

In December of 2009, the WR Board conducted extended water pumping tests at two constructed wells in one area of the Big River. When fully operational, the sustainable water withdrawals from the 2 proposed wells in the areas explored are estimated at approximately 4.0 MGD. However, DEM permit limitations on the water withdrawal rate have been preliminarily discussed as setting the safe yield at 2.1 MGD for protection of the Flat River Reservoir and other wetlands in the watershed. The next steps for the WR Board are to determine the mechanics of who will and how to develop the infrastructure needed for transport of the water to an adjacent water system. No suppliers have yet expressed an interest in purchasing the groundwater. The WR Board will have to file for a wetlands permit from DEM, obtain approval from the State Properties Commission to enter into a contract with an adjacent water supplier to augment potable water supplies currently available, and obtain approval from the PUC regarding setting water rates. As of February 2012, engineering work for a Water Quality Certification Application review by DEM was completed but the application has not yet been filed.

Part 2: Potable Water Issues Today

Key Points:

- Rhode Island has sufficient supplies but potable water is vulnerable to contamination and is not always located where it is needed or available in sufficient quantities for all uses at all times.
  - Northern RI has generally adequate supplies.
  - Southern RI is groundwater dependent, and lacks storage capacity therefore water is not always available when and where needed.
  - Aquidneck Island has shallow reservoirs with developed watersheds and raw water that is challenging to treat.
  - On other Islands, growth is stressing available supplies.
- 60% of Rhode Island's developed water supply comes from the Scituate Reservoir Complex.
  - 16 of 39 RI communities depend upon the Scituate Reservoir for potable water in one way or another.
  - The Scituate complex was not intended to be the main supply of water for the entire State.
- Increasing summer peak water use is one of the biggest water supply management issues along with finding adequate water volumes for new major users.
- The trend of sprawling development as identified in *Land Use 2025* is detrimental to the long term sustainable future of water supply for the State.
- A system of understandable information is needed for making informed and predictable land use decisions based on water availability among other factors.
- The technology, data, management and financing of water systems are coping and vary in sophistication but generally need more financial support.
- Our water resources are finite and require managing for sustainability as well as public health.
- Some potable supplies come from source waters in neighboring states with differing laws and regulations governing source water protection.
- Our water rates compared to our neighboring states show that RI has relatively lower rates. This should be considered an economic advantage for our State.
- Augmenting potable supplies by development and reuse of non-potable sources for non-potable purposes needs state standards to be adopted.

What Have We Got?

The health, safety and economic well-being of citizens in Rhode Island depend on safe and predictable quantities of water that is both potable and non-potable. According to the 2007 Report of the Rhode Island General Assembly Committee on Government Oversight and the Environment and Agriculture:

> "*There is not a water supply crisis today. Overall Rhode Island is in adequate shape- however serious problems could easily develop in the future unless new approaches to water resources protection, water supply, and water use are put into place.*"[1]

The report says that Rhode Island is blessed with high quality drinking water supplies that do not require significant treatment when compared to other places in the Country that have to provide costly treatment to improve the raw water they start with for basic health standards. **This does not mean that potable water supply is picture perfect in the State.** There are real challenges ahead. For example, technology, data, management and financing of water systems are currently coping but the systems need to improve demand management and billing procedures.

Notable Exceptions, such as the groundwater dependent Chipuxet and the Hunt-Annaquatucket-Potowamut (HAP) aquifer systems, need attention along with better source protection in the Aquidneck Island watershed. The Chipuxet River is a river in South Kingstown. It flows approximately 8.5 miles. There are 2 dams along the river's length. The river's aquifer is used as a drinking water supply for several major water suppliers that serve South Kingstown and Narragansett along with the University of Rhode Island. The Hunt River is also a river in Southern RI. It flows approximately 7 miles. The river is formed in East Greenwich by the confluence of Scrabbletown Brook and an unnamed stream. From there, the river flows north along Route 4, then northeast to Potowomut Pond. Below the pond, the river flows southeast to Potowomut Peninsula where the river widens and becomes known as the Potowomut River. Most of the Hunt River forms the boundary between Kent and Washington (South) Counties, and also separates East Greenwich and Warwick from North Kingstown. Due to heavy water supply demands on the aquifer, the river has been known to run dry at times. The reservoirs in the Aquidneck Island watershed are shallow, are beginning to have frequent blue - green algae blooms and routinely test above maximum contaminant levels for disinfectant byproducts.

Rhode Island has sufficient supplies but water is not always located where it is needed or available in sufficient quantities for all uses at all times. Storage capacity must be increased in order to provide long-term supply reliability. Back up water supplies in the event of emergencies or system failures are few, and are difficult for which to find funding for their construction. Freshwater may become contaminated and potable drinking water is routinely used for purposes not

[1] *Water for Tomorrow: From Planning to Implementation,* Findings and Recommendations from the RI General assembly Joint Hearings on Water Related Issues, Report of the Committee on Government Oversight and Environmental and Agriculture, State House, Providence, June 2007.

requiring water of drinking water quality.

Ninety- two percent of the State's resident population is served public water by the 28 major water suppliers and 458 small public systems.[2] The 28 major water suppliers (and the smaller public systems of Richmond and Block Island) provide the majority of this water (98% of this 92% or 116 MGD). The 458 small public systems supply the other two percent(2%) of public water (about 3.0 MGD.) The remaining portion of the population is served by private wells (self supply) and is estimated at eight percent (8%) of the State's resident population. The total amount of persons on private wells varies by each region with the highest percentage (nearly 30%) in the Southern Region. The quantities of water used by small systems and private wells is presently estimated as there is no reporting system to record this type of water use.

Past and current precipitation is very well known; but what happens to the 2.7 billion gallons per day that this adds up to is still not very well articulated. The WR staff, based upon seven USGS watershed basin studies, estimates that total water use state wide is 134 MGD and that 120 MGD of that use is from public suppliers.[3] A new comprehensive statewide water supply analysis of both developed and potential supplies is essential as we begin to look ahead in this next century. The last study of this nature was completed in 1990 by Arthur D. Little for the RI Water Resources Coordinating Council. Many of the assumptions that underpinned that study have not stood the test of time. For example the population has not grown at the rate predicted and the economy has changed. Rhode Island's 2010 population (1,052,567 persons) has shown marginal growth but more importantly the growth has been redistributed within southern and western communities in ways that have changed how, the amounts, and where is used. Likewise the economy is still changing. Further analysis of available water use data, current population trends and compliance with State Guide Polices will be contained in the ongoing strategic efforts of the WR Board.

Groundwater

Long term changes in land and water use in a groundwater basin will change a safe yield in a basin. RI General Law (§ 46-15.7-2) defines safe yield as a sustainable withdrawal that can be continuously supplied from a water source without adverse effects throughout a critical dry period with a one percent (1%) chance of occurrence, or one that is equivalent to the drought of record, whichever is worse. Other safe yield definitions as used in the DEM Streamflow Depletion Methodology (discussed further in Part 3) define groundwater sustainable yield as the sustainable yield of an amount less than the safe yield that can be pumped from a developed wellfield without causing unacceptable stream-flow, wetland, environmental, or water-quality impacts. The overall "safe or "dependable" yields for RI groundwater water set by the Arthur D. Little Study in 1990 was estimated to equal about 150 to 160 MGD. The wellfield yield in RI was estimated by the Study to be 26.6 to 27.6 MGD including the inactive Lonsdale wellfield in Lincoln and the now revoked Pascoag community well located in Burrillville. The Advisory Committee discussed at length the need to standardize the definition for use by all stakeholders in the water supply arena. The Implementation Matrix contains a strategy to so such.

Surface Water

For surface reservoir systems, the safe yield is the maximum quantity of water that can be guaranteed to be available from the reservoir during a critical dry period. A critical dry period is often taken as the lowest natural flow on record for the natural stream. As a result, the American Water

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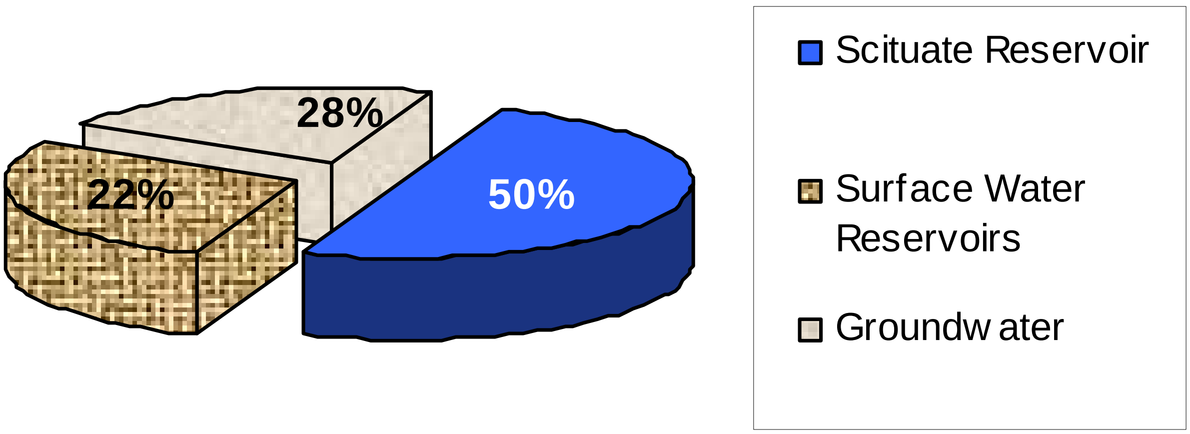
[2] Strategic Planning Workshop, Water Resources Board, June 2, 2010 & Estimated Use of Water in the United States in 2005, USGS Circular 1344, 1344, page 52
[3] Ibid

Works Association says that actual reservoir yield may be less than the reservoir safe yield if a drier period of natural flow, compared to the historic record, occurs. The "safe yield of surface water supplies" can be defined as the amount of water that can be withdrawn continuously on an average daily basis through periods of drought without exhausting the available water supply at adequate quality standards. The estimated safe yield for RI's developed surface reservoirs is 129.1 MGD. In 1990, the Arthur D. Little Study projected the entire safe yield of the State to be within 165.7 MGD. State Guide Plan Element 722 adopted in 1991 refined this figure to be equal to about 150 to 160 MGD depending upon assumptions about droughts of record and reliability. Figure 4 shows the makeup of the 165.7 by supply source.

Figure 4, Rhode Island Developed Water Supply Sources



Existing surface and groundwater supplies are all subject to risk of contamination and catastrophic loss both temporary and permanent. In 2008 the WR Board completed a Statewide Supplemental Water Supplies Feasibility Assessment for major public water supplies throughout the State. The purpose was to identify and evaluate the risks to major water suppliers in the event of a catastrophic failure resulting in the need for a supplemental water supply. The evaluation determined the quantity of water required from the supplemental or alternate water source and identified potential methods for getting the water to where it might be needed. Phase I focused on those systems served by the Providence Water Supply Board. It identified sources and systems capable of augmenting up to 40 MGD in an emergency situation.

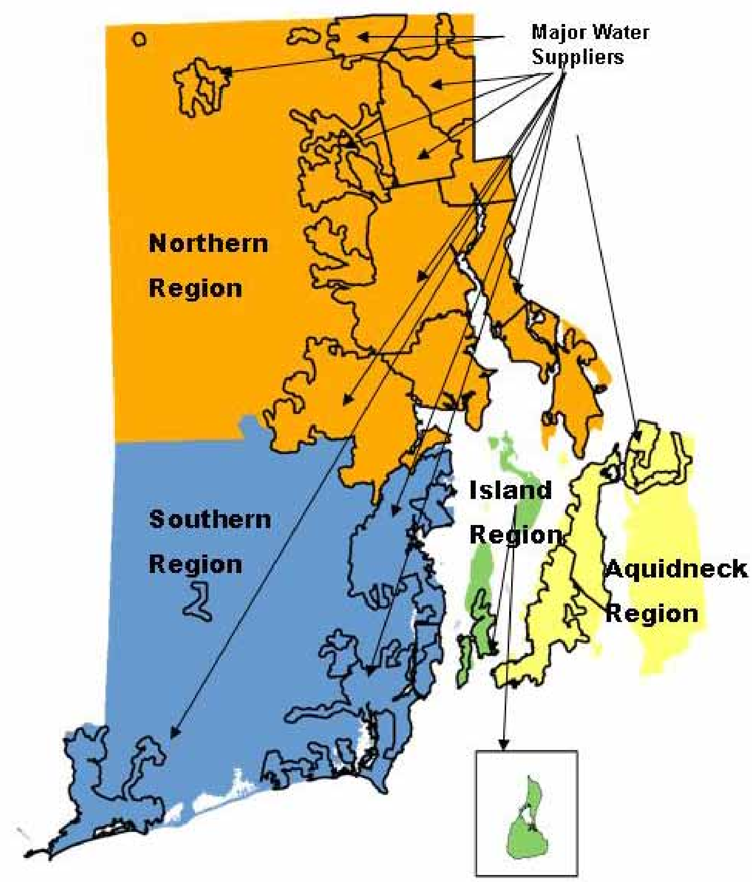
The study also identified a combination of nearby water system interconnections and new or abandoned groundwater sources to sustain emergency water demand for over 600,000 people served within the metropolitan portion of the State in case of failure in the Providence Water Supply Board system. *But it did not find that there was any reliable backup source of supply in existence for Providence.* There is not any existing source of supply that could generate 30 MGD, let alone 40 MGD to serve as such. The Study focused on what might be possible, but did not include the hydraulic and engineering studies to demonstrate what would have to be done to move emergency amounts of water into the Scituate system. Another finding was that the study considered use of contaminated wells out of service. To reuse such wells for supplemental supplies is not supported by the DOH. Most would need to be re-installed as if new and would have to be kept in operating condition which is a very expensive proposition. Phase II of the study examined the State's remaining water supply service areas. In 2005 a risk and needs assessment for residential and commercial/ industrial build-out analyses as well as GIS mapping was completed. Work needs to be done by the WRB staff in terms of determining the engineering feasibility of the recommendations of the study.

What Are We Doing With It?

Presently, Rhode Island on a statewide basis has a reasonably adequate supply situation. The statewide average daily use is equal to about ½ of the maximum statewide daily capacity of the public suppliers[4]. However, just using Statewide averages masks problems: water may not be always available when and where needed. Figure 5 below shows that there is a different picture when looking at the State regionally:

- Northern RI has generally adequate supplies.
- Southern RI is groundwater dependent, and lacks storage capacity therefore water is not always available when and where needed.
- Aquidneck Island has shallow reservoirs with developed watersheds and raw water that is challenging to treat.
- On other Islands, growth is stressing available supplies.

Figure 5, 2010 Water Planning Regions



Small text boxes will appear throughout the text of this Section to correlate key ideas of the text to the strategies of the Implementation Matrix.

EXAMPLE: See Goal IMP-1 Planning Policies 1 &2 8 Strategies

[4] Water Supply for Rhode Island: Today and Tomorrow, Presentation by Juan Mariscal, General Manager, New England Water Works Association, 9/17/2007

Changing Use Patterns

Prior to the 1990's industrial water use accounted for half of the total water used in the State. Industrial water use is down 30% since 1990 while overall water use is up 12%. Residential and commercial now account for 75% of all water used. Climbing summer peak water use is now one of the biggest water use issues due to strain placed on existing water supply infrastructure. Household use averages 58-72 gallons per person each day in winter. In summer, outdoor nonessential water use such as, watering lawns, increases this use an additional 30-50 gallons daily per person.[5] Unlike all other uses, residential water use now doubles or triples in the summer when supply is at it lowest, mostly driven by factors such as residential lawn irrigation. In some areas of the State this is compounded by the influx of summer tourism that uses the same groundwater supplies. This is concerning for economic development for those areas where water is not always available when needed. Locating new large water users after meeting human needs could be problematic in these areas. We need to ensure that adequate and reliable water is available to grow our economy. This summer peak is especially hard for areas supplied by groundwater because of lack of storage for drinking water and use of groundwater wells intercept water that feeds streams and rivers precisely when flows are lowest.

Dependence on the Scituate

Sixty percent of the State's potable water supply comes from the Scituate Reservoir owned by the Providence Water Supply Board (PWSB). The Scituate is the second largest water supply reservoir system in New England. According to the US Army Corps of Engineers, only the Quabbin reservoir system of the Massachusetts (Boston) Water Resources Authority is larger. This is either directly through their retail service area or through a wholesale service to various water suppliers that in turn supply water to various communities. The PWSB is required by RI State Law to provide 150 gallons of water per person per day to 10 communities and one water supplier. According to the PWSB the 150 GPCD figure is inclusive of all water uses expected in a community (residential and nonresidential). Only 3 communities statutorily entitled do not receive water from the reservoir at this time: Burrillville, Foster and Glocester. The current retail service area (where PWSB delivers water directly to users) uses 38.9 MGD and includes portions of North Providence, Cranston, Johnston and all of Providence. In addition, PWSB provides wholesale water to other water utilities that in turn supply potable water to 16 communities.[6]

9 of the State's 28 major suppliers depend upon the Scituate Reservoir

- Warwick Water Department (3,200 MGY*)
- Kent County Water Authority (2,800 MGY)
- East Providence Water Utility Division (1,700 MGY)
- Bristol County Water Authority (987 MGY**)
- Lincoln Water Commission (895 MGY)
- Greenville Water District (408 MGY)
- Smithfield Water Supply Board (346 MGY)
- Johnston Water Department (278 MGY)
- East Smithfield Water District (250 MGY)

**= Million Gallons per Year

16 of 39 communities receive potable water from the Scituate Reservoir:

- Bristol
- Barrington
- Cranston
- Coventry
- East Greenwich
- East Providence
- Johnston
- Lincoln
- North Providence
- Providence
- part of Scituate
- Smithfield
- Warren
- Warwick
- part of West Greenwich
- West Warwick

[5] Ibid
[6] Providence Water Supply Board, Water Supply Systems Management Plan,5 Year Update, April 2010

Appendix A, Major Public Water Suppliers by RI City/Town from Part 1, provides a listing of all 28 major public suppliers by the communities that they serve. The safe yield of 83 MGD is deemed to be the upper limit of potable water that can be generated at the Scituate complex minus the allocation for the treatment process and securing historical downstream releases.[7] The Senate report states that the physical limitations and the safe yield of the reservoir complex are less than the legislatively decreed requirement of 150 GPCD to all towns and jurisdictions. The Report states that it may actually be physically impossible to guarantee water supply to all land areas now covered by the entitlements granted by State Law. The Report highlighted that growing demands from the Scituate Complex are projected to exceed supplies.

Figure 6, Water Consumption versus Safe Yield for the Scituate Reservoir[8]

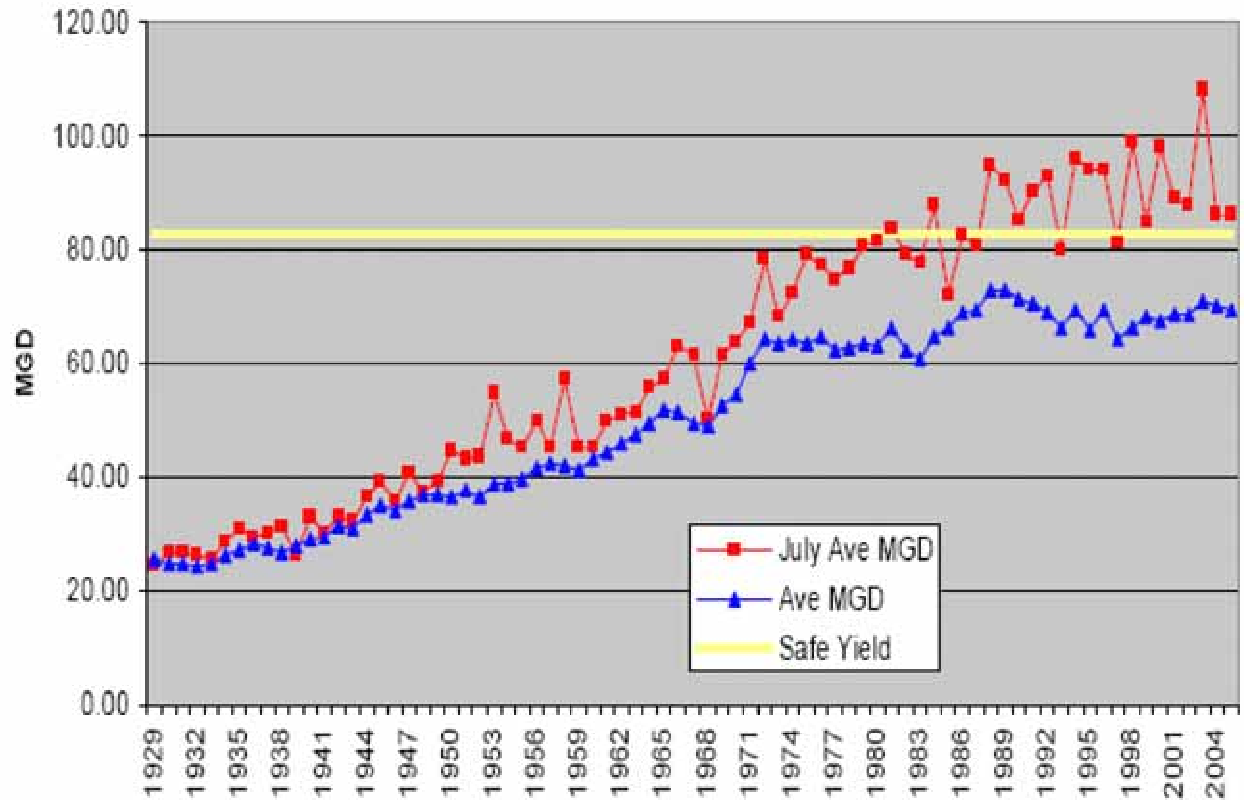


Figure 6, Water Consumption versus Safe Yield for the Scituate Reservoir, shows the growth of the average daily demand on the PWSB system. The Scituate is meeting its demand because of the storage capacity for potable water within the distribution system. However, it is not the answer for all regions and nor was it intended to be the single answer for water supply in the State. It also shows that in the last 12 years only 2 years were below safe yield of the system in summer time. While the internal storage capacity of the system offsets this somewhat, it is not a wise risk for the system to continue. Potable water has a shelf life. It can only be stored for a certain time period in pipes before being used due to quality concerns. Management of the increasing demand needs a structured approach to assure the safe and continued reliability of the system.

See Goal WRM -3
Demand Management Policy 1
Strategies A - J

[7] PWB Supply/Demand Analysis Position Paper DTD 9/28/92, Richard Rafanovic, Chief Engineer
[8] RI Economic Policy Council, 2007, using Providence Water Supply Board data sources.

Land Use & Sprawl

Water quality and quantity are strongly correlated with land use. Land use, transportation and development influence watershed health and water quality, and thus the health of the State's drinking waters. Urban development creates impervious surfaces which can cause water quality and quantity problems, as well as loss of natural habitat. As a general rule, as the intensity and density of land use increase, water quantity and quality concerns also increase.

Land use has changed in the State with major implications for water supplies. The State Land Use Plan, *Land Use 2025,* (State Guide Plan 121) documented that land consumption per person is increasing in suburban and rural communities since 1997. It stated that land consumption and transportation patterns in the State are such that land has been developed at a rate greater than population growth. In addition, the migration of manufacturing, industry, and business away form the urban area has added to the departure from the historic patterns of dense urban centers. This trend is significant to water resources planners because it increases impervious surfaces which can alter the flow and quality of water in the State. The result has been the emergence of storm water pollution, as a primary threat to the health of water resources. Storm water runoff carries a variety of pollutants to rivers, lakes and estuaries. Impacts from existing impervious surfaces and transportation systems remain a significant challenge for the State.

Overall population growth has been slow but population migration and locational shifts are affecting water supplies. The changing land use densities that have occurred in the State have caused more land area to be used to serve the same number of residents. New rural development has been occurring without regard for the availability of potable water and public services. The overall population growth of the State has been fairly minimal since 1997. Figure 7, 2003 -04 Developed & Committed Lands, highlights the sprawl of urban growth into rural areas. All developed

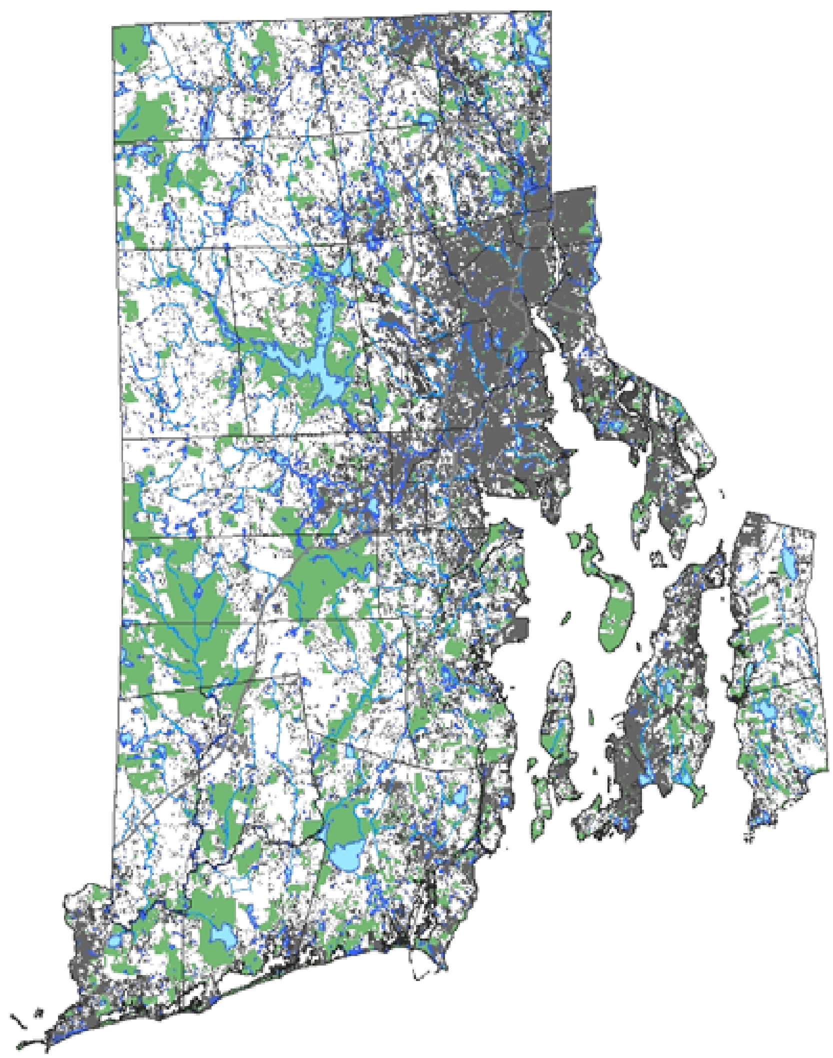


Figure 7, 2003 -04 Developed & Committed Lands

lands are shown in the Figure as gray areas, committed conservation areas as green and undeveloped areas are shown as white.

This type of growth has brought problems related to the delivery of water. Growth affects costs of water infrastructure, demand for water, and efficiency of water delivery. In terms of supply, new or re-development that bears no direct relationship to existing or proposed infrastructure creates problems for the provision of potable water, hinders the protection of potable supplies from degradation, and fails to consider that adequate supplies for future growth will need to come from existing sources as well. The common practice of the extension of distribution systems without consideration of having the quantity of water needed to fill those lines needs to stop. There are areas in the State too remote for economically feasible extensions of water lines and there are areas where sensitive environmental resources would be harmed by extensions of water lines. *Land Use 2025* promotes smart growth, infill development and redevelopment where appropriate in concert with protecting natural resources, including water resources.

The uncontrolled expansion of Rhode Island's developed urban areas into rural areas is the greatest threat to the water resources of the State. Development results in degradation of resources, including the loss of prime agricultural land, forests, shorelines and open space, depletion of wildlife and aquatic habitat, increased susceptibility to aquatic invasive species, and habitat fragmentation. Hydrologic modification and loading of solids, nutrients, pathogens and contaminants such as road salt interrupt natural watershed drainage patterns and degrade water quality. Removal of natural land cover and increasing impervious surface uses change the volume, rate, timing, and duration of stormwater runoff, increasing the total runoff of sediment, and other contaminants. For more detailed discussions of the effects of sprawl on the State see *Rhode Island's State Land Use Plan: Land Use 2025,* State Guide Plan Element 121.

Water suppliers are being challenged to accommodate sprawling watershed development patterns that affect supply quantity and quality. Suppliers must forecast needs that will arise from future growth and invest now in supplies to meet those future needs. Communities face related issues: substantial financial needs for water infrastructure, and concerns about the availability of water. Water policies influence growth decisions and outcomes and in turn affect infrastructure and water resources. The keys to the protection of potable water supplies are to carefully manage land use in accordance with water availability, to encourage land uses with low potential for water quality impacts, to encourage all users to use water efficiently, and to discourage the use of potable water supplies for uses which don't require potable water.

Smart Growth[9]

Municipalities have a powerful affect on water systems and the demand for and cost of potable water. Population and economic growth inevitably create more demand for water. How that growth takes place, how much additional water is needed and how much it will cost to deliver that water are the most common questions municipalities face and need understandable data to answer. How growth is accommodated and managed will affect the quantity of water needed and its cost. The ability for Rhode Island to craft a sustainable water future is closely tied

EPA's 10 Smart Growth Principles

1. Mix land uses.
2. Take advantage of compact building design.
3. Create a range of housing opportunities and choices.
4. Create walkable neighborhoods.
5. Foster distinctive, attractive communities with a strong sense of place.
6. Preserve open space, farmland, natural beauty, and critical environmental areas.
7. Strengthen and direct development towards existing communities.
8. Provide a variety of transportation choices.
9. Make development decisions predictable, fair, and cost effective.
10. Encourage community and stakeholder collaboration in development decisions.

[9] http://www.epa.gov/smartgrowth/

to the ability to maintain the quality and integrity of less-developed lands while planning and managing all land uses intentionally and comprehensively. EPA recommends that communities use more Smart Growth planning techniques, the use of existing infrastructure and investment in current systems maintenance as development practices to reduce costs and make current water resources go further.

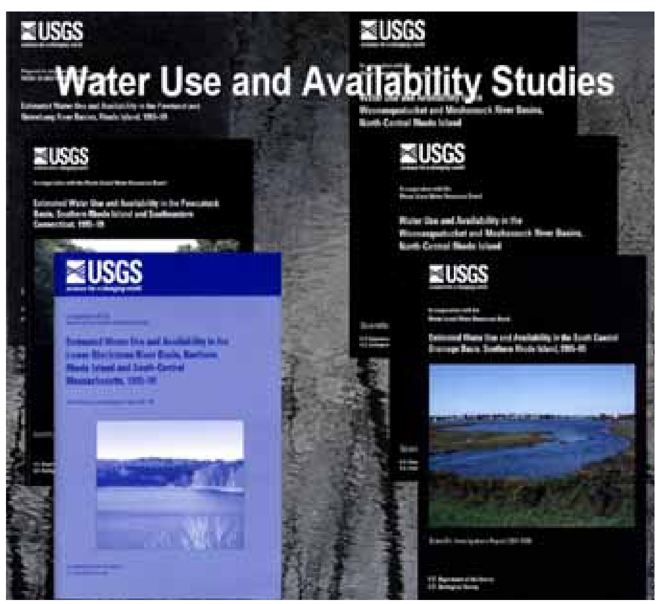
The principles include encouraging compact development and leveraging scarce public funds to improve existing assets, including water systems. Encouraging Rhode Island's municipalities to add Smart Growth Principles within municipal development regulations is an important component to guiding where new water demand will be created and in controlling the impacts of development on watershed functions. Implementation of the principles can also significantly reduce the cost of water provided by communities and the quantity of water needed by new land uses. This water plan will be implemented in coordination with current and future state plans with smart growth principles, such as *Land Use 2025*, that also affect water resources.

RI municipal planners generally understand smart growth principles and have access to many sources of data and information on smart growth. Several communities have already incorporated the principles into their community comprehensive plans. What they do not have at this time is sufficient, understandable information on available water resources to effectively protect their long-term water resource interests. Water resources management must have a sound scientific foundation while recognizing that economic prosperity and environmental quality are interdependent. Improving the information base for water management at the municipal level is critical to supporting current and future uses of water.

See Goal IMP -3
Planning Policies 1 & 2
8 Strategies

Water Availability & Water Budgets

Water sustainability and Smart Growth require knowing the physical water balance of the State. The water budget of the State is much like a bank account but the deposits depend upon precipitation not a paycheck. Good fiscal management requires knowing what is in your bank account -how much was deposited, how much was spent, and how much remains in the account. Your balance is what results from depositing and withdrawing over time. The water balance for the State is the amount of water in the State "water account" – the difference between withdrawals and deposits as a function of time. Using this account requires knowing the quantity of water available over time or what is stored over time in surface water, groundwater, and soil moisture.



Consider the hydrologic cycle, as discussed in Part 1. It includes the inputs of water from precipitation, overland flows, base flows to streams, infiltration to groundwater, and loss of water from evapotransporation, movement of water from aquifers, and withdrawals or use of water by humans and the environment. The Streamflow Depletion Methodology in use by DEM establishes the volume of water that can be extracted from a stream (whether as direct stream withdrawals or indirect groundwater withdrawals) while still leaving sufficient flow to maintain habitat conditions essential to a healthy aquatic ecosystem. Changes in storage can include changes in aquifer storage as reflected in water table elevations or changes in surface water bodies as reflected in reservoirs or streams. When a change occurs in one component of the water budget, the change is offset by a change in another component or components. The State's water balance is still not fully understood.

The WR Board has developed some very complex technical water availability information in conjunction with the University of RI and the USGS. The partnership has completed very detailed water use and availability studies that collect actual and estimated water-use data, track the movement of water, including wastewater, and assess the amount of water available. These studies also contain data regarding wastewater, stream flow, and detailed water use in areas not served by public water suppliers. As a first step the WRB staff have complied this data for the water planning regions of the State. The next step for the WRB staff is to make this information available in understandable formats with decision making templates to enable decision makers at all government levels to wisely manage water resources while understanding and using this information.

See Goal IMP -3
Planning Policies 1 & 2
8 Strategies

Water planning at the State level needs to be detailed enough for communities to match their water use to their available water supply. The WRB staff needs to determine how to improve the current water information for various basins so it can be understood by municipalities. A water portal for available information is needed and technical assistance is needed to help communities better understand the locally available water resources and compare them to anticipated water demands. Data on local water availability, local water use and future water use trends is still needed by communities. Efforts to direct development to areas of water surpluses by the State and communities can help a community balance its water demand with its supplies.

The inherently problematic question *yet to be* answered for Rhode Island is; how can watersheds be divided into more meaningful sub-compartments with clear information for use in management decisions in order to distribute understandable water availability estimates to municipalities?

In water systems a water budget becomes a sort of accounting system used to predict how much water is available in most years for all categories of use (including maintenance of streamflow). Elements that are part of developing a water budget include precipitation, evapotranspiration, surface water flow, ground water flow, withdrawals, out-of-basin transfers, consumptive use, and return flows. In addition consideration must be give to the question of how much water is needed to preserve aquatic habitat (7Q10 - 7-day, 10-year low flow), and how much water should be preserved for future generations. The development of a water budget that includes the above elements requires a detailed understanding of both temporal and spatial variations in the water budget – past, present, and at buildout.

7Q10 - 7-day, 10-year low flow: The discharge at the 10-year recurrence interval taken from a frequency curve of annual values of the lowest mean discharge for 7 consecutive days (the 7-day low flow).

Temporal elements include the complex relationship between the streamflow of record and precipitation record (i.e. how has development shifted the watershed response and how will buildout further affect this?). What are the characteristics of streamflow record? How well defined is the 7Q10 for the period of record? How does the precipitation record for this period compare? Has stormwater changed or will it change in the foreseeable future? What impact, if any, will this have on streamflow? How does water quality vary with streamflow? Will minimum flow standards be required to maintain quality?

Spatial elements include identification of the environmentally sensitive portions of the watershed, major withdrawal and return flow sites, and how baseflow varies between affected segments. What are the ground-water withdrawal sites relative to stream channels and what impact does withdrawal have on streamflow?

A groundwater system serves as both an underground water reservoir and a water-distribution system. The effect of withdrawing ground water from a groundwater source will result in:

- more water entering the ground-water system (increased recharge)
- less water leaving the system (decreased discharge)
- removal of water that was stored in the system
- or some combination of these 3

For most ground-water systems, the change in storage in response to pumping is a transient phenomenon that occurs as the system readjusts to the pumping stress. The relative contributions of changes in storage, changes in recharge, and changes in discharge evolve with time. The initial response to withdrawal of water is changes in storage. If the system can come to a new equilibrium, the changes in storage will stop and inflows will again balance outflows. How much ground water is available for use depends upon how these changes in inflow and outflow affect the surrounding environment and what the public will accept as undesirable effects on the environment such as streamflow depletion and wetlands degradation and loss

The WR Board and DEM are mandated by the 2009 Rhode Island Water Use and Efficiency Act to provide water supply availability estimates for communities. These estimates can be based upon USGS and other studies. They need to be in a form translated from the scientific data produced by the USGS to an understandable format which allows the communities to readily use in their comprehensive plans. The communities then need technical assistance on use of models or more simplified tools from the WRB staff on ways to incorporate the water budgets / availability estimates in their major subdivision and land development regulations for use in ongoing development reviews.

It is important to remember that Rhode Island is one of the most densely populated states with over one million people living on slightly more than 1,000 square miles of land. Many water suppliers are finding it increasingly hard to meet essential public water supply needs for drinking, bathing, cooking, landscaping, and fire protection during annual dry summer periods. The economy of the State is inextricably linked to its resources, water being a critical resource. Thus, the management of Rhode Island's water resources is a priority for future growth and development. It is possible that as climate change potentially dries out other portions of the country, that our water richness will become even more valuable as an economic development advantage. This has been noted for years, but our understanding of the changing hydrology nationally is improving and the possibility, however long-term, is looking more likely. This is all the more reason to appreciate how valuable potable water supplies are to our long-term regional economic viability. A number of obstacles ranging from departmental restructuring from budget cuts, to lowered availability of fiscal resources, to low staffing levels, to work prioritization by the Board itself have hindered efforts to date. The WRB staff is the key technical advisor to assist communities in deciphering the information available to them. The collective interests of the State will be served by actively supporting municipalities in understanding critical water supply issues and supporting the WRB staff in developing assistance which enables the communities to optimally balance development and water resource protection.

See Goal IMP -1
Planning Policies 1 & 2
8 Strategies

What's New to Think About?

Most everyone shares the goals of ensuring clean and safe drinking water for all, protecting the natural environment, and making certain that the State's water infrastructure benefits from sustained investment. Yet the task of providing an adequate supply of clean water in the State is more challenging than ever before.

The introduction to each topic in this Section provides an overview of the issues identified by the Advisory Committee for this Plan. The previous editions of the SGPs were examined to see if they were still relevant. It was found that a number of "old" issues remained the same or had somewhat changed in scope but also that a number of "new" issues would lead the policies on a new courses of action. This Part 2 will also discuss topics that have emerged since the writing of the last plan in 1997. These are maintaining our aging infrastructure and making it sustainable, addressing the challenges of affordability, recognizing small system concerns, providing water for people, economic development and agriculture, ecological and hydrological integrity and climate change. Part 3, Assuring There's Water for Tomorrow, will present goals, policies and strategies to address these issues.

Our Aging Infrastructure & Financial Stability

The infrastructure in Rhode that supplies our potable water has multiple facets. On one hand, as described in Part 1, Rhode Island has some of the oldest water supply infrastructure in the country within our urban core areas. On the other hand many of the water systems outside the urban core were built during the last 60 years to accommodate the spread of suburbanization. None of the more recent systems were constructed with concerns for financial stability. Many of the oldest parts of our systems are at the end of their useful life and need to be replaced. Meanwhile, changes in federal standards require upgrades in plants, technology and new practices that require various forms of investment. In addition, periods of economic distress and changes in service populations have left many water systems struggling to adequately price the cost of water to fully fund the maintenance and replacement of their water infrastructure.

Water Main Leak, Sabin Street, Providence 2010
Source: Providence Journal, 01.12.2010

The traditional 20th century definition of water infrastructure focused mainly on the physical structures associated with drinking water supply. In contrast, sustainable water management policy and planning incorporates these traditional components with the protection and restoration of natural systems, use efficiency, reuse, and the active incorporation of green infrastructure and low impact development to ensure the reliability and resilience of our water resources. This new definition of sustainable water resources includes the traditional man-made components *and* the natural aquatic elements, such as rivers, lakes, streams, groundwater aquifers, floodplains, wetlands, and the watersheds that serve or are affected by water supply activities.

Further, the definition of sustainable water infrastructure should be embraced by all public and private entities involved in water management, and these same entities have a shared role in ensuring that their decisions consider and integrate a set of criteria that include public health, and safety, environmental, economic and social considerations. It is necessary today to ensure sustainable water systems for the State and that state and municipal policies reflect the interplay between the built environment and natural water infrastructure. While this shared leadership role holds the principles in common, the obligations and funding responsibilities of the roles are distinct. Water utilities and their regulators should take the primary responsibility for setting the full cost price for water service that not only includes a sufficient level of expenditure to replace pipes and other capital assets for reliable service, but also improvements which avoid adverse hydrological or environmental impacts on the environment. A watershed-based management approach should be used for drinking water utilities to ensure integrated, sustainable management of water resources.

EPA's Four Pillars of Sustainable Infrastructure

- **Better Management** Better management practices like asset management, environmental management systems, consolidation, and public-private partnerships can offer significant savings for water utilities—both large and small
- **Full-Cost Pricing** A key consideration in constructing, operating, and maintaining infrastructure is ensuring that there are sufficient revenues in place to support the costs of doing business. Sensible pricing can also have the added benefit of encouraging efficient water use.
- **Efficient Water Use** One way to reduce the need for costly infrastructure is to better manage uses of water. There are many options for enhancing water efficiency including metering, water reuse, water-saving appliances, landscaping, and public education.
- **Watershed Approaches to Protection** In addressing infrastructure needs for the purposes of water supply and water quality, it is important to look more broadly at water resources in a coordinated way.

Changing our thinking about water infrastructure can lead to a truly sustainable water infrastructure that provides essential clean water services to future populations, while protecting the natural watersheds on which so much depends. Since water infrastructure includes the rivers, lakes, wetlands and watersheds that serve or are affected by the water system, it follows that maintenance of this natural infrastructure is equally important. This can be called a watershed approach. The watershed approach has been used in formulating this plan. Watersheds may extend beyond state borders; some issues addressed must be from that perspective. This Plan focuses on the potable water aspects of watersheds such as water quantity and quality. Other aspects of watersheds such as river classifications, land use and ecological issues of statewide importance are dealt with in other State Guide Plan elements. State and local governments and other entities should address all sources of pollution, degradation and depletion on a watershed basis. This should be reflected in all actions concerning permits and conditions for water, wastewater and stormwater facilities.

See Goal IMP -2
Planning Policies 1 - 4
26 Strategies

Nationally the American Society of Civil Engineers in 2009 gave the country as a whole a grade of a "D" in its maintenance efforts on water infrastructure. At that time the Society estimated that nationwide $2.2 trillion was needed for repairs and upgrades to our Nation's existing water systems. The 2011 sum of DOH Infrastructure Replacement Plans needed statewide for infrastructure investments is between 8.3 and 8.4 billion. Finding ways to fund projects is a major challenge. The health and well-being of infrastructure is important in creating and sustaining thriving communities. Out water lines lie hidden under the street and play a critical but unrecognized role in our daily lives, until something goes wrong with them.

We need to:

- evaluate old infrastructure against current standards to make sure that good money does not follow bad
- ensure that all investments are performance based
- create a schedule for funding and maintenance and stick to it.
- ensure maximum efficiency from existing supplies and infrastructure before adding new sources.

Our leaders face the challenge of reinvesting in venerable but aging 20th century infrastructure at the same time as they approve new projects necessary to compete in the new economy. It is a basic fact; potable water systems are absolutely necessary and expensive. Political leaders struggle with financing water systems and resist projects with paybacks that take time to materialize, usually well after they leave office. The general public has difficulty connecting the dots that link million dollar projects to future economic gain. Touted benefits for tomorrow may not count for much when the bill comes due today.

The future is precarious if we continue relying on our aging systems. The federal government has no coordinated national infrastructure agenda. Government infrastructure spending has declined since 1960.[10] Towns and Cities compete with each other for economic development. The general public needs constant ongoing education in order to understand how better-maintained, higher-quality infrastructure helps the environment and that repairing and maintaining existing infrastructure keeps communities healthy and competitive.

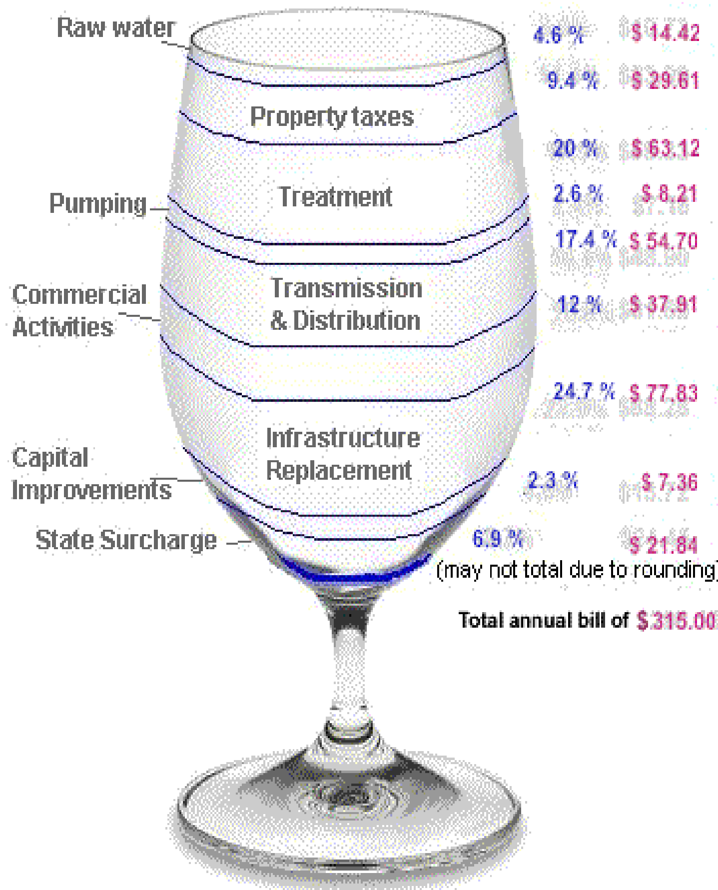
Before needs for additional future growth can be considered, it is imperative that funding be found to replace collapsed pipes, rusted-out storage tanks, and sediment filled reservoirs to satisfy the existing demands that we place on the water systems we have. Further, we need to couple land use decisions with water availability. We need to ensure that land use and water planning are coordinated. We need to look at funding projects that reinforce the smart growth and sustainable land use policies of *Land Use 2025*. And finally we need to encourage suppliers and communities to actively manage efficient water use and ensure that uses match the appropriate water quality needed for those uses.

Water Main Break Pawtucket Avenue, East Providence, 2012
Source: Turn to 10, 01.06.12

[10] *Infrastructure 2008: A Competitive Advantage*, Urban Land Institute, and Ernst & Young, Washington, D.C. ULI, 2008.

The Challenge of Affordability

There are multiple aspects of affordability that water systems need to consider. Many public budgets are in the red from the federal level to the municipal level. Another aspect is that basic essential uses should be provided at a cost that does not exceed all customers' ability to pay. Finally, rates should reflect the total cost of providing water and support the long-term sustainable management of the water system. Balancing affordability issues is difficult. Equitable distribution of environmental, public health and safety outcomes is the one rationale for directing federal and/or state funding to help keep essential water services affordable.



Cost of Providence Water Supply Water in 2009
Source; http://www.provwater.com/pennies_a_day.htm

However, neither community-level nor household-level subsidies should be viewed as a panacea for resolving affordability issues. They should not supplant local assistance efforts or diminish commitments to cost-effective environmental regulations, cost-effective utility operations, and access to essential services in a rising cost environment. Increasing water use efficiency should be factored into uses of water at all income levels. Increased conservation can affect water rates and impact the need and overall costs for supply augmentation. System managers as well as regulators and governing boards should ensure that:

- the price of water fairly reflects the total cost of meeting service and sustainable water infrastructure requirements
- water revenues should not be diverted to unrelated purposes
- all Rhode Islanders have basic access to water for essential purposes
- everyone understands the true value of the resource through educational efforts

The Providence Water Supply Board 2009 case study that follows shows just how little our publically supplied water costs in comparison with other commonly purchased items.

Pennies A Day

by Providence Water Supply Board (PWSB)[11]

Consider the US Penny. Its critics say the penny has become obsolete, and there has been much discussion about taking it entirely out of circulation. The reason for this thinking is simple-there's not much left of any value that you can buy for one cent. Yet, at today's rate, Providence Water customers still receive an astounding value - about 48-ounces of high quality drinking water, delivered right to their faucets, for just one penny!

One reason for the low price of Providence Water is the low costs associated with the treatment of raw water that collects in the Scituate Reservoir system. At the PWSB, emphasis is placed on protecting the reservoir system that collects the water to treat and delivers it to customers. The cleaner the raw water, the lower it costs to treat the water for delivery.

Another reason for low-prices is a businesslike approach to the management of the water system. Since 1990, the PWSB has developed and implemented policies and procedures designed to improve efficiency, minimize costs, and help keep rate increases as low as possible.

It's amazing to realize how much water you get for a $1.00 at Providence Water ... almost 300 gallons!

Consider how much water you could buy for the price of other commonly purchased items[12]:

For the cost of -	you could buy -
a theater ticket	27,500 gallons
a gallon of milk	1,040 gallons
a candy bar	225 gallons
a large coffee	675 gallons
a movie on DVD	5,200 gallons
a large pizza	4,150 gallons

Making improvements to the aging water system is important. Just as critical is the need to prevent loss of water service to customers during emergencies or transmission system failures.

PWSB sees it as important that to take the steps to build for the future like our forefathers did in 1925. With regard to infrastructure replacement and the development of new sources of water, it is not wise to be pennywise and pound foolish. The continued collection, treatment and delivery of a healthy and reliable water supply to customers are an important priority in the 21st century.

According to the EPA, Rhode Islanders spend, on average $345 per year for potable water, in contrast to an average of $707 per year spent on carbonated soft drinks and other noncarbonated beverages.

[11] http://www.provwater.com/pennies_a_day.htm
[12] Based upon 2009 PWSB water rates

Small Systems

As described in Part 1, EPA classifies water systems by size. Small water systems face different challenges from large systems that require separate attention in devising infrastructure policy. Of the 490 community water suppliers in RI, 464 are small systems (i.e., serving fewer than 1,000 customer connections). About 1/2 of these small systems are privately owned, serving fewer than 100 connections and operated by part-time employees.

In addition to extreme differences in the types of organizations involved, there are also great differences in the nature of infrastructure issues involved. About 1/2 of all small systems are in rural communities and about 1/2 are in suburban communities built to serve either small clusters of homes or small businesses. Few have employees dedicated to the provision of water. Part 1 identified that 56% of all regulated water systems in Rhode Island are food establishments. Many small systems were often built when an area experienced an economic boom phase. Replacement needs vary and tend to be temporally concentrated. Unexpected adversities (e.g., well contamination, loss of a large customer, etc.) pose the greatest threats to the operation and affordability of small systems due to their limited ability to absorb large financial shocks. Access to capital is an issue for many of these small systems.

Small community water systems lack resources to:

- adapt to a changing regulatory environment or pay for cost of upgrades
- retain qualified operators
- access capital to fix problems
- set up depreciation accounts for replacement of machinery and components
- pay fines and penalties
- secure grants and loans for improvements, because they lack resources and in-house expertise to apply for these options
- determine best project alternatives even if they are able to secure financial resources
- afford or pay for long-term operation and maintenance needs

Many small systems have limited capacity to plan ahead and take advantage of available options. They do not have the tools that larger municipal systems have to protect wellhead areas and many do no long-term financial planning for infrastructure replacement. Most are concerned with day-to-day operations and short-term survival. Loan programs such as the State Revolving Fund (SRF) and the USDA Rural Development Administration loan program have evolved to provide assistance to such systems. The DOH is responsible for overseeing the technical, managerial, and operational capacity of all water systems in the State and administers the RI SRF. Enhancement of these existing programs should be encouraged.

Another related issue is using multiple private wells to avoid the DOH requirements for small systems. The DOH has begun the registration of water quality in private wells to ensure that potable water is provided but nothing prohibits their use in lieu of requiring small community wells. Some developers have installed multiple private wells rather than meeting the requirement for small community public supplies. Protection of the public health needs to ensure stronger regulations are adopted by the DOH which will not allow this to reoccur.

See Goal IMP -3
Planning Policy 2
Strategy C

Economic Development

Our water rates compared to our neighboring states show that RI has relatively lower rates. This is an economic advantage for our State.

Few resources are as intimately tied to the growth, development, economic and environmental well being of RI as water. Few present so many planning challenges. It is impossible to discuss policy for sustainable potable water resources without considering economic development and agricultural needs. A community, its people, its industry, farms and businesses cannot exist without an adequate water supply. Water availability should dictate what can and should happen in a particular location. This may seem self-evident to those who work with water on a day-to-day basis but it sometimes seems lost on many planners and developers. Development, industry, agriculture, and economic expansion are already constrained by water and sewerage limitations in some places of the State.

Unlike energy, one cannot generate more water. We get what we get from precipitation. Streams and rivers have a finite amount in their boundaries and a finite capacity to assimilate pollution. Significant economic and social benefits are derived from appropriately planning for all water resource needs. Proper planning will ensure water will be available for businesses. Many of the benefits of ensuring sustainable water supplies are not easily quantifiable, but the benefits of protecting public health, and maintaining RI's quality of life, and its unique natural and cultural environments, must not be ignored. Planning for water resource needs should occur before a "crisis" situation and is the best way to implement efficient and effective programs to ensure a safe and reliable water supply for RI businesses and citizens.

Economic development occurs with the expansion of the economic base of a community, region, state, or nation through the efficient allocation and use of available resources. In general, economic development is any activity that results in additional jobs and income. Economic development suggests an improvement in the quality of life for a community. Water is the basis for much economic development and industry, transportation, and energy production. It is also fundamental to agriculture, forestry, recreation, and the environment. Water has influenced where people live, as evidenced by the historical location of our many cities and towns along or near sources of water. Water resources are a vital and underlying component of economic development efforts. At any level, there are five options for economic development:

- improving the ability to capture existing income
- improving the efficiency of existing firms
- encouraging new business
- attracting new industry or businesses, and
- increasing financial aid received from other government levels.

Communities seek to keep money spent on goods and services within the community and prevent "leakage" of income. Water resources, especially recreational ones, can keep income in a community and attract spending from those outside the area. Existing firms seeking to expand the creation of new jobs and additional income will rely on the knowledge of water availability in their decision making processes. New businesses and industry often are attracted to a community when water supply and quality are high. Finally, spending on water projects can provide employment and income opportunities for municipalities.

Not only is our drinking water of excellent quality but it is also an exceptional good value. Our water rates compared to our neighboring states (Massachusetts [MA] and Connecticut [CT]) still show that RI has relatively lower rates.[13] Further details on RI water rates are included in Part 3.

- In Ma average annual water costs ranged in 2009 from a low of $113 per household to a high of $1,962. The 2009 average was $426 per household.
  - In MA 39% of suppliers use a flat rate, 59% use an inclining rate structure, and only 2% use a declining rate structure.
- In CT average annual water costs ranged in 2009 from a low of $146 per household to a high of $590. The 2009 average was $355 per household.
  - In CT 69% of suppliers use a flat rate, 25% use a declining rate structure, and only 6% use an inclining rate structure.

As RI continues to change how it uses its public water, strategic planning by the WR Board needs to continue to address water resources availability for human use and economic growth at multiple levels; statewide, regionally, and for all 39 municipalities. Difficult decisions will have to be made about where to and when not to develop, in order to protect and maintain the availability of potable water. State agencies and municipalities need to consider water resource availability when locating major land developments and planning for future growth that is consistent with *Land Use 2025*. Developers need to resist investing capital into a project before realizing at a late stage that there is not enough water to support the proposed development. Municipalities need technical assistance to better understand how to consider water resource availability when developing their comprehensive plan particular to the amount and type of water resources available to them.

See Goal WRM -1 Potable Supply Policy Strategies A - E

Environmental Working Group

For the last 2 years, (2009 & 2010), the Providence Water Supply Board Water was rated as the 2nd best tasting water in the country in a study conducted by the national environmental organization known as the Environmental Working Group. Arlington, Texas was rated #1 both years and the water from the City of Boston placed #5 in the study. The EWG rated big city (population over 250,000) water utilities from 45 states based on 3 factors:

- the total # of chemicals detected since 2004
- the % of chemicals found of those tested
- the highest average level for an individual pollutant, relative to legal limits or national average amounts, including for the most common pollutants (disinfection byproducts, nitrate and arsenic).

Agriculture

As the number of RI farms increases, the agricultural need for water will increase. This is following national and regional trends. The number of farms in the US since World War II has been increasing. In New England, the number of farms increased from 28,254 to 33,112 and land in farms increased from 3,996,503 acres to 4,044,104 acres. However, the average farm size decreased from 142 acres to 122 acres. Since WWII, Rhode Island as a whole saw an increase, the highest in New England and the U.S., in the number of farms and total land in agricultural use.[14]

Agricultural producers are defined in RI by the General Law 46-15.3-4(2). Nationally, RI ranked 3rd in direct marketing sales on a per farm basis. Direct market sales totaled $6.292 million, up from $3.697 million in 2002 and agritourism income totaled $689,000 on 43 farms, up from $23,000 and 6 farms in 2002. The total value of farmland and buildings in the State was over $1.1 billion. This averages out to a little over $16,000 per acre - the highest value in the nation. RI agriculture is growing and water use will too.

What agriculture produces is driven by consumer demand, and changes in consumer preferences have an influence on the water needed for food and other crop production. Agricultural crops are so dependent on water, purposely adding water, beyond what naturally falls as rain is widely practiced to increase production. This critical practice is known as irrigation. In the areas that depend on groundwater, conflicts may occur when farms need water for irrigation from natural systems at the same time that the residential demand peaks for water from the same natural systems. Agriculture faces a problem that few industries do. Farmers need water most when it is least available. Among the factors that drive water demand for agriculture is the growing competition for water from environmental and urban interests. Another factor is climate change, which may affect stream flow patterns during summer, the period of highest agricultural water demand. Investing in irrigation development provides insurance against erratic rainfall and stabilizes agricultural output, boosting crop productivity and allowing farmers to diversify. The availability of sufficient amounts of water of good quality is fundamental for primary and secondary production functions. For vegetative growth and development, plants require water in adequate quantity and at the right time. Crops have very specific water requirements, and these vary depending on local site conditions. Irrigation is not a practice that farmers take very lightly- it is an expensive practice that they use out of necessity. Few farmers use potable water supplies; most are self-supplied and rely on their "own" sources such as groundwater wells, stream withdrawals or farm ponds. Since the hydrologic cycle links all water resources, private use by agriculture can indirectly affect potable water.

**See Goal WRM -1
Quantity Policy 2
Strategy C**

[13] *2009 Connecticut Water Rate Survey* & *2009 Massachusetts Water Rate Survey,* Tighe & Bond, 457 main Street, Danbury, CT www.rates.tighebond.com

[14] http://www.dem.ri.gov/programs/bnatres/agricult/pdf/riprofile07.pdf

Withdrawals of water from ecosystems have intensified with urban sprawl and the expansion of agriculture. Pressure is increasing to export and transfer water from rurally located watersheds to other parts of the State for urban uses. Agriculture is often seen as a competing user for supplying rural water to urban uses. There is an urgent need, therefore, to reconcile water demands for people, business, for maintaining ecosystem functions and water for producing agricultural products. Water-saving technologies are available and can significantly reduce the use of water in irrigation. Efficient irrigation systems and water management practices can help maintain farm profitability. Improved water management practices may also reduce the impact of irrigated production on offsite water quantity and quality, and conserve water for growing nonagricultural demands. The Division of Agriculture (DAG) of DEM has the authority from RI General Law to plan for the responsible use of water by the Rhode Island agricultural community.

In general, DAG monitors stream flow at the USGS gauging stations. Stream flows are evaluated in relation to selected flow levels indicative of low flow or drought conditions, as well as in relation to rainfall and groundwater levels. DAG provides written information on stream flow and precipitation levels on a regular basis to farmers and stakeholders. DAG in coordination with the USDA continues to plan to reduce the potential vulnerability of farmers to drought conditions, including planning for water supply and use management by farmers of adequate water supplies, improvements to pumping and irrigation conveyance systems, and emergency response planning. The DAG Drought Plan is included as Appendix B.

Improvements in irrigation can also help maintain the long-term viability of the agricultural economy. Water savings at the farm level can help offset the effect of rising water costs and limited water supplies on producer income. Improved water management may also reduce expenditures for energy, chemicals, and labor, while enhancing revenues through higher crop yields and improved crop quality. Strategic irrigation may also enable producers to better withstand risks of drought. The US Department of Agriculture (USDA) identifies improvements in irrigation management as essential to meeting its national priorities for reducing agriculturally induced nonpoint-source pollution, including surface and groundwater contamination, reductions in soil erosion and sedimentation, and conservation of ground and surface water. According to the USDA[15] significant potential still exists for expanding agricultural water conservation. Federal and State cost-share programs that address farm water delivery, field-level irrigation systems, and farm water management practices are key to improving irrigation efficiency.

[15] U.S. Department of Agriculture (2001) *Irrigation and Water Use Briefing Room*, Econ. Res. Serv.

Ecological and Hydrological Integrity

Water sustains life. We need it every day, but we also need to ensure it is also available to support the environment we depend upon now and for future generations. Our historical concept of water management has been providing adequate supplies to sustain a growing human population and industrial needs without consideration of impacts to the environment. One of the luxuries of our society is that we have a choice of where we want to live. Generally, a greater number of Rhode Islanders are choosing to live in communities located in the southern and western areas of the State which are primarily dependent upon on groundwater. Since this growth pattern seems to be continuing, there will have to be a sustainable approach to water use. RI communities that do not plan for the sustainable management of their land use and its impacts on water resources won't have an adequate supply of water to support domestic, industrial, hydropower, and agricultural needs. They will not grow and prosper without water. What we need to be is practical about how growth happens in the future.

See Goal WRM -1
Resource Assessment Policy 1
Strategy F

Rhode Island enjoys access to high quality freshwater resources that for most of the year provide sufficient quantity to support natural systems and meet human needs. Streamflow is the flow of water in streams, rivers, and other channels, and is a major element of the water cycle. Water flowing in channels comes from surface runoff from adjacent hillsides, from groundwater flow out of the ground, and from water discharged from pipes. Stream flow is integral to the ecology of rivers and streams. High and low flows are needed to support hydroelectric generation, healthy river ecologies and good quality potable water. Stream flow is primarily affected by rainfall and runoff along with water recharged from groundwater. In Rhode Island, groundwater and surface water are closely linked and in many cases there is a 1:1 relationship between groundwater withdrawals and reductions in stream flow.[16]

The amount of water that exists in rivers, streams, public supply reservoirs and groundwater varies over time, and with climate and water use patterns. The amount that can be directly drawn or intercepted for human use while supporting the environment can also vary, particularly for groundwater withdrawals and direct stream withdrawals. How water is used and land-use patterns and characteristics affect the reliability of freshwater supplies. As *Land Use 2025* identified, sprawling development patterns have increased populations in the southern and central regions of the State. This population shift, also supported by expansions to the Scituate Reservoir wholesale distribution system , has led to decreased demand and creation of excess capacity in other urban reservoir systems such a the Pawtucket System. Additionally, land development can reduce the available water supply as well as the water quality through impervious surface expansion. In 2003, the Water Resources Board's Water Allocation Program Advisory Committee estimated that the development of 96,000 acres in RI between 1961 and 1995 reduced the available clean water supply by somewhere between 10 and 23 billion gallons a year – enough to serve 250,000 - 600,000 residents.

Rivers and streams depend on ground water to sustain flows during rain and snowmelt-free time periods. Rivers also interact with ground water systems by storing flood flows in riparian aquifer systems that eventually find their way back to the surface water system. Both of these mechanisms are important for supplying the water resources necessary for sustaining ecosystems and society. These mechanisms also alter water quality conditions in aquifers and streams on short and long time scales. Stream flow is naturally low in our dry summer months when rainfall is quickly absorbed by trees and vegetation. During these same months, our demand for water is highest (the peak

[16] Streamflow Depletion Methodology, RI Department of Environmental Resources of Water Resources, DRAFT, May 13, 2010

demand). The agricultural demand is at its peak while in suburban areas residential outdoor water use can double or triple wintertime water use. In some regions of the State, some rivers are showing signs of summertime low flow stress linked to groundwater and direct surface water withdrawals.

This paradox has arisen most noticeably in the Hunt-Annaquatucket-Petaquamscutt (HAP) aquifer system that is located within 3 communities and supplies 3 large public suppliers and some self-supplied users. The withdrawals for the Town of North Kingstown, Kent County Water Authority and the Quonset Development Corporation have resulted in depleted surface water in the Hunt River. In 2005 (see Figure 8, Streamflow in the Hunt River graph below and also the Department of Environmental Management - Streamflow Depletion Methodology Section) the River was observed during the annual seasonal dry period as barely flowing across existing impoundments and in some river reaches extensive areas of riverbank are exposed..[17] DEM Fish and Wildlife fish studies have shown a shift in cold water river fish species to warm water pond fish species due to low flows during the summer months.

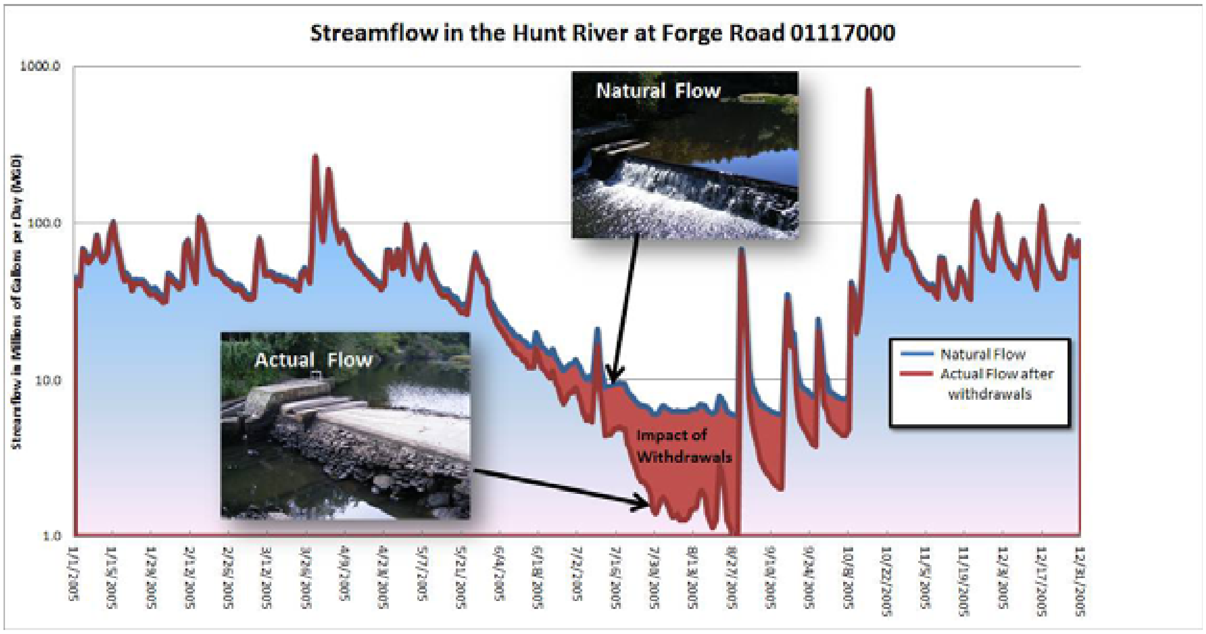


Figure 8, Streamflow in the Hunt River

Sustainable management of water resources requires that scientists, planners, and water managers be aware of the status and trends in the availability of water resources and the linkages to potable supplies. The general public also has a stake in understanding the changing conditions of water availability, especially in the south/western portion of the State where almost all of the water used comes from groundwater and most of the water used by agriculture comes directly from ponds or streams dependent on the same groundwater. The water resources become compromised during very dry periods because of direct stream withdrawals that often coincide with groundwater withdrawals that intercept water that would have discharged into the streams. It helps if we picture our reservoirs like bank accounts with a fixed limit of holdings. The majority of deposits to the bank accounts (reservoirs) are in the winter and spring. We have large reservoirs like the Scituate and Pawtucket and that bank a lot of water that can be used in the summer. If the deposits or rains are less in a particular summer, it is ok because there is enough reserve to cover the withdrawal. However, even though groundwater reservoirs are large too, the useable reserve or storage is less because it can not be drawn down as much as a surface water reservoir. Groundwater is intricately

[17] Comment: Some dam leakage existed at that time but the stream flow was still till low to overtop the dam as in average flow time periods.

linked with associated rivers and streams and drawing the reservoir down even 6 inches can dry a stream. Large withdrawals from public supplies and agriculture often extract more in the summer months than what is deposited during those summer months and so the draw downs begin to lower the streams and change the habitat and fish communities. If the reservoir is full again the next winter, but we have changed the habitats and fish composition in the stream because of a few short weeks of severe stress, is that sustainable?

Are we justified in applying the term sustainable to drinking water resources and our natural water resources? Are our water supplies truly sustainable? Is there a difference between economic and resource sustainability of water supplies? These are questions most planners need help to address. Some utility managers have developed programs that promote water efficiency. Sustainability means different things to different people from different points of view. The supply in the long term needs to be reliable as well. While these programs may be a step in the right direction, do they answer these important questions? How is water sustainability defined? What are current techniques for implementing sustainability? How is sustainability to be validated or measured? Where are future sources of water? How much water is actually available? What are the effects of human consumption on future sources and sustainability? Discussions of water sustainability offer the most promise when they take place with an understanding of major driving forces like populations, income, land use, climate change, and energy use.

See Goal WRM -1
Resource Assessment Policy 1
Strategy A.1

Incorporating the pillars of sustainability from EPA is an ongoing process that will continue to be developed in various state agency strategic work programs, rules and regulations. Rhode Island still needs a comprehensive water resource management system that will speed integration of freshwater resource protection and available water supply considerations into use by State programs, water suppliers, agricultural users, and municipal governments. A comprehensive system is needed that is sustainable to meet today's needs without compromising the ability of future generations to meet their own needs. A sustainable system provides for the economy and the ecosystem with equity. Over the past few decades, questions have been raised about how sustainable our ecosystems and water, land, and other resources are, given current land management practices and expected future changes. Our water resources are finite and now require managing for sustainability—management that may be different than what has been practiced during early years of our State's history. In RI, there are 2 primary state agencies with regulatory authority over the availability of water resources that impact stream flow. These are the DEM and the WR Board.

See Goal WRM -1
Quantity Policy 2
Strategies A - C

Department of Environmental Management - Streamflow Depletion Methodology

Protecting aquatic habitat is an ongoing and very challenging endeavor. The DEM Office of Water Resources is responsible for protecting the ecological health of our State's waters and public health. DEM regulates water withdrawals through the federal Clean Water Act, the State's Water Quality and Freshwater Wetlands Regulations. An ongoing issue for this task is obtaining critical pieces of information that are needed to evaluate water withdrawal proposals on water resources. The total amount of water currently being withdrawn the State's surface waters and groundwater is still not known with certainty. Some information is available with respect to baseline river flows and the amount of water that can be withdrawn from specific aquifers without affecting aquatic habitats. Although multiple agencies (WR Board, DEM, BRWCT, and PWSB) share in funding the current network along with the USGS, the State continues to struggle to adequately fund a comprehensive network of stream gauges.

Currently the DEM is working on a methodology that represents an essential step forward in how RI will define it ecological needs for water resources and how it will manage the needs of these water resources. When completed it will add to the effective planning and better management of water supplies this Plan promotes as a way to avoid the need for costly infrastructure improvements while balancing human uses with ecological health. The stream flow depletion methodology (SDM) will establish the volume of water that can be extracted from a stream (whether as direct stream withdrawals or indirect withdrawals) while still leaving sufficient flow to maintain habitat conditions essential to a healthy aquatic ecosystem. The implications of maintaining viable habitat is shown in the photos below of the Hunt River. Low flows caused by manmade alterations (in extremely dry summer stresses the juvenile river fish and can wipe out an entire year class). Typically, river fish can overcome this stress by reproducing year after year, maintaining a viable fishery. However, if rivers are mechanically lowered due to manmade withdrawals and other alterations to the point that the fish are experiencing this stress every year, entire species can be extirpated from the habitat. This process changes the characteristics of the river's ecosystem and fish community and thus types and diversity of habitats available. The SDM is intended to be protective of RI's river and stream ecosystems by specifying a sustainable depletion (withdrawal amount) so that ecological needs can be met both today and in the future. The methodology recognizes and seeks to maintain natural variations of streamflow and considers ecological sensitivity of each resource. It also incorporates the concept of balancing human and ecological needs for water by differentiating the degree of allowable depletions according to watershed characteristics and current human influences. More specifically, the methodology considers existing water withdrawals for public supplies, agriculture, golf courses, existing impervious cover, future development potential, existing and future land conservation areas, water quality and coldwater fisheries. When determining, the amount of water that can be sustainably withdrawn, consideration has been given to return flows, existing uses, investments in water supply sources, and the need to protect sensitive resources such as coldwater fisheries. This method is presumptive (founded on probability) and leaves room for site-specific studies to specify a more precise withdrawal amount.

See Goal WRM -1
Quantity Policy 2
Strategies D - F

Average Flow: Hunt River
DEM Image 2005

Low Flow: Hunt River
DEM Image 2005

The streamflow depletion methodology is currently available from DEM and is being used as a tool for new or increased water diversions. It may be also used in conjunction with the Water Resources Board water availability / allocation process (described below) for new and existing water withdrawals. DEM is charged with protecting the environment. The WR Board is charged with allocating water amongst all users including the environment.

Adoption of the Stream Flow Methodology by the DEM does not change RI's long established practice of "home rule" regarding development. Most development decisions in RI are made by municipal boards and commissions. Planning Boards and Town Councils for example, generally determine the type and extent to which specific parcels of land may be developed. It is important to take note however that one of the most pervasive factors altering natural stream flow patterns in RI is new urban development and the associated impact of increased impervious surfaces on groundwater recharge and storm water runoff rates. High density, traditional development without appropriate stormwater design results in rapid storm water runoff that can result in flooding and erosion of stream habitat downstream. Extensive impervious surfaces also inhibit the natural recharge of groundwater that provides critical base flow for these same streams during dry periods. Storm water runoff also can cause water quality problems by washing pollutants into the stream along with the storm water, further stressing aquatic life. However the use of low impact development (LID) techniques can mitigate the impact of storm water runoff and reduce the impact of development. The use of thoughtful site design and alternative techniques to infiltrate storm water back into the ground on site can reduce the flashy runoff that occurs with traditional practices. Additional information on Low Impact Development and stormwater requirements will be discussed in Part 3.

Water Resources Board - Water Allocation

On the same front, regulating the allocation of water is another ongoing and very challenging endeavor also underway by the WRB staff. The waters of RI are owned by the public with the State acting as a trustee[18]. Under RI General Law, The WR Board has the authority to adopt a methodology that balances the needs of humans to use water for drinking, washing, fire protection, and manufacturing, which also depend on the availability of water to sustain healthy, natural communities. Since the last Plan's adoption in 1997, the WR Board has completed numerous watershed studies and hydrologic modeling efforts in partnership with the USGS. The Arthur D. Little Study that the 1997 plan was based upon provided preliminary baseline data for categories of water withdrawal and water use by sector for the 29 largest suppliers. The WR Board has continued the partnership with USGS and the University of Rhode Island to complete water use data, track the movement of water and assess the amount of water available to augment the Arthur D. Little Study. These studies provide valuable scientific data regarding wastewater, stream flow, and detailed water use in areas not served by public water suppliers. The next step is to translate these studies into usable information for standards which can be incorporated into municipal development regulations. As discussed previously, municipal development regulations are an important component to guiding where new water demand will be created and in controlling the impacts of development on watershed functions. Municipalities do not have sufficient capacity to understand how to use USGS information in their planning efforts at this time to efficiently protect their long-term water resource interests.

In 2002, the WR Board led a water allocation effort assisted by an ad hoc committee, the Water Allocation Program Advisory Committee (WAPAC). During its 18-month existence the WAPAC relied on the participation of approximately 150 or more persons representing numerous public agencies, water suppliers, affected users, community interest groups, academics, environmental organizations, businesses and the general public. The goal of this effort was to define issues and options associated with the development of a water allocation program for the Board. Nine subcommittees submitted reports that were presented to the Water Resources Board for action. Many of the recommendations of those reports and the subsequent Implementation Team have been incorporated into the foundation of this Plan. Many of the recommendations were also the foundation for the development of the implementation strategies in Part 3 of this Plan by the Advisory Committee.

The WR Board has developed a water allocation program. The WR Board and staff recently completed Phase I. This Phase consists of adopting a Water Use and Efficiency Rule that sets a target of a maximum of 65 gallons per captia per day (GPCD) for residential water use for major suppliers and statewide lawn watering guidelines. The Rule is intended to meet statutory requirements for the WR Board set by the RI Water Use and Efficiency Act (described further below). The purpose of the Rule is to establish targets and methods for efficient water use for major public water suppliers. The Rules sets forth the requirements for increasing water efficiency through demand management strategies along with reporting requirements for the suppliers. The suppliers will use the existing WSSMP process to carry out an implementation schedule to meet the targets of the Rule. Suppliers will be required to report annually on the progress in achieving these goals.

See Goal WRM -1
Quantity Policy 2
Strategy B

[18] Preliminary Findings of the Subcommittee on Water Rights and Regulatory Authorities, Water Resources Board Implementation team , Water Management System Program, December 2003

Efficient Water Use

Rhode Island has a comparably low average per capita water consumption rate, 58-72 gpcd,[19] compared to the rest of the country at 101 gpcd. The Southwest of the USA water use averages around 230 gpcd, in other countries such as Canada; it is 86 gpcd and only 39 gpcd in France.[20] But as population increases so does water demand. As a result water managers have to find ways to ensure that there is enough water to facilitate growth. Traditionally we turned to seeking out new sources of water or supply augmentation for growth areas. Because of decreased opportunities for establishing new sources, and accompanying higher regulatory standards and costs for new sources, water managers need to implement nontraditional supply augmentation strategies such as using water efficient technologies and adapting best water management practices to reduce demand.

Water use efficiency (sometimes called water conservation) includes anything that prevents and reduces unnecessary, wasteful, uneconomical, or impractical use of potable drinking water resources. Rhode Island has had state policy on water use efficiency and conservation of the resource since the adoption of the first water State Guide Plan in 1969. This long standing policy, is a historically over looked policy. In the current fiscal environment it is important to find ways to more efficiently use our available supplies and to substitute non-potable water for uses that do not require drinking water in order to forestall having to pay to build supply alternatives. To do such will entail both the implementation of demand management and water system management practices and programs. Demand management programs, including conservation by the end user, require active involvement by the user as well as the water supplier. Water system management to minimize infrastructure system water loss requires active participation primarily by the water supplier.

Source: Matlette, 2002

See Goal WRM -3
Demand Management Policy 1
Strategies A - J

[19] Gpcd =gallons per capita per day
[20] *Water Sustainability,* Water Efficiency, March / April 2011

Demand Management

Water supply and demand are important factors in growth and development of Rhode Island's 39 cities and towns. More effective management of demand can ensure that our water systems are more sustainable and protect future water supplies for the growing needs of the State. Additional efforts are needed by the major water suppliers and the WR Board. These efforts should address: developing statewide leak detection, reuse and recycling of water and wastewater, water conservation public education, and revision of the major user and residential use technical assistance programs.

Demand management programs are intended to reduce the total amount of water used by eliminating inefficient uses.. Plumbing codes govern the design and flow rates of faucets, showerheads, toilets, urinals, irrigation systems and other plumbing fixtures. There is no data regarding the number of toilets in the State that still do not meet the current building code standard (i.e. 1.6 gallons per flush) adopted in the 1990s. New high-efficiency-flush toilets (less than 1.28 gallons per flush, 20% less than the current standard) are now becoming available on the market and are now required by at least one state (California) based on recent state legislation and building code changes. As part of EPA's national WaterSense program, new, high-quality, water-efficient products are being defined and labeled similar to the EPA EnergyStar Program. Water usage habits of retail customers are typically addressed through public education and awareness campaigns by suppliers.

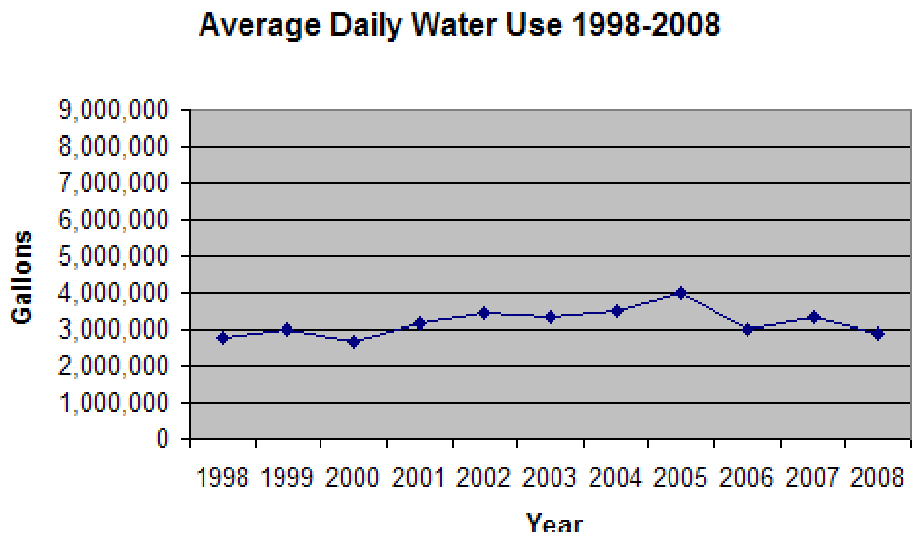
As discussed previously, the most critical water usage period is the summer dry months when some RI water systems more than double the average annual use creating the peak seasonal demand. This considerable increase in use is attributable to growing popularity of outdoor residential water usage in suburban areas. A few areas of the State experience an influx of tourism which can exacerbate the peak demand as well. During the declining summer, precipitation and water availability decrease in most of our watersheds. In groundwater dependant systems, river flows can drop significantly when rainfall does not keep up with water use as groundwater withdrawals increase significantly. Even where there is storage, summer demand can still tax supply capacities. Since the mid-1980's, summer water use from the Scituate Reservoir has frequently exceeded its safe yield while on an annual average basis water usage has not increased significantly since the 1980's.

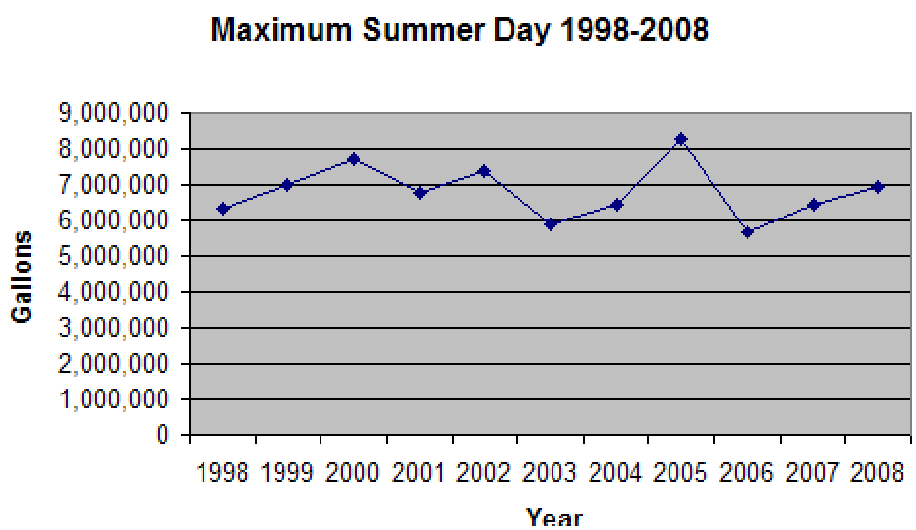
Annual Seasonal Dry Periods

Short-term dry periods occur every year as seasonal events. They involve a spring, summer and maybe fall of decreasing rainfall. These short-term dry periods or annual seasonal dry periods are characterized by extremely dry and hot weather, but they do not extend from one year to the next. They do occur almost every year. ***They are not to be considered droughts.*** They should be considered in ongoing demand management planning by water suppliers. Annual seasonal dry periods in Rhode Island usually commence just after the spring green-up period, reaching their greatest intensity during the mid-summer and early fall (July-August-September). They occur when seasonal peaks demands for water are at the highest for suppliers.

The earlier example of an unusually dry summer in 2005 that resulted in record high water use and record low flows in the Hunt River in North Kingstown most eloquently illustrates this problem. During this summer between 3.5 and 5 million gallons of potable water was used outdoors, primarily for lawn watering on a daily basis. This was more than the annual average daily use for things not including lawn watering. In the hot, dry days of summer all the System's wells were pumping 24 hours per day, 7 days per week. In July and August 2005 water use exceeded the maximum pumping capacity on numerous days. The average verses maximum day water usage is shown in Figure 9.

Figure 9, Average vs. Maximum Day Water Use (1998 - 2008), North Kingstown[21]





Targeted efforts by government agencies, water suppliers, business and industry and individuals to reduce water demand and to use water efficiently will protect RI's freshwater resources and preserve supply for the future. Efforts to reduce demand during periods of peak use and particularly reducing the seasonal outdoor water use in the warm months are critically needed. The WRB staff provides assistance and oversight to suppliers, local governments, industry and agriculture on water efficiency and needs to expand efforts on demand management technical assistance to suppliers. Local water suppliers need to enhance systems operations (including demand management) and participate in and help implement regional planning and demand management efforts. Individuals need to become more aware of how much water they use, how it affects values and resources they care about, and what actions they can take to reduce their water use.

[21] http://www.northkingstown.org/departments/water/water-data

2009 Water Use and Efficiency Act

After more than 3 years of various legislative study committees and bill proposals, the RI General Assembly passed the Water Use and Efficiency Act in 2009. This legislation was based on the input from 3 legislative study committees which were convened to assess the State's freshwater resources and the management of potable water systems. These commissions received testimony from municipal, state, and federal agencies, environmental organizations, user groups, water utility managers, water resource scientists, and water treatment experts. The Act states that scarcity of water is a growing concern and RI's water supply should be an economic advantage for our state.

The purposes of the Act were to secure a reliable supply of quality water for the protection of public health, safety and welfare, and to ensure a sustainable balance between human and ecological water needs. Environmental stewardship and integrated water resource management, including land conservation, wetlands protection, and protecting the ecological integrity of water resources, are essential to implementing the Act. A key finding of the Act (as demonstrated earlier in this Plan) was that we are using large amounts of potable water for inefficient outdoor non-agricultural summer landscape irrigation. The Act states that more efficient use of our water supplies, especially by residential users, is the most cost-effective and quickest way to maximize available water supply. Water efficiency was set by the Act as a key to for successful water management in our State.

2009 Water Use and Efficiency Act Directs Water Suppliers to:

- manage demand more proactively in order to curtail seasonal peak demands
- maintain fiscal integrity by establishing revenue stabilization accounts and debt service reserves, and infrastructure replacement and capital improvement program funds as necessary
- operate as an Enterprise Fund
- maintain adequate capacity by establishing revenue stabilization funds, operating reserves
- establish remote frequency reading systems by 2012
- establish quarterly billing by 2013
- reduce leakage to less than 10 %
- use conservation pricing to reduce overall demand
- use seasonal rates to reduce non-agricultural outdoor water use

The coordination responsibilities and data development required by the Water Use and Efficiency Act must be shared between state agencies, water suppliers and municipalities. The Statewide Planning Program was directed to include strategies in the State Guide Plan (through this Plan) for incorporating the water availability estimates of the WR Board and DEM in community comprehensive plans when available and major land development and subdivision reviews. Part 3 will discuss this further. The strategies in the Implementation Matrix contain actions to do that.

The Act also requires that major land use projects reviewed by communities be linked to water availability. It also reinforced an existing provision of RI General Law that Executive Summaries of Water Supply System Management Plan(s) (WSSMPs) of major suppliers within the municipality must be included within the CCP. In RI, the CCP typically identifies and maps important water resource features, such as wetlands, estuaries, streams, rivers, lakes, floodplains, and groundwater recharge areas. Many communities that rely heavily on groundwater also have general CCP policies (and implementing ordinances) protecting groundwater supplies from water quality degradation. But none have any regulations that deal with excessive withdrawals or export of water at this time.

**See Goal IMP - 1
Planning Policy 1
Strategies A - D**

Water Reuse

The task of supplying water for drinking water purposes can be eased by a variety of methods. One of which is developing the reuse of water for non-potable purposes from previous uses. Across the country, water and wastewater utilities are beginning to recognize that water reuse can be an important component of a comprehensive plan for watershed management and water supply. Historically, the primary driver for water reuse has been the lack of available potable water supplies in given geographical area. The second and more emerging driver is that of environmental stresses that are caused by wastewater disposal practices including both pollutant loadings to receiving waters and the hydrologic changes associated with the out-of-basin transfer of wastewater In other areas of our country such as Arizona, California and Florida where natural water is scarcer than here, the use of wastewater reuse and rainwater harvesting is an established alternative method to new source development. (Water utilities, municipalities, agriculture and businesses in these areas have been using such methods for decades to meet the demand for water). More recently as demands have continued to stress available supplies, projects have been developed to implement wastewater reuse as a means to indirectly replenish potable supply sources. More commonly, however, utilities are substituting reused water for potable water and applying it to non-potable uses which are regulated under different standards. In some states, the water is used to recharge depleted over allocated aquifers.

Artificial recharge of groundwater is the process of adding water to an aquifer through human effort. Many different techniques and purposes exist for such recharge, but primarily artificial recharge is used for augmentation of a water supply for later use. Recovery (withdrawal) of the stored underground water commonly is by wells. Site selection for recharge is critical. Some aquifers hold little or no potential for successful recharge projects, whereas others have great potential. Ideally, an aquifer will hold, store, and transmit desired amounts of recharge water without significant migration and chemical degradation of that water. Site investigation would include hydrogeologic mapping of the aquifer to identify aquifer characteristics. Advanced techniques would use computer simulations for modeling groundwater flow and transport. The Advisory Committee discussed the applicability of this methodology for RI's aquifers at great length. Although not yet investigated, the general consensus of the Committee was that was that the characteristics of the aquifers of the State would not be conducive to this technique with the current best available technology and our aquifers hold little or no potential for this type of recharge due to RI's hydrogeologic conditions.

The re-use of wastewater and or rainwater provides a renewable supply of water that can be used for a variety of non-potable purposes such as fire protection, landscaping irrigation, flushing toilets, laundry, and as emergency backup during power outages. DEM has established specific guidelines for the reuse of treated wastewater for landscape irrigation, non-contact cooling water and irrigation of non-food crops, such as turf. Technology and devices to make greater use of this uncommitted water in our State is possible but regulations and standards to support expansion of water re-use for other purposes would need to be established by the DEM and DOH in collaboration with other relevant agencies; e.g. building code officials. Water reuse can help reduce the cost of transported potable water by decreasing demand so recycled water could be used via a separate distribution system to offset the potable water demand.

See Goal WRM - 3
Demand Management Policy
Strategy A

Rainwater Harvesting

Rainwater harvesting is the collection, conveyance, and storage of rainwater. It is an ancient stormwater management technique enjoying a revival in popularity due to an interest in reducing consumption of potable water.

Advantages and benefits of rainwater harvesting are numerous:

- The water is free; the only cost is for collection and use.
- The end use of harvested water is located close to the source, eliminating the need for complex and costly distribution systems.
- It can help recharge limited groundwater supplies.
- It reduces flow to stormwater drains and also reduces non-point source pollution.
- Decreasing storm water volume also helps keep potential storm water pollutants, such as pesticides, fertilizers, and petroleum products, out of rivers and groundwater.
- It can help reduce the summer demand peak and delay expansion of existing water treatment plants.
- It can reduce consumers' utility bills.
- It reduces demand for water from the water distribution infrastructure.

The scope, method, technologies, system complexity, purpose, and end uses vary from simple rain barrels on drain spouts for residential gardening, to large-scale collection of rainwater for all domestic uses. Residential rainwater harvesting systems can be installed by the home gardener, the weekend cabin owner, and the homeowner intent upon using "green" building practices. Rainwater harvesting is also recognized as an important water conserving measure, and is best implemented in conjunction with other efficiency measures in and outside of the home. In RI, the Narragansett Bay Commission has established a program to distribute rain barrels at a subsidized cost in order to promote the capture of rainwater before it would otherwise enter the combined stormwater sewer system. In Texas, the State offers financial incentives for rainwater harvesting systems to businesses and homeowners. Rainwater harvesting equipment is also exempt from sales tax in Texas, and the State allows municipal governments to exempt rainwater harvesting systems from property taxes.

Rainwater harvesting is not just about water supply. It's also about stormwater management. Stormwater collection captures runoff thorough storm drains built directly into streets and parking lots. Continued urban development has led to increased amounts of impervious surfaces that prevent stormwater from permeating the ground to replenish it. Capture of excess water during rainy periods permits use of that water during drier times. The use of Low impact design (LID) systems for storm water retention can support storm water collection, natural aquifer recharge and reuse.

During a 1-inch rainfall, approximately 620 gallons of water can be collected for every 1,000 square foot of surface area. That means a 1,800 square foot house roof will collect over 1,000 gallons for every inch of rainfall.

Wastewater Reuse

Wastewater reuse offers opportunities to meet non-potable water demands in a manner that can help water suppliers to meet demands for potable water. Additionally, wastewater reuse can have environmental benefits including supporting management of the hydrologic balance within a watershed. Currently, about 75% of volume of wastewater treated through Rhode Island wastewater treatment facilities (WWTFs) is discharged out of basin into coastal waters. Wastewater reuse of treatment plant effluent offers opportunities to retain a greater volume of water within watersheds and use it for beneficial purposes.

As noted above, DEM has established guidelines that govern wastewater reuse projects in RI. Reuse is currently a limited practice. To date, treated wastewater effluent generated from public wastewater facilities has been successfully reused for golf course irrigation and non-contact cooling water. In recognition of the potential benefits of wastewater reuse, and in response to the Environmental Protection Agency initiatives on "green infrastructure", DEM undertook a statewide planning study to identify and assess potential reuse opportunities with respect to WWTF effluent. Factors considered in the assessment included volume of wastewater, water use, proximity to WWTF and environmental constraints among others. The DEM report identified 105 priority potential reuse opportunities. Clusters of opportunities were associated with the following 8 wastewater treatment facilities:

- East Greenwich
- Narragansett Bay Commission (both Bucklin and Fields Point)
- RI EDC/Quonset
- South Kingstown
- West Warwick
- Westerly
- Woonsocket

The report was intended to provide information to direct further investigation of the technical and cost feasibility of specific wastewater reuse opportunities. The potential to reuse treated wastewater from other wastewater treatment plants and smaller wastewater dischargers; e.g. package plants, industrial discharges etc. were not assessed. No projects have yet been initiated as a result of the report.

The benefits of gray water reuse include:

- Lowers potable water use
- Less strain on failing septic tanks or treatment plants
- Less energy and chemical use
- Groundwater recharge
- Plant growth
- Reclamation of otherwise wasted nutrients

To promote greater reuse, RI should consider broadening the allowable reuses of treated wastewater as well as the adoption of policies that will encourage reuse projects. For example, New Jersey requires wastewater utilities to complete a reclaimed water feasibility study as part of its operating permit renewal process. Certain local jurisdictions in Florida require that purple pipe, known as reclaimed water pipe, be installed as part of new development and that the projects be connected to a reclaimed water source when the transmission lines become available.

Another means of reusing wastewater is through the separate handling of gray water. Gray water is water that drains from bathtubs, shower drain, sinks, washing machines, and dishwashers but not toilets. Outside RI, gray water, typically with some degree of treatment, is used for exterior irrigation and other water conservation applications. Gray water accounts for 60% of the outflow produced in homes. By designing plumbing systems to separate it from black water (toilet water), gray water can be recycled for exterior non-potable irrigation and reuse in toilets, resulting in potable water conservation for those purposes.

There are 16 states in the US which currently have adopted gray water policy for the spectrum of all gray water systems, from the small homeowner system to communitywide municipally run systems. Conditions in RI should be examined to facilitate the reuse of treated gray water. General regulatory trends around the Nation are going this direction. Los Angeles County's sanitation districts have used treated wastewater for landscape irrigation in parks and golf courses since 1929. Also in Orange County, CA and in other locations such as Singapore, and Japan, grey water is given more advanced treatments and is used for drinking water. Massachusetts has adopted non-potable standards for this type of reuse. To effectuate more gray water reuse in RI, state regulations including building and plumbing codes need to be reviewed and clarified as needed to support reuse.

The following nationally highlighted case study from our neighbors in MA shows how applying this principle and the technology enabled construction of an otherwise questionably buildable facility from a water use viewpoint.

Case Study[22]

Gillette Stadium
Foxborough, Ma.

The Stadium that serves as the home to the National Football League New England Patriots and the New England Revolution of Major League Soccer has the distinction of having one of the largest recreational water reuse systems in the US.

At the time of the initial design The Town of Foxborough did not have enough water supplies to meet the water use demand or the excess capacity to treat the wastewater proposed from the 68,756-seat stadium. Additionally the distance of the stadium from the existing wastewater treatment facility would have made transfer of the wastewater cost-prohibitive. In order to meet the demand for water, the reuse of gray water was the only answer to allow the stadium to be constructed.

The Stadium opened in 2002 and continues as a venue for football games, soccer matches, concerts, and other public events.

Stormwater disposal chambers installed under parking lots at Gillette Stadium treat excess wastewater and stormwater.

A water reclamation scheme was developed that would allow wastewater from the stadium and the community to be collected, treated, and reused for such purposes as toilet flushing, irrigation, cooling watering, and flushing of streets and sidewalks.

The solution to the problem was to capture the wastewater from the stadium, treat it to a high degree, and store it for reuse when necessary. The treatment process is based upon membrane bioreactor technology along with ultraviolet radiation. The Town keeps the treated water stored for use at the stadium or elsewhere. Excess water is discharged below the surface of the parking lots which have the capacity for over 16,500 vehicles in a series of chamber beds (pictured above) allowing recharge of the local aquifer. An infrastructure design was developed that resulted in the construction of the following:

- 250,000-gallon per day membrane bioreactor facility capable of being expanded to treat 1.1 MGD.
- 680,000-gallon equalization tank to capture the half-time wastewater surge.
- 2.4 acre groundwater chamber recharge field for the excess highly treated effluent.
- 500,000-gallon evaluated water tank for reclaimed water storage.

[22] *Reuse in Action*, Water Efficiency, November/ December 2010

Climate Change

The water resources and economy of the State have been shaped by many aspects of its climate. A new issue that water resource planners must consider is climate change. As defined by the EPA, climate change refers to significant change in measures of climate (such as temperature or precipitation) lasting for an extended period (decades or longer). The scientific consensus of climate change is changing our assumptions about water resources. The EPA predicts that climate change will have numerous and diverse impacts, including impacts to human health, natural systems, and the built environment.

Concerns for the future of water have arisen because climate changes may alter the blueprint of the hydrogeological cycle. How change may impact our potable water supplies in RI still needs to be defined. Considerable uncertainty in specific climate change impacts on water supply will continue, and decisions on water infrastructure and new supplies should follow the precautionary principles of the EPA. According to the US Global Change Research Program[23], since 1970, the annual average temperature in the Northeast has increased by 2°F, with winter temperatures rising twice this much.

Climate-related changes for Rhode Island include:

- The average annual State temperature has risen 1.7°F since 1905
- Precipitation has increased by .12 inches per year over the past 100 years
- Precipitation in RI has varied from a low of 28" to a high of 64" in the last 50 years
- Less winter precipitation is falling as snow and more as rain
- Wind speed at T.F. Green Airport has declined since 1960
- Narragansett Bay surface temperatures have risen 4°F since 1905

This section is not intended to be a scientific dissertation on all aspects of climate change. It is included for the purpose of raising awareness among water resource planners and utility managers on the projections for the future which could impact the potable water supplies of RI. The US Global Change Research Program states that by mid-century and beyond we might be facing different climate futures which contain:

- Shorter winters with fewer cold days and more precipitation.
- A snow season that is reduced to a week or two.
- A longer growing season.
- More days above 100°F each summer.
- Typical hot and dry summer conditions would arrive 3 weeks earlier and last 3 weeks longer.
- Sea level rising more than the global average.

[23] *Global Climate Changes Impacts in the United States*, US Global Change Research Program

The impacts of climate change projected for RI are too little water in some places, too much water in other places, and degraded water quality. Some locations are expected to be subject to all of these conditions during different times of the year. Climate change is projected to alter, the water cycle, affecting where, when, and how much water is available for all uses. Regional and seasonal precipitation patterns are predicted to change. Rainfall will be more concentrated into heavy events with longer, hotter dry periods in between. A greater share of precipitation will fall in heavy snow and rainstorms and there will be shifts in the seasonal distribution of precipitation. This is important as RI may experience even drier portions of the already dry summer which is the time of the greatest water demand. Other implications for water supply are longer growing seasons with greater water agricultural water use, more intensive storms with greater runoff that contributes less infiltration to groundwater, a greater variable in precipitation over the year, and potentially sea level rise that could inundate some surface water reservoirs.

Some of these predictions we've already experienced as recently as the Spring of 2010. In March of 2010, Rhode Island received record setting rainfall. It was the "all-time rainiest month" ever recorded in Providence since weather records were started to be recorded around 1900. We saw the rains create flooding events never before seen in the State. The Pawtuxet River crested 12 feet higher than its usual level, flooding, sewage treatment plants, homes, and businesses, and leaving part of Interstate 95 underwater.

Climate change will have an increasing effect on stream flows. In the New England region, precipitation has increased 4 % from 1895 to 1999. However, Rhode Island has seen an even larger increase in precipitation than the rest of the region – of 27 % during the same time period. In addition, there has been an 88 % increase in the frequency of extreme precipitation events in Rhode Island since 1948, the largest increase of any state in the United States. Our sea level has risen over 8 inches as measured at the Newport tide gauge since 1930. Implications for every aspect of water supply, demand, and quality, as well as ecosystem health, are considerable and need to be factored into planning for water supply.

Groundwater Impacts

Many parts of RI as described in Part 1 are heavily dependent on groundwater for all water supplies. How climate change will affect groundwater is not well known at this time. Increased water demands in regions that already rely on groundwater will clearly stress this resource, which is often drawn down faster than it can be recharged in the annual summer dry periods. Most areas are dependent on the groundwater itself stored in the aquifers as opposed to constructed storage tanks. The lack of storage capacity is a climate based vulnerability for these areas. Many parts of the State have low rates of stored water in relation to the average daily demand let alone the seasonal peak demands. In many locations, groundwater is closely connected to surface water and trends in surface water supplies over time affect groundwater. Changes in the water cycle that reduce precipitation or increase evaporation and runoff would reduce the amount of water available for recharge. Changes in vegetation and soils that occur as temperature changes are also likely to affect recharge by altering evaporation and infiltration rates. Agricultural groundwater use will be affected too.

In most cases a stream is merely the visual level of the groundwater table. Small changes (drops of 6”) in the groundwater table can cut a stream’s flow in half or make it dry altogether. Further, the interface between streams and groundwater is an important site for pollution removal by microorganisms. Their activity will change in response to increased temperature and increased or decreased streamflow as climate changes, and this will affect water quality. Another issue of concern for groundwater is that sea-level rise is expected to increase saltwater intrusion into coastal freshwater aquifers, potentially making some unusable. Increased evaporation or reduced recharge into coastal aquifers could exacerbate saltwater intrusion.

Adaptation

Adapting to gradual changes, such as changes in the average amount of precipitation, is less difficult than adapting to changes in extremes. When droughts or floods become more intense or more frequent with climate change, the economic and social costs of these events will increase. Water systems have life spans of many years and are often designed with spare capacity to reduce their vulnerability to risks. These systems are able to cope with small changes in average conditions. Water system planners need to consider a broad range of factors including adaptation to climate change in order to minimize water system vulnerabilities.

Potable water infrastructure is very expensive to install and maintain. Climate change will present a new set of challenges for designing future upgrades to the State’s water delivery infrastructure. It will impact every aspect of the water cycle. Water demands are expected to change with increased temperatures. Evaporation is projected to increase over most of the State as temperatures rise. Higher temperatures and longer dry periods are expected to lead to increased water demand for irrigation and outdoor water uses. In addition, greater cooling requirements in summer will increase electricity use, which in turn will require more cooling water for power plants.

Climate change poses a variety of challenges for water management, and there is a need to develop methods for understanding and managing risk to supplies. Climate change is a complex issue, and more work is needed to establish reliable practices for incorporating climate change into water utility decisions and planning. Typically most utility managers possess a strong technical understanding of their water systems, their hydrologic and management models, and the local hydrology. They have more limited access to climate change information.

See Goal WRM - 1
Climate Change Policy
Strategies A - C

Desalination

The process of desalination involves the removal of dissolved solids (such as salts) from seawater, treated wastewater, or brackish water in order to produce fresh water. There are approximately 12,000 desalination plants worldwide; more than 60% are located in the Middle East. By contrast, fewer than 2,000 desalination plants exist in the United States. In the US, 2 major issues have hindered the expansion of desalination from a secondary water-supply source to a primary water-supply source: high cost (the cost of desalination has been higher than that of available alternative supplies) and adverse environmental impact.

Tampa Bay Seawater Desalination Plant, Florida
Source: http://www.water-technology.net/projects/tampa/

It takes approximately 2 gallons of seawater to make 1 gallon of fresh water. Methods fall into 2 categories: distillation and membrane filtration. Distillation involves heating seawater in order to collect the resulting freshwater vapor. With membrane filtration, also known as reverse osmosis (RO), water passes through membranes that separate dissolved solids. These membranes allow for the application of high pressure to specific ionic water molecules, thereby producing fresh water from a salt solution. Currently, more than 60% of the world's desalination plants use some form of RO.

The expenditures associated with desalination can be attributed to technological expenditure and the enormous amounts of energy required by such a facility. In addition, the enormous amounts of energy needed to run the plants is difficult to replace by emergency back up power in the event of a full power failure of the primary power source. Currently 40% of desalination costs come from energy. According to the American Water Works Association, the price of desalinated drinking water is approximately $3 per 1,000 gallons, but in most places the current price for natural source water still comes in well below the costs of desalination.

The environmental impact of desalination plants is also part of the reticence to build desalination plants. The plants require energy via fossil fuels in order to operate, resulting in air pollution. In order to build and operate a desalination plant, the project must comply with federal and state regulations governing water pretreatment, drinking water processing and brine disposal.

Some facilities transfer seawater into pipes using the once-through cooling method developed by power plants. Once-through cooling draws water directly from the ocean using pumps that then run it through the system. Unfortunately the pumps suck up more than just water, inevitability killing a variety of marine life. Larger organisms, such as adult fish get trapped in the intake screens, while smaller organisms, like eggs or larvae, make it through the intake screens only to be trapped and killed inside the treatment facility. Construction of desalination plants impacts dune and surf zones, air quality, sea life, and seafloor ecology. The possible negative impacts of desalination construction and operation on fragile coastline habitats elicits concerns from environmental organizations, municipal governments, and state and federal agencies.

Federal laws and regulations implemented by state agencies govern the construction and operation of desalination plants. Desalination projects must comply with all state and federal laws.

The Clean Water Act, the Safe Drinking Water Act and other state / federal regulations require the protection of marine ecosystems, pollution control, and potable drinking water. Desalination projects are subject to all Safe Drinking Water Act requirements related to the production of potable water, and also to the provisions of the Clean Water Act related to the regulation of by-product waste discharge, brine. A successful desalination project must demonstrate it that it is fiscally viable and able to meet all regulatory requirements, that it can balance the environmental issues and has fiscally viable operating procedures.

The Safe Drinking Water Act calls for the enforcement of health standards for contaminants in drinking water. All desalination facilities must comply with this Act. The DOH oversees the implementation of this Act for RI. The Clean Water Act also regulates desalination's by-product: brine. Water treated by reverse osmosis splits into two categories: 50% of it becomes drinking water, and the remaining 50% becomes brine. Currently classified as an industrial waste by the EPA, brine requires an involved and complex disposal process. One of the biggest challenges for desalination plants is developing a brine disposal method that meets the requirements set by the particular state NPDES permit process. The DEM oversees the implementation of this Act for RI. The type of membrane technology, cost of energy use, salt separation efficiency, the cost of labor, the cost of production, and durability of the membrane elements Safe Drinking water Standards, and discharge permit limits largely determine the cost of desalinated water.

In 2007, the Quonset Development Corporation conducted a study on constructing a desalination treatment facility would be feasible at the Quonset Business Park located in North Kingstown. The study examined whether portions of the Park could be developed into a reliable source of potable water, and what would be the project costs to develop those areas in compliance with DOH drinking water permitting requirements. This was not a classic salt water source project. The study proposed using the available groundwater beneath the Park rather than a direct intake from Narragansett Bay. Groundwater wells were drilled to estimate the depth of the freshwater /salt water lens interface and to locate potentially high yielding future wells. The water was tested for salinity, inorganic contaminants, volatile organic and synthetic chemical contaminants, natural organic matter, particulates and radionuclides. A brackish groundwater desalination process along with a reverse osmosis treatment plant was proposed. The costs projected for the project included well drilling, raw water transmission, a reverse osmosis water treatment plant and plant outfall. Project related development costs, and annual operation and maintenance costs were projected. The project costs projected by the Study ranged from $14.1 to $31.8 million with water estimated to costs $2.78 to $3.76 per 1000 gallons after debt payment and annual operating and maintenance costs were included. The study indicated that there appeared to be a very good potential for developing groundwater wells and a treatment system, however due to lack of financial resources for the project the QDC did not pursue further research.

In 2008, the WR Board looked at the possibility of desalination for RI in the *Supplemental Source Water Study.*, Research on desalination as an option to meet emergency demands in coastal communities was included. The study evaluated 3 possible reverse osmosis facility locations: East Bay, West Bay and Aquidneck Island. The total estimated capacities would have been 18.25 MGD based on the emergency demands projected. Capital construction costs were estimated at a minimum of $161.9 million with operations and maintenance annual costs estimated to be at least $11.1 million. Total costs of distribution and delivery of the potable water produced would have ranged from $5.45 to $8.00 per gallon depending upon which of the 3 proposed facilities was examined. Using the 2007 water rates for PWSB, $1.00 for 300 gallons would equate to a price of $1,635 for 300 gallons at the lowest cost of $5.45 per gallon from this study. It was concluded that desalination could be an emergency option and but the price for natural source water in RI was still well below the estimated costs of desalinated water.

See Goal WRM - 1
Resource Assessment Policy
Strategy G

New England's First Municipal Desalination Plant: Swansea, Massachusetts

New England's *first* municipal desalinization facility has been completed. The desalination plant aims to alleviate the Town's water shortages by transforming salt water from the Palmer River to drinking water. The significance of the desalinization plant is vital to this town which has experienced chronic water shortages with demand often outstripping supply, especially during the summer. The Palmer River, the raw water source for the facility, is a brackish to saline estuary that serves as an important local fishery source.

The facility takes salt water from the Palmer River at low tide when salinity levels are low, treating it for drinking water and discharging at high tide. Cold water desalination has not been used much in the Northeast because the reverse-osmosis membranes – which are what removes the salt from the water – don't function well in very cold weather. To enable the process to work, the plant site was located 2 miles away from the river, allowing the water's temperature to increase in the pipeline.

The desalination plant withdraws 4 million gallons of water from the river during 2 daily cycles. The raw water is pretreated with membrane filtration, followed by reverse osmosis; producing 1.2 million gallons of drinking water and returning 2.8 million gallons of wastewater back to the river. The desalination process is combined with a separate process for treatment of a groundwater source at the plant site, for a combined total daily production of 2.2 million gallons, a capacity that can serve 20,000 people. Construction of the facility cost $19.5 million (including $1.2 million in federal stimulus funds and a low-interest $5.7 million loan from the State of MA.) It was activated in late 2010. The cost for potable water from the facility is estimated to be $3.25/1,000 gal.

Part 3: Assuring There's Water for Tomorrow

Key Points:

- The vision for water supply in RI is to ensure safe, reliable, ample water supplies to meet the State's short and long range needs while preserving the physical, biological, and chemical integrity of the water resources of the State.

- Goals and policies are presented in two over arching categories:
  - Integrated Management and Planning
  - Water Resources Management

- There are two over arching categories of Integrated Management and Planning and Water Resource Management

  - The Water Resource Management category is further divided into nine sub themes:
    - Water Resource Management
    - Resource Assessment
    - Water Quantity
    - Water Quality
    - Demand Management
    - Climate Change
    - Potable Supply Management
    - Emergency Management
    - Drought Mitigation

- Strategies are presented for each subtheme with designated lead and supporting agencies and timeframes.

- Timeframes were set for strategies; As Needed, Ongoing, Short term (1-2 years), Medium term (3-5 Years) and Long term (more than 5 years)

Vision

This section outlines the actions for the State and others to follow to assure that there is potable water for now and the future. It is based upon the adaptive and integrated planning approach to water resources described in the previous two parts of this Plan. Water resource decision-makers need goals and policies which enough flexibility in order to respond to changing current and future conditions while not foreclosing future resource use options. The water planning process should not be stagnant. Policy issues will be added or modified as needed. The Implementation Matrix at the end contains the goals, policies, and strategies for the two over arching general areas and the nine policy themes as detailed in the text of this Section.

The goals and policies presented in this Part are the result of an evaluation of issues and debate by the Water Supply Advisory Committee. Many of the issues and the resultant policies could be classified in more than one category, just as they could be implemented at more than one jurisdictional level. Much like the 1997 policy plan, the statements are classified in two over arching categories --- Integrated Management and Planning and Water Resources Management. Water Resources Management is further subdivided into eight sub-themes. The issues of this Part 3 are presented as follows (not in any priority order):

- Integrated Management and Planning
- Water Resource Management
  - Resource Assessment
  - Water Quantity
  - Water Quality
  - Demand Management
  - Climate Change
  - Potable Supply Management
  - Drought Mitigation & Response
  - Emergency Management

The Vision of this plan is to:

> ***Ensure safe, reliable, ample water supplies to meet the State's short and long range needs while preserving the physical, biological, and chemical integrity of the water resources of the State.***

Several new issues, considered critical at this point in time, were added to this Plan. Specific goals, policies and strategies were proposed to implement the Plan as suggested by the Advisory Committee. The quality and diversity of knowledge and perspectives that contributed to the final form of this Plan cannot be overemphasized. Working together, issues were identified, goals established, and policies drafted to ensure that the high quality of potable water we have come to know and depend on in Rhode Island remains available for use. The issues are not independent but are highly interrelated. These concepts were then refined by the principal author and finally through meetings and hearings of the Technical Committee and State Planning Council.

The Integrated Management and Planning category establishes the planning and administrative management policies needed for water systems and governmental units concerning the ongoing maintenance of the infrastructure of supply systems as well as the functional responsibilities for coordination and planning required for source protection, cost controls and maintaining the viability of all water systems within the state.

The Water Resource Management category addresses the needs for; fully understanding and categorizing what are our available resources, what water resource protection efforts are needed, the development of new sources, emergency and drought management planning, and finally demand management efforts. The demand management efforts are aimed at ensuring increased awareness of the importance of water resources, stressing water use efficiency, and encouraging technological advances to promote efficiency both in system management and the overall use of water.

Summarizing water-related issues is a difficult undertaking and responsibility for addressing these issues is shared by various levels of government, water supply managers, and private organizations. User concerns are diverse and include distinct but fundamentally related subjects like cost, source water protection, conservation, quality, and availability.

Pertinent information from each of these components was brought to bear in defining the issues, developing policies, and recommending the strategies that comprise the remaining part of this document. The Advisory Committee reviewed and considered issues of the five previous state guide plan elements (as discussed in Part 1) concerning water supply during development of this Plan. As stated in Part 2, previous issues were reviewed and updated, consolidated, or removed – depending upon the Committee's judgment as to whether they were a continuing concern or had been acted upon. Goals were established within each category, and policies developed under each goal to address the sub-themes that had been identified. Strategies for the Plan were developed around each subtheme as follows:

- Goal(s)
  - Policies
    - Strategies for each policy
      - Lead agency (Lead)
        - Supporting agencies (Support)
          - Timeframes
            - As Necessary
            - Ongoing
            - Short Term (1-2 years)
            - Medium term (3-5 years)
            - Long term (more than 5 years)

From this framework a matrix was developed for this Plan, which shows the goals, policies, and strategies. (See Table 4, Implementation Matrix) The Framework provides a long-range plan that frames statewide major water supply issues and provides strategies and recommendations for addressing those issues. It includes recommendations for investments that may come from sources beyond state funds, as well as recommendations that require little or no investment by the State. Small text boxes will appear throughout the text of this Section to correlate key ideas of the text to the strategies of the Implementation Matrix.

EXAMPLE: See Goal IMP-1
Planning Policies 1 &2
8 Strategies

The matrix is not intended to supplement any strategic planning done by the various state agencies with responsibilities for water resource planning but rather to provide overarching goals and policies for all agencies to use in common for those strategic planning efforts. The framework was also developed for use in, but not limited to, municipal comprehensive community planning, water supply systems management plans and other water resource planning efforts.

Future Needs

Adequate amounts of water in the right place, and of sufficient quality, are required to balance drinking water, manufacturing, energy, agricultural, recreational and ecosystem needs now and in the future. What will Rhode Island look like in 2030? Will the economy change from current conditions? This Section is a broad view of what potential future water supply needs may be on a statewide basis to establish the goals and policy for water supply planning. There are many ways water demand can be calculated. In this Section, four ways of anticipating water demands with different future conditions were considered. These are described as future scenarios. When viewed together, the future scenarios show

The following Scenarios were considered:

Scenario 1: Population Based Demand
Scenario 2: WSSMP Anticipated Demands
Scenario 3; *Land Use 2025* Demands
Scenario 4: WRB Draft Strategic Plan Demands

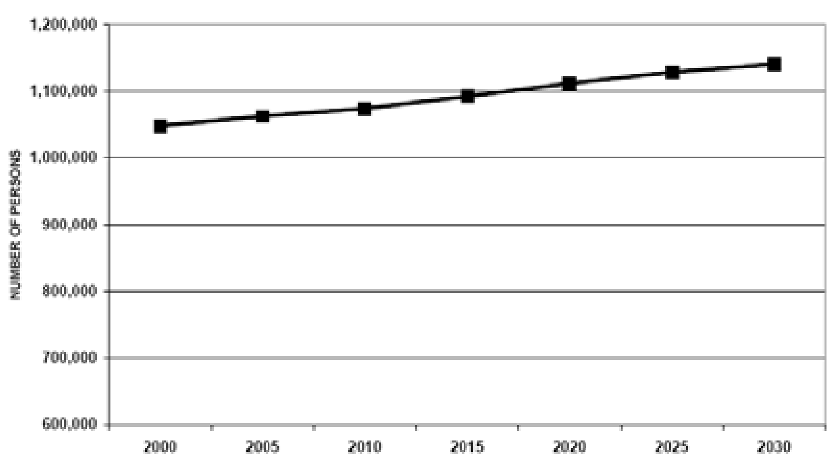
what range of management options need to be considered to provide for the continued sustainability of our drinking water resources. Projection of future water uses by use category is beyond the scope of this Plan. That is the strategic planning responsibility of the WR Board. None of the scenarios considered explosive future growth for the State.

Scenario 1: Population Based Demand

This scenario will be based upon population projections made by the data published in the 2004 Technical Paper 154, *Rhode Island Population Projections: State, County, and Municipal 2000-2030*.[1] This Paper presents the most current projections available at this time. It illustrates plausible courses of future population. The projections are based on an estimated population projected forward using the cohort-survival method. In this scenario, the water needs of the State are expected to grow in the future in response to potential population growth and continual changes in the rate of consumption. Rhode Island's 2010 population is 1,052,567. The traditional assumptions of water supply planning for this scenario are that public water systems will have to provide more water to meet the needs of an increasing population and an increase in economic development that accompanies rises in population. Therefore, an increase in the rate of consumption is be expected to accompany the growth in the population served. To calculate demand for this Scenario, population and rate of consumption are equated through the use of per capita consumption figures. The population served is divided into the amount of water consumed yielding a per capita use or consumption figure. Since the last SGP plan in 1997, generally the per capita consumption figure has been increasing in RI. This is due to the increasing use of automated, in ground residential sprinkler systems, and water consuming appliances and devices such as air conditioners, garbage disposal, dishwashers, and luxury shower heads. This trend is expected to continue in the future for this scenario.

The average annual water use is estimated by the WRB staff is 65 gallons per person per day year round. In the summer this rises to 88- 122 gallons per person per day.[2] In fact water use in some areas of the State is growing at a faster rate than the growth of population. Given that the population in the State is projected to grow by about 8% in the next 20 years to 1,140,543 people by 2030, it is projected that water demand would grow by an equal amount. The projections showed that Rhode Island would see a slow but steady growth rate over the next 30 years as employment opportunities increase. This is shown in Figure 10 below.

Figure 10, RI 2004 Population Projections 2000-2030[3]



[1] http://www.planning.ri.gov/census/tp154.pdf
[2] Water for Rhode Island: Today and Tomorrow, Environment Council of Rhode Island, 2006
[3] *Rhode Island Population Projections: State, County, and Municipal 2000-2030*, Technical Paper 154, August 2004

Scenario 1 involved multiplying the estimates of future population 1,140,543 (in 2030) served by the estimated future per capita consumption. This allows for the total estimates of the combined residential, industrial, commercial and other uses to be formulated in conjunction with only one independent variable, population.

Scenario 1: Per Capita Basis x Statewide Average GPCD needs:

Total Population 2030 X Water Use & Efficiency Act GPCD = Additional GPCD needed

1,140,543 X 65 GPCD = 74,135,295 Additional GPCD needed or
74.14 MGD needed

Scenario 2: Water Supply System Management Plans Anticipated Demands

For Scenario 2, the most recent Water Supply System Management Plans (WSSMPs) prepared by major water suppliers were examined. The WSSP information varies per submittal dates and therefore has differing 5 and 20-years planning periods. For the purpose of this Plan, the 5 and 20-year planning periods have been defined as years 2015 and 2030. The differing 5 and 20-years planning periods have been translated into the years 2015 and 2030. The water data within the plans including the system's safe yields, total volume of water consumed, the available water to the systems and anticipated future demands were used. Both the anticipated future demands for the 5 and 20 year planning periods were compiled by scanning the most recent WSSMPs of each major supplier. Appendix C, WSSMP Anticipated Demands vs. Available Water, shows a detailed comparison of the anticipated demands in relation to available water the systems reported. The values developed in Appendix C are based upon assumptions and varying data developed from a number of WSSMPs. WSSMP for the wholesale customers of the PWSB were specifically reviewed with respect to the anticipated 5 and 20-year planning periods verses the specific demand for the PWSB retail service area. For this Scenario, all suppliers predict growth in water use in both planning periods and the wholesale purchasers of PWSB rely on the legislated 150 GPCD to make water use projections. Additional demand ranges from +11.73 to +18.65 MGD for this Scenario.

Scenario 2 findings were:

- In 5 years Anticipated ADD will be approximately 120.06 MGD **or + 11.73 MGD**
- In 20 years Anticipated ADD will be approximately 126.98 MGD **or +18.65 MGD**
- Also in 20 years:
  - 4 suppliers predict a deficit of current available water:
    - East Smithfield
    - Greenville
    - North Tiverton
    - University of RI
  - 7 suppliers predict the current available water will fall within 1 MGD of source capacity:
    - Harrisville
    - Jamestown
    - Lincoln
    - Portsmouth
    - Smithfield
    - South Kingstown (South Shore and Middlebridge portions)
    - Stone Bridge

Scenario 3; *Land Use 2025* Demands

It is not possible to know for certain how population, water demand patterns, environmental conditions, the climate, and many other factors that affect water use and supply may change by 2030. We have no way of predicting the long future, but we have an accepted future land use map already adopted in *Land Use 2025*. This Scenario will use the future land use map created for *Land Use 2025* to illustrate how the demand for water would need to respond to implement the desired future land use conditions.

The forecasts of estimated growth needs from Part 4 of *Land Use 2025* and goals and policies from Part 5 of *Land Use 2025* with the land intensity classifications from the GIS land suitability analysis were used in this Scenario to project future long-term water demand *Land Use 2025* projects a pattern of concentrated growth, which is balanced geographically. New development and redevelopment is expected to focus within and adjacent to the existing developed infrastructure surrounding Narragansett Bay, on Aquidneck Island, in the major river valleys (Blackstone, Pawtuxet), and in the Westerly area.

Land Use 2025 offers growth opportunities to all areas of the State, including indentifying potential compact growth centers in the rural western and southeastern portions of the State. It proposes minimal impact to conservation lands, preserves lands for water supply, and balances a combination of both high and medium residential densities. It also allows for growth in the western communities of the State but suggests that growth centers would be the most efficient land use for those locations. Data on the current status and capacity of developed areas to accommodate additional water supply fpr development was not yet available when *Land Use 2025* was adopted in 2006. This somewhat hindered the land use analysis to determine how much of the State's growth needs through 2025 could have been accommodated via reuse and intensification of currently developed areas, especially within the Urban Services Boundary. In the absence of such data, the base assumption applied was that land use and water needs currently being satisfied within the existing footprint of developed land would continue to be met through 2025.

See Goal IMP-3
Planning Policies 1 &2
8 Strategies

The future land use map establishes policies to restore and reinforce the State's tradition of focusing growth in and around existing centers and cities. This option is the best prospect for allowing future Rhode Islanders to use the past and present public investment in water services, while creating the fewest impacts to critical water supply resources and maintaining the distinctiveness of various parts of the State's urban and rural landscapes. For more details of the State's desired land use see the full version of *Land Use 2025* on the DOP webpage.[4]

Table 1, Potential Future Dwelling Units (f*rom Land Use 2025*) provides an estimate of additional dwelling units needed to accommodate future growth in the future land use plan. Further documentation of the calculations is provided in a Technical Paper available on the DOP website.[5] This Scenario calculated demand based on the projected demand for new housing units. A high range estimate was selected for the analysis.

Additionally this Scenario considered two different calculations for potential additional 2030 water needs in order to present a range of options for long-term water supply planning. The first estimate is based upon using the per capita methodology, projected housing units from *Land Use 2025*, and the gpcd set by the 2009 Water Use & Efficiency Act. The second is calculated with the same information but uses the current legislative mandate for the PWSB system (established in

[4] http://www.planning.ri.gov/landuse/121/landuse2025.pdf

[5] Geographic Analysis for Land Available and Suitable for Development for Land Use 2025, http://www.planning.ri.gov/landuse/121/D.pdf

Chapter 1278 of the Public Laws of 1915 as Amended) to provide 150 gallons per capita per day for communities that lie within the watershed of the Scituate Reservoir System. This is the figure which the PWSB uses when projecting all water demand for any water sold and delivered through its system. It is a number which is assumed to cover both residential and nonresidential water demands.

Table 1, Potential Future Dwelling Units Land Use 2025

Land Use 2025	Composite Scenario
RESIDENTIAL LAND USE	Add'l Dwelling Units
High(*+ du/ac)	6400
Med-High (4-8 du/ac)	7,800
Medium (1-4 du/ac)	12,800
Med-low ((0.5-1 du/ac)	5,250
Low (<0.5 du/ac)	4,500
Total	36,750

Scenario 3A; Per Capita Basis Statewide Average GPCD & *Land Use 2025* needs:

Additional Dwelling Units X Average Family Size[6] X Water Use & Efficiency Act GPCD = Additional GPCD needed

36,750 X 3.04 X 65 GPCD = 7,268,000 Additional GPD needed or

Scenario 3B: Per Capita Basis PWSB legislative GPCD& *Land Use 2025* needs:

Additional Dwelling Units X Average Family Size X PWSB GPCD = Additional GPD needed

36,750 X 3.04 X 150 GPCD = 16,758,000 Additional GPD needed

Scenario 3: The estimated 2030 long-term future water needs for *Land Use 2025* ranges from 7.2 additional MGD to 16.7 additional MGD.

[6] American Fact Finder 2010 Demographic Profile Data, http://www.planning.ri.gov/census/DEC_10_Dem_profile.pdf

Scenario 4: WR Board 2012 Strategic Plan Demands

> **The WRB staff estimates that the 2011 total water demand for all major public systems is:**
> - Average Daily Demand: ~134 MGD
> - Maximum Peak Daily Demand: ~180 MGD

In 2011 the WRB staff compiled and analyzed data related to water availability and water supply. This Scenario uses the four water management planning regions described in Part 2 and the WRB staff projections of the state's current and future water supply needs. This Scenario's projected demands for water were derived by the WRB staff using the *2008 Supplemental Water Supply Study*. This study included a buildout analysis for the State based upon 2005 land use and zoning data as well as data from major public suppliers. Other data used was the average day and 20 year projected demand data collected from water suppliers and "normalized" to the base years of 2005 and 2025 by the WRB staff. It is important to note in this Scenario that the base year of 2005 for the buildout predates the major state economic downtown which began in 2008. Looking at the buildout predicted in 2005, the growth has not actually happened as expected. As previously stated, we can't predict what the economy will be in 2030 so these anticipated demands should be considered at the high end or a worse case of what may be needed. Self supply data from the Water Use and Availability Studies and community comprehensive plans was also used that was not collected in the Supplemental Water Study. These are the numbers summarized from the 01.25.11 draft of the WR Board Strategic Plan which are in addition to current needs which were estimated by the WRB staff to be 134 MGD in 2011.

> **Scenario 4: WRB 20 year Demand**
>
> Northern Region – Major suppliers 7.4 MGD + Self supplied 0.8 MGD = 8.2 MGD
> Southern Region – Major Suppliers 3.9 MGD + Self supplied 1.8 MGD = 5.7 MGD
> Aquidneck Region – Major Suppliers 1.9 MGD + Self supplied 0.4 = 2.3 MGD
> Island Region – additional demand 0.1 MGD
>
> **Total additional water = 16.3 MGD**

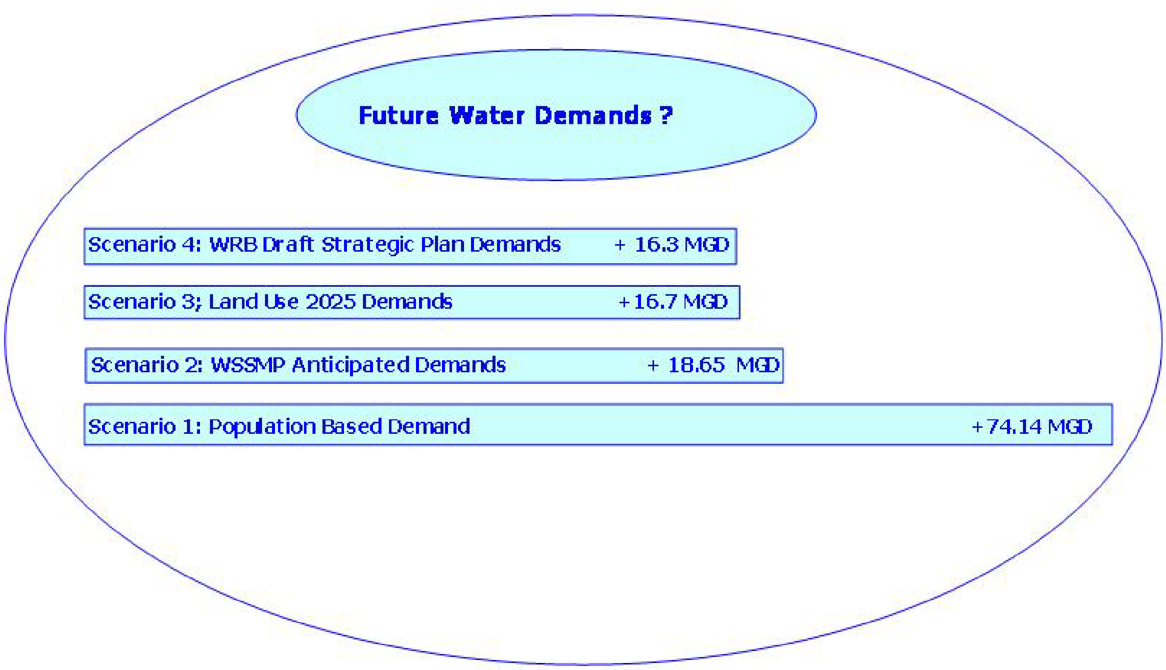
Comparing Demands

Each scenario that was considered has factors that affect water demands and supplies differently. They are compared below in order of increasing demand. The actual need may play out differently in different areas of the State. Other more difficult influences to capture such as adopting state codes for more efficient water use and the effect of using rates to reduce demands were not included in the scenarios. The Scenarios were crafted to assist in developing the implementation strategies contained in the Implementation Matrix at the end of this Section. No single management strategy will meet all future demands. Rhode Island needs to ensure that each region can tailor water supply actions to local conditions. More refined information needs to be defined through the WR Board strategic planning process to consider the combined demand for each region of the State along with the uncertain economic future. We cannot predict exactly what changes will occur to affect our State but we have made certain planning based judgments about what we would like to achieve and tried to show the most likely futures in terms of the distribution of future water use. These anticipated demands should be considered at the high end or a worse case of what may be needed.

Land Use 2025 depicts a future in which our communities and our environment are healthy with water systems that follow the future land use map in order to attain that desired future. Our biggest challenge will be determining what constitutes a sustainable supply. If the future demand increases as proposed below in any of the Scenarios, a sustainable water supply for the State will require:

See Goal IMP-3
Planning Policies 1 & 2

- stronger demand management
- more efficiency (conservation) practices
- increased interconnections between systems for sharing supplemental supplies
- more storage of potable water in groundwater areas, and
- more reuse of non-potable water for non-potable purposes at all scales; regional, community, neighborhood, and individual projects.



Integrated Management and Planning (IMP)

Many issues discussed in this section have counterparts within other policy categories. Generally, the issues here are classified as challenges for the planning and administrative functions of water systems and their financial management. Rhode Island's water resources have certain capacities that govern their use. This Plan recognizes that exceeding these capacities is likely to have detrimental effects on current and/or future users and on the health and well-being of natural systems. Rhode Island needs to manage the use of water from current (surface water and groundwater) sources to ensure that sufficient amounts remain to allow all users – present and future – the opportunity to benefit from the values and opportunities provided by the resources.

Likewise, in concert with a comprehensive consideration of the myriad effects of water quantity and quality decisions, Rhode Island needs to manage point and non-point source pollution to Rhode Island's waters on a watershed basis to ensure the physical, chemical and biological integrity of those waters and maintain assimilative capacity, now and in the future. This requires protecting waters that currently meet water quality standards and restoring waters whose physical, chemical, or biological integrity are impaired.

The integrated policy is predicated on the notion that the primary use for potable water is for human needs and that use of the waters of the State must be "reasonable." Such reasonable use must be accomplished in a manner that does not unduly foreclose opportunities for other users of the resource. Key steps in implementing the integrated water policy are completing the water resource assessments called for in this Plan. Once the capacities of all water resources have been determined, an array of management practices may be strategically developed to ensure the sustainable use of each source.

Water suppliers reserve primary responsibility for water supply management at the local level but it is recognized that state laws, policies, and programs will strongly influence local initiatives. This is true for aspects of management that focus on preventative maintenance, structural rehabilitation, and financial management. Maintaining system reliability and proper maintenance of production and distribution equipment is essential. Major systems through the WSSMP and Infrastructure Replacement Plans are required to perform infrastructure planning that are intended to maximize efficiency of water use and achieve better protection of the public health.

Water Supply Policies in Community Comprehensive Plans (CCPs)

Rhode Island has a nationally recognized land use planning system based upon three state enabling laws that empower the State's 39 cities and towns to plan for and regulate land use through municipal comprehensive plans, zoning and land development regulations. It is the community comprehensive plans that serve as the basis for land use regulation by 39 municipalities. These comprehensive plans are reviewed, and once certified by the Division of Planning, become binding on RI agencies by requiring conformance of their programs and projects to the comprehensive plan.

See Goal IMP-1
Planning Policy 1
Strategies B, C, & D

Given the importance of water to each municipality and the State's future, a community will be well served to create a water supply section within the Services and Facilities element of the CCP, in conjunction with the appropriate water supply and resource agencies. Before embarking on water supply policies, it is important to understand the institutions that provide water in the area, the various plans and projects in the works, and the constraints on future water supplies. The 2009 state law requiring major land use decisions to be linked to water availability makes including water resources information in CCPs of increased importance. There are a number of reasons why an integrated water section might be of benefit to a community. By having all water supply related policies and actions in one place, the complex issues surrounding water supply are more accessible and understandable to the general public. Few people interact with water districts or the plans and documents they produce, but many lay people interact with a CCP.

An integrated water section can also lead to reduced costs and increased efficiencies for needed infrastructure. Future water supply demands, wastewater demands, and drainage needs (as applicable to each community) should all rely on the same future land use map and build-out assumptions established by the CCP. This will lead to more coordinated infrastructure and capital decisions. Each agency involved in water supply related decisions, regardless of jurisdiction, should use the future land use map for planning any water-related infrastructure plans and

Community Comprehensive Plan Water Resource Policies

There are already many and diverse policies related to maintaining healthy water resources in CCPs which typically consist of:

- special districts that protect floodplains, recharge areas, riparian corridors, wetlands, and other ecologically significant lands
- erosion control policies to maintain water quality
- setbacks from riparian corridors, water bodies, and wetlands to maintain water quality
- low-density land uses in groundwater recharge zones or water supply watersheds

policies. For example, placement and location of wastewater treatment and conveyance facilities may be better linked to potential land uses, such as industrial facilities or golf courses that might take advantage of recycled water. Finally, a single water supply section might increase the visibility of drinking water and highlight its importance in the future of the community.

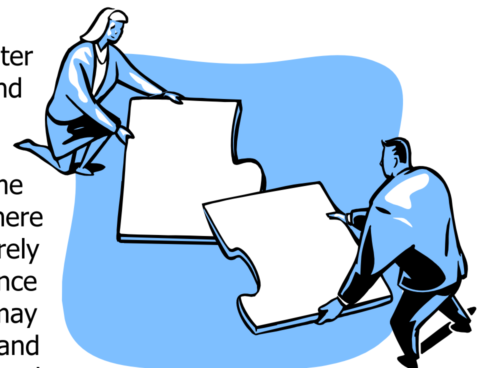
Water supply related information; including policies, resource inventories, and supplies are typically located within two key elements of a community comprehensive plan (CCP): the natural resources and the services and facilities elements. The Act requires more coordination of water supply availability information with land use planning. The type and quality of data to be included in such a section will vary by municipality depending upon its water resources and other factors, such as but not limited to, water districts and other agencies in the community, and the level of public attention that has been devoted to water supply in the past. This is not a one-size-fits-all item to which an exhaustive checklist can or will apply but rather a unique topic that can combine water supply, issues of quantity, and quality into a section. Additionally, since there are many jurisdictions that already have polices and programs for water resource protection there may be policies for water resource protection in other elements of the CCP that need to be considered by a water supply section.

Checklist for a Water Supply Section of a CCP

- Inventory of water-related features related to water supply. Such information is typically already in CCPs and updates are available from the state RIGIS database. Specific studies, such as USGS basin studies, should be available in summarized, understandable formats from the WRB staff.
- Delineation of the boundaries of watershed(s), aquifer recharge area(s), and various general parameters about groundwater basins. Summary of generalized water quality in the watershed. General data on groundwater should be available in summarized, understandable formats from the WRB staff. Other sources would be the DEM, DOH, WSSMP, USGS, and designated watershed councils.
- Identification of and review of existing drinking water sources, distribution systems, and water service district boundaries/map. These data are available from each individual district or suppliers or some municipalities maintain them. The Executive Summaries of Water Supply Systems Management Plans (WSSMP) are good sources for water supply, demand, conservation, and other related water supply information. The water availability estimates of the WR Board and DEM should be included.
- The strategies for the protection of water bodies, aquifers, groundwater basins, rivers, and streams used as source waters.
- Assessment of the capacity of existing and or planned water infrastructure to accommodate existing land uses and desired future land uses. This would include land-use based projections of build-out and water build-outs specific to each land use. The Executive Summaries of Water Supply Systems Management Plans (WSSMP) is a good source for water supply, demand, conservation, and other related water supply information.
- The need for the careful review and siting of major land uses and new major water users in relation to system capacities.
- Assessment of future opportunities for improving water use efficiency, and or recycling of waters in relation to system capacities.
- Drought planning and coordination responsibilities as described in more detail in a later section of this Part 3.
- Emergency response and coordination responsibilities as described in more detail in a later section of this Part 3.

Challenges to Integrating Comprehensive Planning and Water Supply Planning

Communities are often served by multiple districts, agencies, or companies for the different aspects of water management. State law already requires coordination between water suppliers and municipalities. The comprehensive planning requirements in RI direct communities to cross reference projected future water demands and projected needs to the availability of supplies in major water supply systems management plans (WSSMP). A municipality must address future land use, zoning, and growth projections and evaluate the availability of potable water within a 20-year planning horizon. To do this the DEM, WRB staff and water suppliers must assist communities in making determinations of available potable water as the CCP is drafted. It is important that in those communities where there are applicable WSSMPs and infrastructure replacement plans that these plans be consistent with the community comprehensive future use plans. A water supply section of a CCP should incorporate policies and procedures for coordinating all of the entities involved in water resources management for a community. Recommendations for a CCP to address concerning water supply along with suggested sources for such data are in the text box above.



Planners will face challenges in preparing a water supply section. Water districts often serve multiple cities and towns with other customers and other planning and reporting requirements. Some Towns, such as Smithfield have multiple water providers from different sources; some have a mixture of public suppliers and some have areas where there are no public supplies. Then there are those that rely entirely on our largest wholesaler of water, the Providence Water Supply Board. The data for a water supply section may be difficult to collect and analyze. The plans, time horizons, and projections made by various districts and jurisdictions may not be consistent or easily integrated. CCP follow municipal borders but water plans and data do not. It is important that the water section neither contradict nor diminish already agreed upon community goals contained in other elements of the CCP. Still, given the complexity of the topic and the critical role water will play in every community's future, a water section is a valuable way to focus on key issues and policy choices for water supply. Any water section policies should conform to those found in other elements, such as the land use, circulation, economic development, and open space elements. In particular, water use efficiency and water recycling can become major "sources" for communities to stretch their available supplies and enable growth without costly new water projects. These policies and actions can and should be referenced in a CCP.

See Goal IMP-1
Planning Policy 1
Strategies E-J

Although on a statewide basis there may be sufficient availability, shortages generally occur regionally in areas without the ability to share water. The problem is exacerbated by communities or systems that have endorsed expansions, either in land development or infrastructure, without analyzing the ability of the water supply source to accommodate new growth. Availability of water historically was not a factor in most development proposals.

Where water is not provided by large public suppliers it becomes more difficult for communities to quantify water availability and future demands. They will need the assistance of the WRB staff and DEM to provide factual data of this nature. Integrated planning requires municipal officials, state officials and water suppliers to coordinate information in order to better balance future demands against water availability.

Reservoir and surface storage are well documented but groundwater storage in the state is just beginning to be understood. Past and current precipitation (39-54 inches per year) is very well known; but what happens to the 3,321 MGD statewide that this adds up to is still not very well categorized. The WRB staff based upon 7 USGS watershed basin studies estimates that water use state wide is 134 MGD and that 120 MGD of that use is from public suppliers.[7]

The impacts of climate change on future base flows are not known yet with certainty but there will be changes to the status quo. Infiltration rates are very difficult to measure and they are only partially identified for RI in general. The use of water for all major categories (domestic, industrial, recreational, agricultural, etc.) has been studied by the USGS for groundwater basins. The information however still needs an interpretation by the WRB staff from the scientific data published in a useable format for land use decisions that various planners at municipal, regional and state levels will understand. An understanding of the water balance, uses/withdrawals, recharge rates, and amounts of stored water in aquifers is needed. The cumulative impacts of multiple extractions from groundwater, especially the impacts on base flow over time, are not known.

See Goal WRM 1
Resource Assessment Policy 1
Strategy A

The WR Board and staff are mandated by Rhode Island Water Use and Efficiency Act to provide water supply availability estimates for communities. These estimates need to be produced from the scientific data produced by the USGS and others. The USGS scientific formats do not enable most planners to use that data. It needs to be translated to an understandable form which allows the communities to readily incorporate water budgets into their CCPs. The communities then need assistance on developing a process from the WR Board staff on ways to use the availability estimates in their major subdivision and land development regulations for ongoing land use reviews.

See Goal IMP 1
Planning Policy 2

Water Rates

A water rate structure is a fee or schedule of fees designed to recover the utility's costs. Rates structures vary from supplier to supplier, but generally include three elements. First is consideration of the classifications of customers served (i.e., residential, commercial, and industrial). Second, is the frequency of billing. Third, are the charges or schedule of charges each classification will be assessed. It was recognized by the RI Legislature in 2009 in the Water Use and Efficiency Act that the price of water must reflect the total cost of providing water, including capital costs for the facilities and distribution systems, protection of public health and water quality, operations, maintenance and replacement of infrastructure, and depreciation of capital assets. According to the EPA, most Americans use about 100 gallons a day per person. As discussed in Part 2, Rhode Islander's annual water use is somewhat lower than that average at about 58-72 gallons per person each day. Compared with other developed countries, the United States has the lowest burden for drinking water bills when measured as a percentage of household income. Utilities in need of infrastructure upgrades and capital

[7] Strategic Planning Workshop, Water Resources Board, June 2, 2010

improvements are finding it essential to meet new federal requirements for health and safety. These costs need to be considered in establishing pricing and rate structures. Prices signal value to consumers and it is important for prices to reflect the increasing scarcity of water as well. Part of this value includes the increasing financial obligation needed to maintain our water systems' infrastructure. Most of the funding for water comes from the revenues generated by fees. Therefore, pricing water to accurately reflect the true costs of providing water services to consumers is needed to both maintain infrastructure and encourage conservation.

The most important source of revenue for water systems is their customers. The income customers provide is critical to ensuring that systems are operated properly and efficiently today—and that they will be able to continue providing high-quality service tomorrow. Fees will somewhat determine whether consumers use water efficiently. If prices are too low, consumers will use too much water. Fees and public education that explains about the actual price of the full cost of water service will help customers to recognize the value of that service and to become more aware of how much water they use and how they use it. A large portion of our drinking water providers are publicly-owned and have constrained funding sources for infrastructure repairs let alone public education efforts. Municipal and state laws can also constrain a publicly-owned utility's rate setting ability. Many current water prices do not cover the full and complete costs of past and future capital and operating costs. Price structures are available for water providers to recoup full cost pricing and encourage efficient water use. Full cost pricing is usually interpreted to mean factoring all costs - past and future debts, operations, maintenance and capital costs into fees. Full cost pricing can take the form of any of the rate structures mentioned below.

See Goal IMP 2
Planning Policy 2 & 3
8 Strategies

Another issue for setting water rates for suppliers in that under R.I. Gen. Law §39-3-33, the Public Utilities Commission regulates the one for-profit water supply utility in the State (United Water Rhode Island) and 5 other suppliers that serve areas outside their respective municipality. Under Rules adopted by the PUC the major suppliers listed below are regulated as to how they may charge rates, provide information to customers, provide public education, provide meters & service, collect past due water charges, conduct meter reading, perform billing, handle complaints of customers and terminate services. Additionally, minimum water pressure requirements are set along with procedures for service interruptions, records retention, accident protocols and providing water quality information to the public. Appendix D, Water Rates, contains more detailed information from the American Water Works Association about water rates.

The Public Utilities Commission regulates:

- Kent County Water Authority
- Newport Water Department
- Pawtucket Water Supply Board
- Providence Water Supply Board
- United Water Rhode Island
- Woonsocket Water Department

Current Water Rate Structures in Rhode Island

Declining Block Rates – A rate structure in which the unit price of each succeeding block of usage is charged at a lower unit rate than the previous block(s).

Flat Rates - Rates do not vary by customer characteristics or water usage.

Increasing Block Rates – Rates charge increasing volumetric rates for increasing consumption. (Also known as Inclining Block rate)

Residential Water Rates in RI[8]

The WRB staff annually reviews the State's major water supplier's residential water rates. A variety of different rate structures are used throughout the State. Surveyed are the 27 major suppliers who submit WSSMP to the WR Board and two other public suppliers; Block Island and Richmond. In 2010, the WRB staff compiled data and normalized the rates to compare the water rates between different systems. The 2010 survey (Figure 11, Residential Water Rates Survey 2010 below) compared the cost for a household consuming 60,000 gallons per year, which reflects a target consumption of 65 gallons per capita per day for an average household size of 2.54. These values were selected to coincide with the water use efficiency target that is being contemplated for major suppliers under the Water Use & Efficiency Act. The entire survey can be fold at www.wrb.ri.gov/2010ratessurvey.pdf. The Block island Water Company has the highest rates in the State at $1,075 annually per household while the Smithfield Water Supply Board has the lowest rates at $175 annually per household. The average normalized annual cost for Rhode Islanders is about $345 per household.

Figure 11, Residential Water Rates Survey 2010

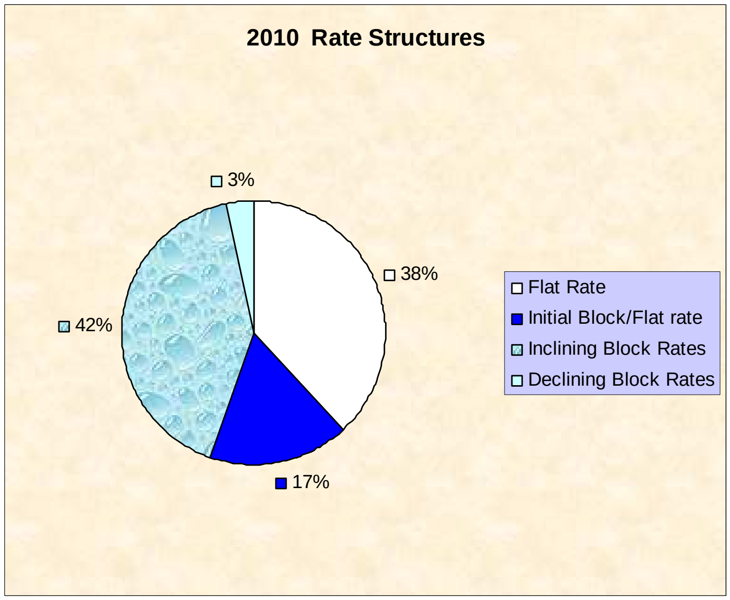
Highest

Water Supplier	Annual Water Bill for 60,000gal/yr (65gpcd)	Average Cost-per-1000gal
Block Island Water	$1,075.02	$17.92
North Tiverton Fire District	$569.14	$9.49
Jamestown Water Division	$530.28	$8.84
Bristol County Water Authority	$529.70	$8.83
Pascoag Utility District	$528.70	$8.81
North Smithfield Water Department	$501.00	$8.35
Kent County Water Authority	$416.12	$6.94
Kingston Water District	$405.67	$6.76
Newport Water Division	$376.24	$6.27
Pawtucket Water Supply Board	$352.36	$5.87
East Providence Water Department	$324.22	$5.40
Johnston Water Control Facility	$322.58	$5.38
Stone Bridge Water District	$320.40	$5.34
Woonsocket Water Dept.	$314.46	$5.24
Portsmouth Water & Fire District	$311.60	$5.19
Greenville Water District	$308.50	$5.14
Cumberland Water Department	$306.90	$5.12
Harrisville Fire District	$293.60	$4.89
Providence Water Supply Board	$290.56	$4.84
North Kingstown Water Deptartment	$276.60	$4.61
East Smithfield Water District	$257.20	$4.29
South Kingstown Water Department	$251.02	$4.18
Lincoln Water Commission	$230.50	$3.84
Westerly Water Department	$229.95	$3.83
United Water Rhode Island	$225.08	$3.75
Warwick Water Department	$224.95	$3.75
Richmond Water Supply System	$208.00	$3.47
Narragansett Water Department	$196.35	$3.27
Smithfield Water Supply Board	$175.20	$2.92

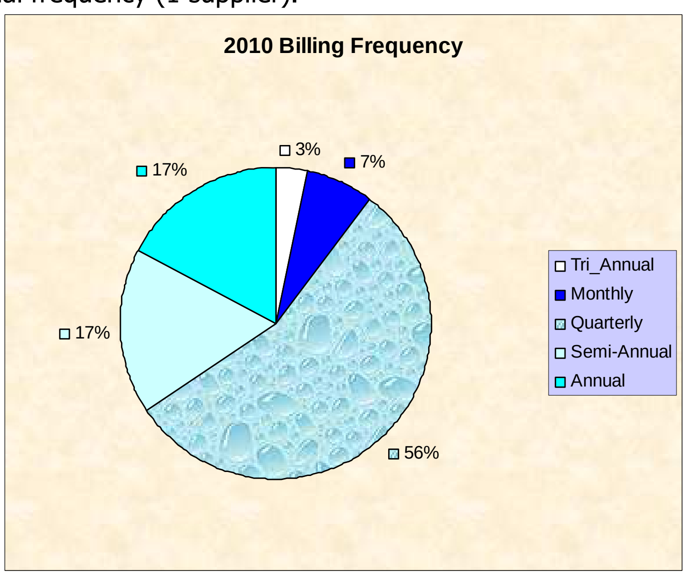
Lowest

[8] Water Resources Board 2010 Annual Report, http://www.wrb.ri.gov/reports/AR_RIWRB_2010.pdf

In 2003, the WR Board WPACA Sub-Committee surveyed water rates and found that; 15 had flat rates, 3 had declining block rates, 10 had inclining block rates and 1 had an unknown structure. Based upon the 2010 survey by the WRB staff, some of the rate structures have changed since 2003. There were 11 or 38 % of suppliers that still use a flat rate, 5 or 17% have an initial fee then a flat rate, 12 or 42% have an inclining block rate and only 1 or 3% still have a declining block rate structure.



In additional to different rate structures, water suppliers use a variety of different billing frequencies. The WR Board WPACA Sub-Committee surveyed water billing frequencies in 2003 and found that 14 suppliers billed quarterly,1 billed tri-annually, 1 billed semi-annually, 6 billed annually, and 8 systems had unknown frequencies. Based upon the 2010 survey by the WRB staff, the majority of water suppliers use a quarterly billing cycle (16 of 29 or 56%). More than a third (10 suppliers or 34%) use a semi-annual or annual billing cycle and the reminder either use a monthly (suppliers) or tri-annual frequency (1 supplier).



Regionalization

Rhode Islanders pride themselves on independence and resourcefulness. Our State Capital is topped by a bronze likeness of "The Independent Man". Our heritage is a State that historically has put the ideal of individual liberty before all others. This is pretty much true for water suppliers. Most of our 490 community water supply services are provided on a localized scale by local people. Water has been traditionally recognized as a local need and met with local resources. Most water systems operate independently of other systems except during water supply emergencies. We are now recognizing that as population shifts around the State, and water use changes that the water supply equation has become more complex and more than local solutions may be needed. We know for some groundwater dependent areas that locally available resources are stressed. It is worth considering that water supply provision could be better served by regionalization. This Section offers a summary of the key ideas related to regionalization that are most pertinent to RI water suppliers.

Regionalization has often been referred to using various terms. 'Consolidation' is often used interchangeably with the terms restructuring, regionalization, and cooperation. Consolidation activities can range from multiple water systems developing an agreement for sharing an operator to one water system acquiring the ownership and control of another. Although it is not always the end result, regionalization can lead to multiple systems physically interconnecting their infrastructures. Regionalization has also been defined as an administrative or physical combination of multiple water systems as a way to improve planning, operation, and/or management. For the purposes of this Plan, regionalization is defined as any form of cooperation between multiple water systems including, but not limited to, activities resulting in a change in ownership.

> The **American Water Works Association** policy encourages regional solutions to resource management, water supply and utility service needs. It defines regionalization as a creation of an appropriate management or contractual administrative organization or a coordinated physical system plan of 2 or more community water systems in a geographical area for the purpose of utilizing common resources and facilities to their optimum advantage.

Regionalization does work in RI. When one looks to the history of other infrastructure and its organization in our State, regionalization is very much a reality. Within the wastewater arena, the State (by legislation) mandated regional approaches to solving wastewater pollution problems. In response to increasing water pollution in the Blackstone Valley in 1947, the General Assembly passed legislation establishing the Blackstone Valley Sewer District. The area was recognized as a major source of pollution because large volumes of waste were introduced into the rivers with insufficient or no treatment at that time. Title 46, chapter 21 created the Blackstone Valley District Commission and charged it to deal with the sewage and industrial wastes which originated in municipalities and industries located in the Blackstone and Moshassuck Valleys. Governor Pastore appointed a Commission which was charged with issuing state bonds to be used for the planning, construction, operation, and maintenance of wastewater facilities to abate the wastewater pollution. The District created was about 75 square miles and drained by 3 rivers; the Blackstone, Moshassuck and the Ten Mile Rivers. It encompassed the Towns of Lincoln and Cumberland and the Cites of East Providence, Pawtucket and Central Falls. Engineering studies and plans were completed by the Commission in 1948 and the Bucklin Point Wastewater Treatment Plant in East Providence began operating in 1952.

Wastewater infrastructure in the rest of our metropolitan area can trace its history to 1854 when the Providence City Council reacted to a series of deadly cholera epidemics before the Civil War. The Council began efforts to eliminate the water pollution causing the cholera. In the 1870's, the City of Providence constructed a sewer system to convey the City's waste through a series of sewer outfalls emptying directly into Providence's rivers and harbor. In 1901, the City added centralized treatment of the waste by constructing the Field's Point Treatment Plant.

This sewage treatment plant ran into maintenance and financial problems after Congress enacted the federal Clean Water Act in 1972. The Clean Water Act sets national standards for pollution reduction and defines limits that must be achieved by the public's wastewater treatment plants. The Field's Point Plant had declined to the point where nearly 65 million gallons of untreated or partially treated sewage flowed into Rhode Island's waters everyday. In 1979 the EPA ordered the City of Providence to address the chronic pollution problem associated with the aged Field's Point Plant and CSO discharges, which violated the Clean Water Act. Governor Garrahy created a Governor's Sewerage Facilities Task Force to address the EPA mandates. The Task Force recommended the creation of a quasi-public commission to take over and rehabilitate the Field's Point facility.

Based on the recommendation of the Task Force, the Narragansett Bay Commission (NBC) was created in 1980 by the General Assembly to address the federal mandate and improve the quality of Narragansett Bay. The NBC is a public corporation of the State having a distinct legal existence from the State. It is regulated by the Public Utilities Commission. It provides wastewater collection and treatment services to over 350,000 people in a region consisting of Providence, North Providence, Johnston, Pawtucket, Central Falls, Lincoln, Cumberland, East Providence, and portions of Smithfield and Cranston. It was modeled after the Blackstone Valley District which it absorbed when the system was activated in 1991. The actions of the State in creating the NBC, presents parallels which could be applicable to our water supply challenges in the future.

Major drivers to regionalize and create the NBC;

- There was an unmet federal mandate to address existing water pollution threatening public health.
- Economy of scale and technology dictated the desirability of having 1 entity to coordinate an overall plan to reduce the discharge of sewerage and industrial wastes originating from the Blackstone and Moshassuck Valleys.
- The method used was to create a new commission, for the acquisition, planning, construction, financing, extension, improvement, and operation and maintenance of publicly owned sewage treatment facilities in a new water quality management district.
- The most efficient method of effectuating such an overall plan was to merge the existing Blackstone Valley District Commission into the new district.

As discussed in Part 2, many of our public systems have limited capacity to plan ahead and take advantage of available options. Most are concerned with day-to-day operations and short-term viability rather than affordability and long-term sustainability. They often struggle to provide increased levels of service in a staged, orderly manner. Very few look ahead to addressing the future growth of the system and future water quality concerns. In some cases regionalization may be an answer for them. This is a very contentious issue for most water systems, therefore it very rarely happens. Regionalization should be examined as one of many approaches that can be used to help solve or relieve these and other challenges. Although it would seem that water systems would readily consider regionalization as a solution for problems, many systems do not. This may be due to a lack of understanding or misconceptions about regionalization.

The prior efforts of the Drought Steering Committee provides more evidence of the effectiveness of water supply planning through regional cooperation and conservation when addressing water supply issues. There is a growing need to develop a more strategic approach to plan for and consider regional water supply issues in the State.

Advantages of Regionalization

Regionalization is often a suggested remedy for many of the challenges that community water systems face. Water systems participating in some type of regionalization activity can receive economical, financial, and operational benefits. Water system customers and state regulators can also benefit from water systems developing partnerships and working together. Listed below are some advantages for participating in regionalization activities.

- Increased economies of scale. Fixed capital, operation, and maintenance costs will be spread over a larger population base lowering the per customer costs which can potentially lower water rates.
- Greater access to capital making it easier to borrow funds to make the necessary improvements including those required to comply with mandated regulations.
- A larger customer base will be created leading to greater access of grant and public funding.
- Duplicated services can be eliminated to save money and may lead to greater efficiency of personnel, equipment, operation and maintenance, billing, and management.
- Access to supplemental emergency water sources. Systems that may only have one water source will have access to an additional source in the case of emergencies.
- Access to more skilled employees, which increases the level of expertise.
- Fewer systems to regulate meaning that State regulators can spend more time assisting a greater percentage of systems.
- Low cost or cost sharing means for complying with regulations.

Disadvantages of Regionalization

Regionalization can be a useful tool for solving problems, but regionalization is not the answer for all problems and challenges water systems face. There are some barriers that cause systems to use regionalization only as a last resort. Short-term costs often associated with restructuring can hinder systems from pursuing it. Many small water associations may also be hesitant to pursue any of the regionalization strategies because of the fear of losing independence. Listed below are some of the barriers and disadvantages associated with consolidating.

- Potentially feeling the loss of autonomy and independence.
- Debt can be acquired when a water system merges or acquires a system that has pre-existing debts.
- Possible loss of jobs.
- Customers may get confused about who actually provides their water service.
- Political barriers, personal differences, and mistrust.
- Cost and benefit inequities may occur. Some communities may bear a disproportionate share of the costs involved with regionalization while receiving equal benefits.
- It is sometimes impossible for water systems to physically interconnect due to hydraulics and other design issues with the systems involved.
- The management goal of the systems involved may be different causing conflict and tension.

Approaches to Regionalization

There are a variety of approaches to regionalization. Regionalization activities can be considered non-structural or structural. Nonstructural approaches involve creating partnerships with other entities, typically in the form of managerial or administrative arrangements. Structural approaches create a new management or political entity and have a more direct impact on the water supplier. Non-structural approaches result in "procedural" changes rather than organizational changes. Structural approaches result in the reorganization of the entities involved. Nonstructural approaches tend to be less expensive to implement than structural approaches and have less affect on water suppliers' independence.

Questions when considering regionalization:

- How do the systems' expenses compare to their income?
- What are the conditions of the infrastructure?
- How much can the system afford to contribute to the costs of needed improvements?
- How would you describe the systems' rate base?
- Are the price and terms reasonable?
- How will customers be impacted?
- Are any additional investments required?
- Are there any other alternatives and what are the impacts of not pursuing regionalization?
- Is the current staff capable of operating the facilities of the combined system?
- How does the public feel about a potential regionalization?

When considering any form of regionalization, it is imperative to evaluate the specific situations of all involved entities before making a final decision. When deciding which regionalization solution is best suited for a water system, it is imperative for decision-makers to consider the needs of their individual system. These needs depend on a variety of factors such as local water quality, nature and cost of required improvements, current user and customer ability to pay, geography and distance between systems, availability of grants and loans, availability of technical assistance, and local political considerations. The option that decision-makers choose to pursue should have the following four characteristics: economic efficiency, fiscal equity, political accountability, and administrative effectiveness.

While there are legal and political barriers to regionalization, many states and utility districts have established new laws encouraging the practice. North Carolina, Florida, Virginia, Colorado, California, New Jersey, Pennsylvania, Maryland and Massachusetts passed legislation to promote regionalization to some degree. EPA's authority to form regionalization policy is limited under the SDWA to the provisions in the SRF (state revolving funds), enforcement, and variance sections). EPA supports regionalization when it will result in the greatest public health protection for the consumers.

RI General Law § 46-30, Public Water Supply Systems Act of 1995, regulates regionalization of water systems.

Rhode Island already has a law regulating the regionalization of public water systems, the Public Water Supply Systems Act of 1995 (§ 46-30). The law recognizes that financial and regulatory pressures may force some small public water supply systems into economically losing propositions and that economy and efficiency dictate the desirability to combine with other public water supply systems. The Act provides a mechanism to combine small public water supply systems and/or annex small systems to adjacent water supplies in order to provide viable water supplies capable of meeting federal and state drinking water regulations at all times.

Under the Law, the merger process begins with the petition of a local jurisdiction, city, town, water authority, water district, small supplier, or small public water supply system to the adjacent supplier for the purpose of merging or annexing with the supplier. The merger must have the consent of the governing board of each respective entity or, in the case of a municipally owned system, a vote of the majority of the entire town or city council or, in the case of a private supplier, the consent of the owner of the facilities in question and the governing board of the petitioned governing agency. The merger is paid for by calculating the financial obligation for the upgrading of the public water supply system to be annexed and the continued management and operational responsibility to bring that system into compliance with the applicable regulations and on parity with the existing facilities of the governing agency. An annexation fee to the governing agency's existing rate structure is added to the customer's accounts, to be annexed.

The annexation fee will terminate when the contractual obligation for amortizing the upgrading of the system petitioning annexation has been discharged or no later than 30 years from the date of financing said improvements, whichever comes first. Upon the merger of the public water supply system and the governing agency, the governing agency assumes responsibility for the planning, construction, operation, and maintenance of the appropriate facilities, water mains and appurtenances of the merged public water supply system. This provision of law is not used very often. The DOH commented that lack of incentives for regionalization perhaps has contributed to the infective use of this Section of Law. Also according to DOH large water systems are not supportive of the State having a "merger" authority but some small systems are simply not viable and larger water systems have no reason to take on those liabilities voluntarily.

As discussed in Part 2, in RI, the 28 large public water suppliers serve 92% of the State's resident population. Private systems supply the remaining 8% of the population. The 28 major water suppliers (and the 2 smaller public systems of Richmond and Block Island) provide 98% of this 92%. The remaining 458 small community systems provide the remaining 2% of public water. Continuing the current status quo scenario of multiple systems for the State could result in portions of the State struggling to meet water demands while other portions remain relatively water rich. The new regulatory emphasis on water quality in the distribution system will increase the need for the cooperation and coordination of consecutive water systems. Other future regulatory requirements will undoubtedly raise the cost of doing business. RI has multiple tiers of opportunities for regionalization. One opportunity is at the macro level is for the WR Board to study the 28 major systems for regionalization potential within the four water planning areas of the WR Board Strategic plan.

Another opportunity is to encourage in WSSMP and CCP the regionalization of multiple major systems within a single municipality such as in the Tiverton Case Study that follows. Although offering many advantages, this type of regionalization is often the most difficult to accomplish due to perceived political constraints. Many suppliers would prefer to remain more autonomous and to maintain greater control over owned resources. There are a number of communities where there still are multiple suppliers where this type of regionalization could occur.

Cities/Towns with Multiple Major Water Suppliers

City / Town	Major Water Systems
Burrillville	Harrisville Fire District & Pascoag Utility District
Cranston	Kent County Water Authority & Providence Water Supply Board
Cumberland	Cumberland Water Department & Pawtucket Water Supply Board
East Greenwich	Kent County Water Authority & Warwick Water Division
Johnston	Johnston Water Control Board & Providence Water Supply Board
Narragansett	Narragansett Water Department, North Kingstown Water Department & United Water Rhode Island
North Kingstown	North Kingstown Water Department, Quonset Point Business Park Water Department, Kent County Water Authority
Smithfield	East Smithfield Water District, Greenville Water District & Smithfield Water Supply Board
South Kingstown	Kingston Water District, Narragansett Water District, South Kingstown Water Department, South County Water District, United Water RI & University of RI Water Department
Tiverton	North Tiverton Fire District & Stone Bridge Fire District
Warwick	Kent County Water Authority & Warwick Water Division

A third way and perhaps the most sensible form of regionalization is nonstructural cooperation by some of the 458 smaller community systems. As outlined in this Section, there are a wide variety of approaches ranging from simple cooperation among systems for mutual aid, cost-sharing of materials, sharing of contract service agreements, to contracting with larger major suppliers for technical oversight and administration of the smaller systems. Regionalization and ongoing assistance from the WRB staff can improve the technical, managerial, and financial management of smaller water systems. This Plan puts forth that water supply regionalization represents a way to meet many of the water supply goals of the State for all systems.

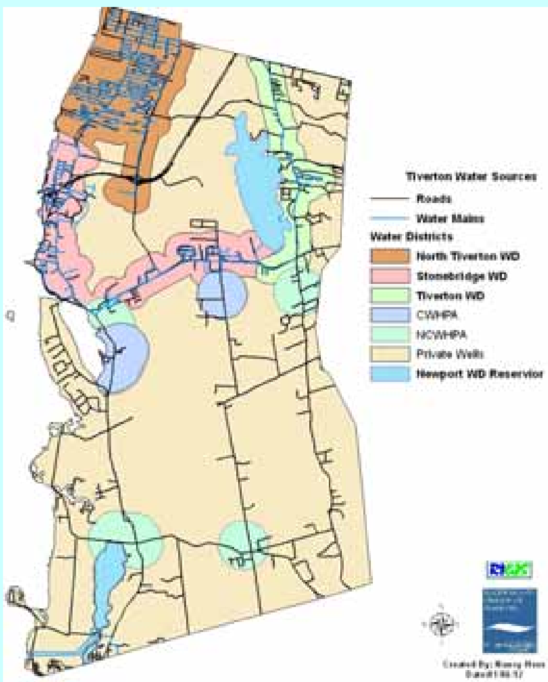
See Goal IMP-1
Planning Policy #2
Strategies A - G

Regionalization: Tiverton

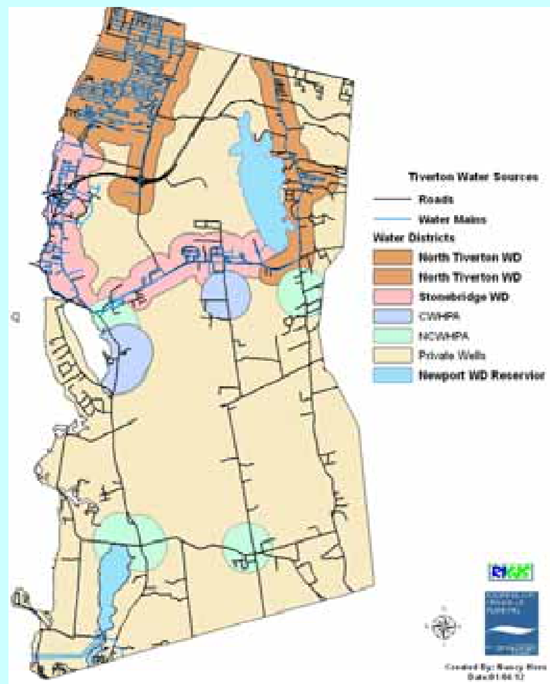
North Tiverton Fire District & Tiverton Water District

The densely settled northeast portion of the Town is served by public water from 2 water systems; the Stone Bridge Fire District and the North Tiverton Fire District (NTFD). The remainder of the town is serviced by small community and non-community systems or by private wells. The NTFD absorbed the former Tiverton Water Authority (TWA) in 2002. This was a mutual and voluntary effort. Both systems were wholesale purchasers of potable water from the same sources. Absorption of the former town managed TWA has taken a step towards creating a town-wide water system which is consistent with the Town's Comprehensive Plan policy for developing a long-range plan for the unification of water management authorities within the Town.

Before: 3 water districts



After: 2 water districts



The NTFD does not manage any water supply sources. The District purchases water on a wholesale basis from the Stone Bridge Fire District (from Stafford Pond in Tiverton) and the City of Fall River, Massachusetts Watuppa Water Board. The Fire District maintains the system. Since acquiring the TWA, NTFD has jurisdiction over the entire town, except for the area served by the Stone Bridge Fire District. The NTFD district presently serves nearly 3,000 households, and would potentially serve new developments east of Stafford Pond and south of Bulgarmarsh Road.

Integrated Management and Planning (IMP) Goals and Policies

Goal IMP-1: Integrate water resources and supply planning for water systems across intergovernmental and regional jurisdictions.

Planning Policies:

1. Include water quality/quantity issues for water supply sources in state water use and or municipal land use regulations. (Strategies A – J)

2. Promote regional resource planning and management for existing and future sources of water supply. (Strategies A – E)

Goal IMP-2: Ensure the adequate technical, managerial, and financial capacity of water systems.

Planning Policies:

1. Ensure the reliability of water supply infrastructure and water supply sources. (Strategies A – N)

2. Ensure the investment in and charge all customers the full capital, operating and replacement costs of water systems. (Strategies A – L)

3. Fairly impose the total cost of meeting the requirements of sustainability and demand management on all users. (Strategies A – D)

4. Encourage and facilitate regionalization where viable. (Strategies A – G)

Goal IMP-3: Manage and plan for water systems that support sustainable, compact land use and concentrate development within the urban service boundary and or growth centers.

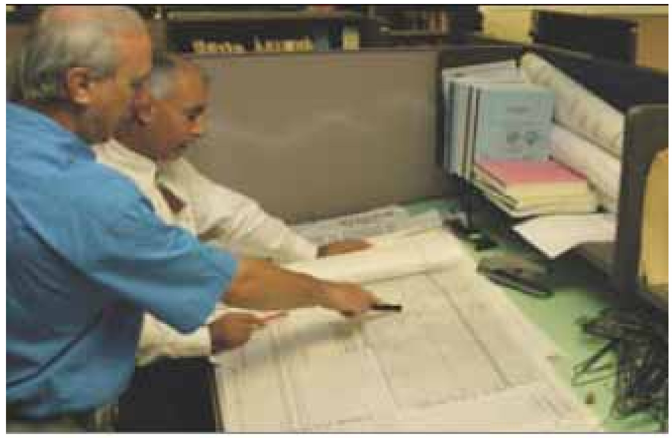
Planning Policies:

1. Consider the cumulative impacts on water quality, overall water availability and public health when establishing the density of development. (Strategies A – E)

2. Match future land use to existing water supply availability & demand, water use priorities and infrastructure. (Strategies A – E)

Water Resource Management (WRM)

Resource Assessment



This section identifies the key areas of concern in formulating policies and strategies dealing with the ongoing need for technical water-use data by the multiple levels of water resource management agencies. Assessing these resources and their condition, as well as determining what factors influence the ability to use these resources in a sustainable manner, is vital to effective water management. To ensure that long-term needs for water are met in a sustainable manner, however, we must build on existing data with a systematic assessment of water availability.

If Rhode Island is to continue ongoing effective water resource planning that will allow continued sustainable use and enjoyment of the State's water resources, the State must define the capabilities and current use of these water resources. These resource capabilities must be defined in terms of the ability of each water resource to support additional water withdrawals without unreasonably foreclosing other opportunities for resource use or otherwise causing undesirable impacts upon the resource. A thorough assessment of resource capacity will require compilation of a substantial information base, a comprehensive monitoring program, and a well-coordinated system for information management. This system will include the compilation of existing data, the coordination and integration of ongoing governmental and voluntary monitoring programs, the identification of gaps in current information and the development of a program to fill the gaps. The information collected and analyzed for these resource assessments must also be available to all state agencies and all other entities involved in planning and implementing resource management plans, as well as to the general public.

**See Goal WRM-1
Resource Assessment
Policy #1
Strategies A - H**

The WR Board and staff should continue agency specific strategic planning on a regular basis to support water resources planning. This, in turn, could improve coordination among the different agencies and levels of government involved in potable water supply management which would accomplish some of the policies in the Integrated Management & Planning Section. Data now supports the realization that withdrawal of fresh surface water in some parts of the state is approaching the operational capacities of developed water supplies and stressing the ecological functions of the natural resources the systems are dependent upon. A thorough evaluation of alternatives to these situations requires accurate and comparable water use data, and the development and implementation of a well-thought-out strategic plan by the WR Board and staff.

**See Goal WRM-1
Resource Assessment
Policy #1
Strategy H**

The WR Board strategic planning activities should provide a foundation for the more efficient management of the consumptive use of water and protection of the ecological functions of water resources. Resource assessments should standardize and define hydrologic units and identify the geographic boundaries from which a water source derives its waters (i.e., sub-basins or watersheds, aquifers). Resource assessments should also evaluate historic flows and flow regimes of water resources. Historic flow regimes are not necessarily the same as natural flow regimes. Human activities have altered the flow regimes in many of Rhode Island's water resources, and historic flow regimes reflect the location, size and operation of water storage facilities, water withdrawals, water returns, land use and other factors.

A comprehensive stream-gaging program is needed that provides hydrologic information needed to help define, use, and manage the State's water resources. Currently, the State has very limited coverage with only 19 long-term continuous gages. One of the recommendations from the Streamflow Subcommittee's final report to the WR Board Water Allocation Program Advisory Committee (WAPAC) was to develop a comprehensive streamflow gaging network for RI. The WAPAC recognized that there are many issues in assessing the State's water resources, such as understanding the impact of out-of state activities, how inter-basin transfers work, understanding the pollutant loadings to Narragansett Bay, and how to calculate the demand for new and supplemental sources of public drinking water. The stream flow committee recommended this comprehensive gaging network to support the water resource management functions of various State and local agencies. The subcommittee's recommendation called for the 19 existing continuous gages be maintained and 35 additional gages be activated.[9]

See Goal WRM-1
Resource Assessment
Policy #1
Strategy F

Finally, resource assessment activities need to determine the sustainable yield and consumptive use for each water source. These determinations would be based on dry year conditions, to provide a baseline for water supply planning purposes. Such assessments should be conducted as part of the WR Board's Water Allocation Program as discussed in greater detail in the issues of Part 2.

See Goal WRM-1
Resource Assessment
Policy #1
Strategies A - H

Goal WRM-1: Manage and plan for the sustainable water use and development of the water resources of the State.

Resource Assessment Policy

- Ensure the availability of technical data necessary for the overall long-term provision of potable water statewide
  Strategies A-H

[9] *Recommendations for a Streamflow Gaging Network in Rhode Island,* WRB Water Allocation Program Advisory Committee, Streamflow Committee, April 2004

Water Quantity

This section identifies the key areas of concern in formulating policies and strategies dealing with the efficient management of the use of potable water. Whether at the watershed scale or water system scale, a prominent quantity issue is competition for water by multiple users, including domestic, industrial, commercial, recreational, and agricultural users. In RI, drinking water is generally available when, where, and in the quantity needed, however this is not always the case, Competition for water is most evident during the summer months – when increased pumping to meet demand for outdoor water use and seasonal populations "competes" with recreational users and others including the aquatic ecosystem dependent upon continuously flowing streams. The competition makes it all the more necessary to determine how much water is available to use It is critical that we remain mindful of the varied interests competing for the use of water; however, it is just as essential to realize that the quality and quantity of our drinking water are essential to protecting public health and the essence of our existence.

**See Goal WRM-1
Quantity Policy #2
Strategies A - F**

As competing demands on water supplies are expected to continue in Rhode Island, more planning and management of water resources will be required to ensure that water supply shortages and unhealthy low stream flows do not become ongoing problems. There is evidence of shortages in the increasing frequency of mandatory and voluntary water bans in some communities and decreased or even interrupted flows in some streams and tributaries during critical low water periods.

In theory, consumers can be persuaded to curtail water use during times of drought, and implementing drought or emergency management programs could reduce demand perhaps by several million gallons per day in a major system. The keys to success are cooperation, strong and active public education programs, and enforcement. It is essential not only to avert conflict but to protect the hydrological connections that underpin a functional system.

The issue raises the question of priorities -- how tolerant are we to reducing volumes for specific uses? Are we willing to forgo summer car washing and lawn watering on a regular basis? Are we ready to commit a guaranteed volumetric flow to farmers? How can we maintain flow rates for fish, aquatic habitat, and recreation along river corridors? Are we able to support economic growth and maintain a reliable supply of potable water for our citizens? These are all value judgments that must be decided by a process that appropriately assigns responsibility for decision-making of this magnitude. Rhode Island State Law assigns responsibility for water management to several agencies. Decisions must be made through a process that includes representation of the multiple users and interests.

It is the intent of this Plan that within all defined hydrologic systems of surface water and groundwater that sufficient amounts will remain within a water source to allow all users and uses – present and future – reasonable opportunities to benefit from the values provided by the resources. Water use is consumptive when water is removed from a specified hydrologic system of surface water or groundwater and is not returned to that same system within a time frame that allows contemporary users and uses to avail themselves of the benefits of that quantity of water.

Consideration of consumptive use, in addition to water withdrawals, can more clearly show how water uses in some areas affect the water availability at other points within the water source and at points hydrologically connected to the source. With accurate reporting by users, the cumulative consumption from a water source can be quantified and compared with an assessment of the water available from that source for consumptive use. This consumptive use assessment, which is intended to reflect the capabilities of these resources under dry year conditions, will incorporate the effects of the current management of that water source, including surface water storage or other practices that supplement available water.

A comprehensive accounting of the yields for all aquifers in Rhode Island is likely to be extraordinarily expensive, time consuming, and may not produce results that are equally useful for each aquifer or overlying geographic area. Therefore, in deciding where and when to apply capital to this task, several variables must be considered: the functional characteristics of the aquifer, existing evidence of adverse affects due to withdrawals from the aquifer, and whether forecasts suggest significant increases in demands placed on that aquifer in the years ahead. While the process to be employed to develop a consumptive use assessment for a given aquifer must be fundamentally the same across the state, this approach will allow priorities and financial resources to be properly placed. Absent site-specific studies, the Streamflow Depletion Methodology is a tool for DEM to use in issuing wetland permits by quantifying the allowable net depletion effect that the proposed water withdrawal(s) can have on a stream.

Resource assessments and forecasts of future demands will allow identification of gaps between water needs and the water expected to be available for consumptive use under dry year conditions. They will also support selection of the management practices to be used to meet current and future needs while protecting resource users and uses. This policy provides flexibility in the use of an array of water quantity management practices. Stressing efficient use of water by all users, which is the most economically efficient way of meeting water needs, will be a priority water quantity management practice for implementation across the state. A variety of water quantity management practices can be implemented to manage and use water resources in conformity with the integrated water policy established by this Plan. The purpose of these practices is to manage the consumptive use of water from a given source in a sustainable manner by managing demand and returns or, when it can be done without unreasonably foreclosing opportunities for reasonable use by other water users, to supplement the consumptive use assessment of a water source.

Goal WRM-1: Manage and plan for the sustainable water use and development of the water resources of the State.

Water Quantity Policy

- Manage water use and withdrawals based on water availability that considers hydrologic capacity, public health, and protection of aquatic resources.
  Strategies A - F

Climate Change

This section identifies the key areas of concern in formulating policies and strategies dealing with Climate Change. It is important to note that not all the near-term impacts of climate change are expected to be disruptive, and this Section focuses on impacts that are of concern for water suppliers. Droughts, changing patterns of precipitation and snowmelt, and increased water loss to evaporation as a result of warmer air temperature may result in changes to the availability of water for drinking. In some places in the State, sea level rise and salt water intrusion will have the same effect. Warmer air temperatures may also result in increased demands on drinking water supplies and the water needs for agriculture, industry and energy production are likely to increase.

There remains significant uncertainty about the exact scope and timing of climate change-related impacts on water resources for RI. Water suppliers and communities of the State need to access emerging climate change information, evaluate potential impacts of climate change on water programs, and identify needed responses. Better information and technical assistance to understand the likely impacts on watersheds, water supply, water infrastructure, and water quality is needed.[10] Temperature change drives other changes in natural environment processes that in turn affect the quality and quantity of our water resources.

The future effects of climate change on water resources in the State will depend on trends in both climatic and non-climatic factors. Evaluating these impacts will be challenging because water availability, quality and stream flow are sensitive to changes in temperature and precipitation. Other important factors include increased demand for water caused by population growth, changes in the economy, development of new technologies, changes in watershed characteristics and water management decisions. Decisions on water infrastructure and new supplies should follow the precautionary principles of preparedness based upon advice of the Environmental Protection Agency (EPA). Sea level rise will affect a range of water programs and pose significant challenges for water system managers and land use planners;

- emergency plans for drinking water systems need to recognize long-term projections for sea level rise and to consider relocating facilities or intakes to prevent salt water intruding into freshwater aquifers used for drinking water supply;
- the possibility of increased risk of high flow and high velocity events due to intense storms as well as potential low flow periods need to recognized;
- damage from intense storms may increase the demand for public infrastructure funding and may require re-prioritizing of infrastructure projects;
- greater use of biological monitoring to help water system managers assess system impacts of higher velocities from more intense storms and other climate change impacts; and
- watershed-level planning will need to incorporate an integrated approach to coastal management in light of sea level rise including land use planning, building codes, land acquisition and easements, shoreline protection structures, wetlands management, and related programs.

[10] http://www.epa.gov/climatechange/effects/water/index.html

Climate change introduces an additional element of uncertainty about future water resource management. The degree of management of water resources in the State varies by the capacity of our suppliers. Strategies are needed to address these issues. Implementation of adaptation measures, such as water conservation, allocation of water, and the application of appropriate management practices will have an important role to play in determining the impacts of climate change on water resources.[11] Water utilities must lead in building partnerships that will use integrated water resource planning and management as a tool for preserving and restoring water resources while meeting human and ecosystem needs for water in the context of a changing climate.

The residents of the State face increasing risks of: rising temperatures, more extreme weather, and the erosion of the coastline by storm surges and rising waters from climate change. Such changes will endanger coastal human populations and water supply infrastructure, as well as fisheries, sea grass, and marsh ecosystems. The increased risks need to be addressed through revising building codes, improving and updating emergency plans, prioritizing adaptation actions, and planning for such in on-going land development, transportation systems and infrastructure investments in the State. Following the lead and information available at the EPA will be critical for addressing this topic in RI. Water utilities must be ready to use existing partnerships for integrated water resource planning and management as a tool for preserving water resources while meeting human and ecosystem needs for water in the context of a changing climate.

See Goal WRM-1
Climate Chage Policy #3
Strategies A - C

The EPA Toolbox provides access to resources that support climate adaptation planning at water utilities. The Toolbox is organized into two sections: a highlighted resources section provides a selection of resources from each category and a map to help users select resources by geographic region; and a second section that features a search function that helps users to select resources based on their location, the size and type of their utility, and resources of interest. The Toolbox can be accessed at: http://www.epa.gov/safewater/watersecurity/climate/toolbox.html.

Goal WRM-1: Manage and plan for the sustainable water use and development of the water resources of the State.

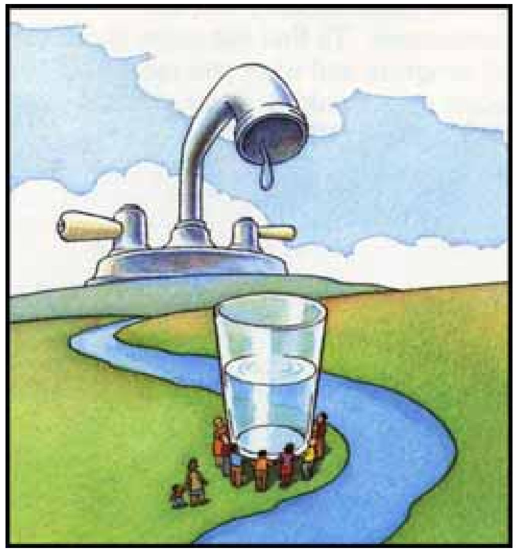
Climate Change Policy

- Ensure adequate potable supplies for now and the future in the context of a changing climate.

  Strategies A - C

[11] Ibid

Potable Supply Management



This section identifies the key areas of concern in formulating policies and strategies dealing with potable water supply management. Techniques for meeting existing and potential demands can be either structural or programmatic. In recent years the task of potable water supply management has been expanded beyond the realm of the component parts of the system infrastructure to the consumer level, to activities concerning residents, landowners, and assessments of the cumulative activities within the watershed that may threaten water supply.

These ideas reflect the realization that safeguarding sources to meet current and future needs is a product of management practices that occur within the watershed and/or groundwater recharge areas. They also appeal to a need to incorporate community initiative and public awareness into the process of comprehensive management, and to implement practical efficiency initiatives to extend the utility of existing supplies. Source water protection refers to the practical objective of preventing pollution and degradation of drinking water sources. Whether a water source is pristine or whether it has already experienced some water quality impacts, there is no time like the present to ensure it will be protected into the future. Effective supply management extends to protection of the quantity and quality of the resource.

Even with the most well-thought-out policy guidelines, the impact caused by the need for a large amount of additional supply can create an extremely difficult management situation. Whether the need comes from source contamination, expansion of a service area, the requirements of a single new user, or by sprawling land uses, the problem has traditionally been resolved by replacement of the supply source, often by tying in to the Scituate Reservoir. The perceived abundance and availability of this as a source of supply in the past obviated the need to seek other solutions to water supply problems. It is now recognized that, while we are fortunate to have such a high-quality water source, the source is finite and will require integrated management in order to meet present and future needs.

As traditional supply sources approach full utilization, and water systems confront increasing costs for every component of their activity, more emphasis is made on developing alternatives to new sources and stronger implementation of demand management activities. Some supply management policies address finding new source alternatives or what conditions must exist to allow development of a new water source. These provisions result from the idea that maximizing use of existing supplies is a more reasonable, cost-efficient, and environmentally preferred option than the development of new sources, especially surface water sources. More emphasis is shifting to managing the use of potable water for non-potable purpose and trying to match the quality of water provided with the intended end use.

See Goal WRM-1
Potable Supply Policy #4
Strategies A - E

Small water systems, which comprise the majority of the State's potable water systems, primarily need help to protect the public health and to meet regulatory requirements. Many of them were built by developers and left with no business or capital planning mechanism in place. DOH says that the people that rely on these systems tend to ignore the system until it fails. The general failure to maintain the system and do any financial planning is the most common problem. Compliance monitoring just identifies that the system is failing. There is no blanket provision for state assistance to these small and very small water systems. Regionalization is one option among small systems, or geographically related water systems, that will help support the increasing costs of compliance and promote small system viability. Unlike problems related to quality, small system crises can sometimes be rectified by mechanical means (plumbing); sometimes the cause is frequently attributable to misuse or a lack of system maintenance. State assistance is offered to aid the resolution of documented public health issues, but the water system owner is generally the responsible entity for managing the supply beyond that point.

Improving and expanding interconnections facilitates emergency response while offering an additional safeguard during critical low water periods and assuring a stable long-term supply of potable water statewide. Currently, several communities do not have sufficient water to handle an extended dry period. Many rely on short-term efficiency measures to accommodate essential needs in the dry season but are lacking viable alternatives should a prolonged drought occur. Others are unprepared should they see increases in consumption due to growth, and still others experience shortages simply due to a combination of water quality issues with their distribution systems.

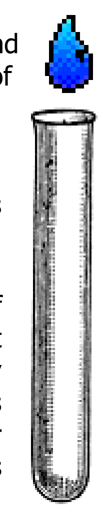
Goal WRM-1: Manage and plan for the sustainable water use and development of the water resources of the State.

Potable Supply Management Policy

- Ensure the protection of public health, safety and welfare as the priority use of potable water while striving to protect other uses and the economic well-being of the State.

  Strategies A - E

Water Quality



This section identifies the key areas of concern in formulating policies and strategies dealing with water quality. Aspects related to the natural resource functions of water resources and water quality protection will be addressed in other State Guide Plan Elements. This Plan sets the goals and policy foundations for potable water management. Rhode Island's future growth will continue to be accompanied by conversion of land cover, more intensive land uses, and significant increases in the volume of pollutants discharged to waters from both point and non-point sources. If not managed properly, these increases will limit opportunities to beneficially use the State's water resources. Generally, aspects of water supply related to public health and maintaining availability of supply fall under the guidance and standards of the federal Safe Drinking Water Act (SDWA). The intent of the SDWA is for each state to accept primary responsibility (primacy) for the operation of drinking water programs within the state. The DOH has primacy for enforcing these standards in Rhode Island. The standards are enforceable for all public water systems, and the DOH requires stringent testing and monitoring to assess compliance with the regulations and to ensure proper water system operation and protection of public health.

All surface waters, as well as groundwater that are under the direct influence of surface water, are at risk of contamination by bacteria and other microorganisms – as well as other contaminants. Federal Regulations require all water systems to use source protection or a treatment technique that ensures adequate removal or inactivation of harmful organisms. Many other parameters are tested and must not exceed maximum contaminant levels. These can be categorized as inorganics, volatile organic compounds, semi-volatile organic compounds, metals, pesticides, herbicides, radionuclides and disinfection by-products. Water testing for bacteria is carried out daily to quarterly, depending on system size; more comprehensive analysis are conducted on a schedule that varies from monthly to once in 3 years depending on vulnerability, past history, system size and a variety of other factors. An additional treatment technique requirement assures that water supplies are not corrosive to lead and copper.

See Goal WRM-2 Quality Policy Strategies A - T

There is more to the problem, however, than monitoring, testing, and maintaining SDWA compliance, especially for small water systems. Historically, most small water systems were established in an environment of abundant, high-quality water supplies when treatment requirements were minimal. All that was needed were a well, pump, and tank; costs were low, deterioration was slow, and maintenance was not an issue. Small water systems do the minimum of what is required and often unwisely defer maintenance and infrastructure replacements.

No longer are supplies considered unlimited. Treatment requirements are broader and tougher for conventional contaminants, and the need for a higher level of operation and maintenance of small water systems is evident. These new challenges require long-term, comprehensive initiatives that include early evaluations of system viability. Otherwise, as small systems sink more and more money into upgrades and compliance expenditures, there will be a greater reluctance to reorganize, even if it is the most rational alternative.

The DOH tracks and monitors water quality violations of all water systems. Quality violations occur when the monitoring results for a particular contaminant exceed the drinking water standard or fail to comply with a treatment technique requirement within a specific time period. Public water systems must monitor for 90 contaminants including inorganic compounds, volatile organic compounds, synthetic organic compounds, radionuclides, and pathogens. During 2008, 45 of the 487 public systems exceeded a drinking water standard for a total of 62 violations. Of those 62 violations, 51 were bacteriological violations, three (3) were for total trihalomethanes (TTHMs), four (4) were for nitrate, three (3) were for Di(2- ethlhexylphthalate), and one (1) was for beryllium.

Stormwater

The State has a long history of aquifer and watershed planning dedicated to protecting groundwater and surface water supplies used for potable water through its wellhead protection, nonpoint source management and source water protection programs. Today, the primary threat to the quality of the state’s drinking water sources is from urban stormwater runoff and other nonpoint sources of pollution, such as failing or improperly functioning septic systems, leaking underground fuel storage tanks, and runoff from agricultural operations. So while pollutants are discharged to the state’s surface waters each day in treated effluent from municipal wastewater treatment facilities and industrial sources, DEM regulations prohibit the discharge of such point source discharges to drinking water sources, or tributaries thereto. Stormwater is a significant contributor of pollutants causing impairments in many of the state’s rivers, lakes and ponds, including several water supply reservoirs and their tributaries. As the population grows and more land is converted to urban uses, the amounts of pollutants sent to our streams via urban runoff will likely dramatically increase unless storm water and land disturbance are managed more effectively. Keeping development out of source water areas remains a challenge. Once pollutants are present in a water body, or after a receiving water body's physical structure and habitat have been altered, it is much more difficult and expensive to restore it to an un-degraded condition.

In addition to chemical pollutants in storm water, the physical aspects related to urban runoff, such as erosion and scour, can significantly affect other water resource properties. Alterations in hydraulic characteristics of streams in urbanized watersheds receiving runoff include higher peak flow rates, increased frequency and duration of bankfull and sub-bankfull flows, increased occurrences of downstream flooding, and reduced base flow levels. Past approaches to managing stormwater focused on traditional flood control measures that relied on the detention (storage) of the peak flow from the property. These flood control structures are generally ineffective at addressing water quality concerns and in urbanized watersheds, may have exacerbated the problems associated with changes in hydrology and hydraulics downstream.

DEM has documented water quality problems caused by storm water runoff, including stream impairments, beach closures and shell fishing closures. The DEM and CRMC have new storm water regulations that will dramatically impact the design of new development and redevelopment projects. The new regulations consist of a new expanded storm water design and installation manual. The revised *Rhode Island Storm Water Design and Installation Standards Manual* was adopted by DEM and CRMC in January 2011. It was mandated by the "Smart Development for a Cleaner Bay Act" passed in 2007.

See Goal WRM-2 Quality Policy Strategy A

The new stormwater manual includes water quality performance standards that storm water management practices must meet in order to minimize impacts to our waters, including both surface water and groundwater. The manual incorporates LID as the "industry standard" for development, representing a fundamental shift in how development projects are designed. LID involves a more comprehensive approach to managing storm water that minimizes the hydrological impacts of development. Storm water is managed in smaller, more effective treatment practices located throughout the development project rather than being conveyed and managed in large pond facilities located at the bottom of drainage areas. DEM has also published a separate guidance manual in 2011 on the LID design approaches to aid municipalities in adopting LID standards.[12]

Stormwater is also regulated in accordance with rules adopted by the Rhode Island Department of Environmental Management's Rhode Island Pollution Discharge Elimination System (RIPDES) Program. The Storm Water Phase II Rule has been in effect since 2003, and generally requires operators of small municipal separate stormwater systems (MS4s) in urbanized areas, as well as certain industrial sector facilities, to develop and implement a storm water management program. Detailed guidance is provided to municipalities and other regulated entities by the RIPDES Program and through a coordinated arrangement with the RI DOT, the University of Rhode Island Nonpoint Education for Municipal Officials Program.

The key to protecting drinking water supply sources is to carefully manage land use to encourage those uses with a low potential for water quality contamination and to prohibit land uses with a high potential to contaminate. The continued diligence of the DOH, DEM, WRB staff, water suppliers and municipalities working together to protect drinking water sources from land use activities that threaten their quality is essential. Water suppliers play a vital role in maintaining current watershed inventories of potential and actual sources of pollution, as required by the WR Board's Water Supply System Management Plans.

Water quality standards are a crucial element of Rhode Island's water quality protection programs. Under the federal Clean Water Act, the state has established water quality standards which serve as the foundation of the state's water quality protection programs. DEM promulgates the water quality standards that establish the minimum water quality requirements for all surface waters of Rhode Island. Water quality standards define the *goals* for a waterbody by designating

[12] http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf

uses, setting criteria to protect those uses, and establishing provisions (anti-degradation policies) to protect water quality from pollutants. In Rhode Island, all surfaces waters are designated for swimming use, aquatic life use, and fish consumption use. A subset of surface waters are also designated for drinking water use and another subset of surface waters are also designated for shellfish consumption. The state has adopted water quality criteria, both numeric pollutant concentrations and narrative requirements, to protect and achieve each of the designated uses.

Waterbodies that are not supporting their criteria or designated uses are placed on the State's List of Impaired Waters which is developed in accordance with Section 303(d) of the federal Clean Water Act. Surface waters placed on the 303(d) List have one or more designated uses impaired by one or more pollutants and require a Total Maximum Daily Load (TMDL) study for each pollutant causing impairment. The current list includes the following water supply reservoirs and tributaries:

- Stafford Pond (Phosphorus)
- Kickemuit Reservoir (Fecal Coliform & Phosphorus)
- North Easton's Pond (Phosphorus)
- Sands Pond (Phosphorus, Excess Algal Growth, Turbidity & Taste and Odor)

Since federal guidelines require that states assess all designated uses for a waterbody, the listing of these waters and other tributary waters include non-drinking water use impairments. A TMDL (total maximum daily load) study establishes the allowable contributions for specific pollutants that a waterbody can receive without exceeding water quality standards. TMDL studies have been completed for each of the water supply reservoirs listed above, and include recommendations for pollution abatement actions to restore water quality.

From the perspective of a drinking water system manager, the ideal drinking water reservoir is one that is large, deep, remote, low in nutrients, off limits to public access and surrounded by a wooded, fenced watershed wholly controlled by the water supplier. If all these conditions are met, water drawn from such a reservoir would likely be stable and inexpensive to treat and would present very little risk to the drinking water public. Unfortunately, not all RI's surface water reservoirs are like this. The Scituate Reservoir is the exception rather than the rule. Very few other systems meet more than a few of the ideal criteria. More typically, RI's surface water supply sources are located in fairly developed watersheds. In 2003, The Office of Drinking Water Quality of the DOH completed Source Water Assessments for the larger public water suppliers in the State. The Source Water Assessment Program (SWAP) was established by the 1996 Amendments to the federal Safe Drinking Water Act (SDWA). Its stated purpose is to assess the threats to our sources of drinking water, "for the protection and benefit of public water systems, and to support monitoring flexibility".[13] According to the DOH, Rhode Island has had very high quality water over the years, but contamination has occurred, from time to time, from the sources addressed in the SWAP. The goal of the SWAP is to assess the susceptibility of water sources to contamination by the substances and microbes regulated under the Safe Drinking Water Act, as well as certain threats for which regulation is being considered. It is generally recognized that protecting the quality of drinking water is cheaper than treating water after it has been contaminated, and more certain than seeking new sources. The SWA Program is intended to make suppliers, developers, planners and consumers aware of the threats to the future quality of our water, so that we may take action before contamination occurs. Many of the water quality strategies in the Implementation Matrix were developed in SWAPs.

See Goal WRM-2
Quality Policy
Strategy B

[13] http://www.health.ri.gov/publications/plans/SourceWaterAssessment.pdf

Another concern for water quality protection is controlling public access and use of land within the watershed of surface reservoirs. RI General Law Chapter 46-14 says that bathing, swimming, discharge of any sewage or drainage or refuse or polluting matter which may pollute or corrupt or impair the purity or quality of a public drinking water supply or which renders the water supply injurious to health or poses a potential significant risk to public health and any activity which leads to such discharge in, or on, or in the immediate vicinity of any water body used as a source of public drinking water supply shall be prohibited. A further irony is that the more a water body meets the criteria listed above, the more valued it probably is as fisheries habitat and for boating, swimming, and other types of recreation. In other areas of the Country, water supply reservoirs are used for both active and passive recreation. The level of protection afforded public drinking water reservoirs in RI varies by each system.

See Goal WRM-2
Quality Policy 3
Strategies A - C

Various human activities on and near a water supply source can represent additional risks to the consumers of water from that source. Humans remove vegetation and pave land in the watershed, transport and dispense fuels and chemicals, discharge pollutants directly or through non-point sources, and engage in recreational activities on and therefore come in contact with the very same water we drink. Short of sewage discharge, human body contact with the water is the most threatening such human activity The introduction of microbiological pathogens, such as *Cryptosporidium*, *Giardia*, and other bacteria, viruses and parasites, poses one of the most serious threats to water quality, and thus to public health. Both humans and animals can serve as hosts to these pathogens. Suppliers are particularly concerned by the possible contamination of the drinking water supply from improper disposal of fecal waste from humans, dogs, horses, and other domestic animals on their water supply lands. Other impacts from public access that can threaten water quality include forest fires, fuel spills from motorized vehicles, and soil erosion (from motor vehicles, horseback riding, mountain biking, foot trail use, and fishing). The seriousness of these threats is typically related to: the proximity of an activity to the shoreline, reservoir intakes, or reservoir tributaries, the magnitude and intensity of an activity, the hydrodynamics of the reservoirs, as well as the slope and soil type of the land.

Past policy, determined by individual suppliers has largely taken a conservative approach to protecting water supply sources by focusing on restrictive access within the owned watershed. The New England Water Works Association (NEWWA) has a policy on recreational use of public water supplies.[14] The fundamental principal of the NEWWA policy is that drinking water should be obtained from the highest quality source feasible, and every effort should be made to prevent or control pollution of that source. Although the State has legislated grandfathering of uses on some water bodies, it is essential for the State to minimize risks to public health and prohibit direct contact with the water when possible. High risk activities such as swimming should continue to be expressly prohibited.

Another conflict with allowing public access concerns the responsibility of suppliers to protect public resources from terrorist threats. According to the EPA water utilities are in the forefront of ensuring that our nation's water systems are protected against terrorist threats. The EPA has recognized the increased need to protect the nation's water supply and utilities from terrorist attacks. The Homeland Security Presidential Directives (HSPDs) and the Public Health Security and Bioterrorism Preparedness and Response Act (Bioterrorism Act) of 2002 specifically denote the responsibilities of EPA and the water sector in:

[14] New England Water Works Association Surface Water Committee, Final Revised Policy, "Resolution and Policy Concerning Recreational Use of Public Water Supplies," 2006

- Assessing vulnerabilities of water utilities
- Developing strategies for responding to and preparing for emergencies and incidents
- Promoting information exchange among stakeholders
- Developing and using technological advances in water security

The Water Security (WS) initiative is an EPA program that addresses the risk of intentional contamination of drinking water distribution systems. EPA established this initiative in response to Homeland Security Presidential Directive 9, under which the Agency must

> *"develop robust, comprehensive, and fully coordinated surveillance and monitoring systems, including international information, for…water quality that provides early detection and awareness of disease, pest, or poisonous agents."* [15]

EPA is implementing the WS initiative in 3 phases:

- **Phase I**: develop the conceptual design of a system for timely detection and appropriate response to drinking water contamination incidents to mitigate public health and economic impacts
- **Phase II**: test and demonstrate contamination warning systems through pilots at drinking water utilities and municipalities and make refinements to the design as needed based upon pilot results
- **Phase III**: develop practical guidance and outreach to promote voluntary national adoption of effective and sustainable drinking water contamination warning systems.

Goal WRM-2: Protect and preserve the health and ecological functions of the water resources of the State.

Water Quality Policies

1. Mitigate and prevent water contamination to protect existing and future sources of potable water.
   Strategies A - T
2. Assure enough water is available to support the ecological functions of water resources.
   Strategies A - B
3. Prohibit public access and recreational use of surface water supply reservoirs.
   Strategies A - C

[15] *Homeland Security Directive 9*

Resources of State Significance

Sole Source Aquifers

The 4 sole source aquifers in RI are the Block Island, Hunt-Annaquatucket-Pettaqumascutt, the Jamestown, and the Wood-Pawcatuck aquifer complexes. The purpose of the EPA designation of "sole source" is to ensure that federal financial aid is not provided to projects that might contaminate the aquifer and create a hazard to public health. The designation in itself does not have specific management criteria but it can allow the EPA to deny access to federal funds for a project if it is determined there will be a significant impact to the aquifer. When a federal Environmental Impact Statement (EIS) is required under the National Environmental Policy Act, EPA requires the applicant's EIS to evaluate the project's impact on the sole source aquifer. It is EPA's role to determine if the EIS is sufficient to find no significant impact to the sole source aquifer.

Big River

The natural resources of the watershed are managed by the WR Board and staff. The Board plays an important role in guiding uses of the watershed to ensure that uses are compatible with the primary purpose of the lands as a public water supply area. Polices and Strategies for the watershed are proposed in the Implementation Matrix topical areas similar to the policies included for the Scituate reservoir and compatible with the WR Board 1997 adopted policies for the area[16]. An update of the land use policies has been mandated by the General assembly and may be included as part of the 2012 WR Board Strategic Plan. The Board has allowed use of the area as open space consistent with a General Assembly designation. Organized groups and/or organization are required to provide verification of general liability insurance coverage for allowable activities. Individual activities which do not require Board approval include, but are not limited to, hunting, fishing, individual mountain biking, hiking, canoeing on the Big River and horseback riding provided all pertinent State laws for such activities are required to be followed. Activities that are forbidden are swimming, trapping, camping, off-road motorized biking, cutting of firewood, dumping, and canoeing on ponds.

See Goal WRM-2
Big River Policies 1 -4
28 Strategies

Just as in the Scituate watershed, the forestlands of the Area should be managed as a healthy forest that can rebound from natural and manmade disasters that could have a negative effect on water quality. Planned timber harvests and other activities should be continued and carried out to create a varied pattern of forest stands with a variety of tree species, sizes and ages.

A water sampling program involving sampling of the streams and ponds in the watershed every month should be developed. Analyzing them for pollutants and water quality trends should be monitored in partnership with the USGS. Sampling stations should be established in the watershed. Such a monitoring program is important to establish the base water quality of the watershed before groundwater extraction, to examine the effect of road salts use, and the condition of individual water bodies.

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[16] http://www.wrb.ri.gov/lawsregs/BRMA_Policies.pdf

The State owns most of the watershed; the WRB staff must work with the municipalities (Exeter, Coventry and West Greenwich) as partners in taking care of the land in the watershed. Water Quality is strongly correlated with land use. The key to protecting the yet to be used water supplies in the area is to carefully manage land use to encourage those uses with a low potential for water quality contamination and to prohibit land uses with a high potential to contaminate. For the remaining residential properties still occupied in the Watershed, the proper maintenance of onsite wastewater systems is essential and critical to maintaining water quality.

Public water supply is currently unavailable in most of the watershed. The Town of West Greenwich has the only public water line in the watershed near its Coventry border. There are currently no public sewer facilities in the watershed, and none are planned for the future. Infrastructure such as new roads, public water and sewage facilities have a high potential for encouraging new growth in unwanted areas. The introduction of sewers to an area previously not sewered will almost always increase new development. [17] There is also a great deal of pressure to reduce lot sizes and rezone for more intensive uses that are not compatible with watershed protection. Any new infrastructure such as new roads and or public water facilities have a high potential for impacting water quality and should be compatible with the land use policies established of *Land Use 2025*. The key to protecting the future drinking water supply of the watershed is to carefully manage land use to encourage those uses with a low potential for water quality contamination and to prohibit land uses with a high potential to contaminate. The entire watershed should remain unsewered and continue to depend on individual or community on-site wastewater disposal.

Goal WRM-2: Protect and preserve the health and ecological functions of the water resources of the State.

Big River Policies

1. In addition to water supply uses the area shall be kept as open space for enjoyment by state residents.
   Strategies A - E
2. A safe and habitable environment shall be maintained for the tenants and uses within the watershed lands controlled by the State.
   Strategies A - E
3. Encourage proactive watershed management for water quality protection.
   Strategies A - K
4. Use the watershed for water supply augmentation though ground water development.
   Strategies A - C

[17] Scituate Reservoir Management Plan State Guide Plan Element 125, 1990.

Scituate Reservoir (Providence Water Supply Board - PWSB)

Activities related to land use planning and the natural resources of the watershed are managed by the Water Resources Division of the PWSB. Because 2/3 the watershed is still privately owned the Division plays an important role in guiding land uses to ensure that they are compatible the State's largest water supply. The Division focuses on protecting, conserving, and managing the lands of the PWSB. The efforts are driven by practical reasons along with environmental concerns. One of the strongest arguments for watershed protection is that is has been shown to be less expensive to water rate payers than building more expensive bricks-and-motor treatment facilities. Policies and Strategies for the watershed are proposed in 5 main areas consistent with the PWSB WSSMP and SWAP prepared by the DOH:

- Forest Management
- Land acquisition and conservation
- Water sampling and water quality protection
- Land use planning and policy engagement
- Education and outreach.

On the 12,500 acres of forestland around the reservoirs of the watershed, the PWSB uses science-based management to guide a comprehensive plan to support protecting raw water quality. The forestlands that surround the reservoirs should be managed as a healthy forest that can rebound from natural and manmade disasters that could have a negative effect on water quality. Planned timber harvests and other activities are and should be continued to be used to create a varied pattern of forest stands with a variety of tree species, sizes and ages.

Since 1990, PWSB has purchased about 60 individual parcels of about 3,000 acres for the purpose of land acquisition to protect public water supplies. The best means to preserve land in the watershed are land acquisition, dedication and donation. The PWSB has developed a watershed protection plan. Included in that plan is their Strategic Lands Inventory Program which includes critical areas for protecting water quality. Also the PWSB uses other tools such as conservation easements in lieu of land acquisition to protect particular tracts of land. In addition the watershed communities and the PWSB should encourage the formation of land trusts to accept donations of land or easements.

See Goal WRM-2
Scituate Reservoir Policies 1 -2
25 Strategies

The PWSB maintains a water sampling program that involves sampling dozens of streams very month and analyzing then for pollutants. Water quality trends are monitored in partnership with the USGS which also maintains several sampling stations in the watershed. The monitoring program is important to examine and demonstrate the effect of road salts use, the connection between ground and surface water, and the condition of individual ponds and reservoirs.

Since the PWSB only owns about 1/3 of the watershed, it must rely on the municipalities and private landowners as partners in taking care of the land. Water Quality is strongly correlated with land use. The key to protecting the Scituate Reservoir or any public drinking water supply is to carefully manage land use to encourage those uses with a low potential for water quality contamination and to prohibit land uses with a high potential to contaminate. The Water Resources Division of the PWSB gets involved with policy related to land use planning by monitoring the activities of the planning and zoning boards in the watershed. The PWSB also works with the DEM to ensure that state regulations related to land modification and development are being upheld. The proper permitting and installation of individual or community onsite wastewater systems and monitoring of wetland modifications are essential and critical to maintaining water quality in the watershed.

Public water supply is currently unavailable in most of the watershed. The Town of Johnston has the only public water line in the watershed. There are currently no public sewer facilities in the watershed, and none are planned for the future. Infrastructure such as new roads, public water and sewage facilities have a high potential for encouraging new growth in unwanted areas. The introduction of sewers to an area previously not sewered will almost always increase new development. [18] There is also a great deal of pressure to reduce lot sizes and rezone for more intensive uses that are not compatible with watershed protection. For these reasons, the entire watershed should remain unsewered and continue to depend on individual or community on-site wastewater disposal systems. The only exceptions to this policy would be to mitigate any existing septic failure areas where the repair or rehab of existing systems is not feasible. In the event that sewers are deemed necessary to mitigate a problem area, the sewer system should be designed to accommodate existing development only, with no reserve capacity to serve future growth. In the event that public water is e deemed necessary to mitigate a problem area, as with any sewers, the water system should be designed to accommodate existing development only, with no reserve capacity to serve future growth.

The lands surrounding the Scituate reservoir are closed to unauthorized access. However, the PWSB supports public education and research and provides opportunities for visiting the water shed property. The Scituate Reservoir Watershed Education Program engages students, residents, businesses, and forest landowners in the watershed communities on watershed issues. This program is a partnership between the PWSB and the Northern Rhode Island Conservation District.

Goal WRM-2: Protect and preserve the health and ecological functions of the water resources of the State.

Scituate Reservoir Policies

1. Encourage proactive watershed management for water quality protection.
   Strategies A - O

2. Develop and implement tools that foster controls to minimize water quality impacts in the watershed.
   Strategies A - K

[18] Ibid

Demand Management

This section identifies the key areas of concern in formulating policies and strategies dealing with demand management. In communities across RI, particularly in the southern planning region, the available water supply is becoming more limited with increased sprawl and competing uses. The regulatory requirements for new source development continue to become more complex as the right balance is sought between existing and future water supply needs for different purposes and environmental concerns. Consequently, demand-side management of public water suppliers through water conservation and efficient water usage will become increasingly important with time. Demand management is any conscious effort to modify water use. Accepting demand management as a concept, however, is often complicated by different interpretations of how to determine actual demand and the effect of various factors on withdrawal rates of different water systems. Demand management is not synonymous with water restrictions, changes in lifestyle, and a reduced standard of living; demand management is efficient utilization of the available supply.

See Goal WRM-3
Demand Management Policy
Strategies A - J

Implementation of demand management strategies should result in properly designed programs that assure supplies at prices that reflect the true value and cost of providing that resource, combined with the ability to reduce wasteful use. This updated plan considerably expands on what was established in the 1997 plan. The basic issues and concerns remain familiar. What has changed over the past decade is that new demands placed on consumers and suppliers have encouraged more activities that should increase the long-term efficiencies of water utilization. The term water efficiency replaces what was formerly water conservation. It encompasses many different methods, procedures, and devices designed to promote the efficient use of water and eliminate the waste of potable water. It is also an important practice to ensure responsible use of a public resource.

Efficient water use benefits both consumers and suppliers. Potential drawbacks should also be recognized, and mitigating drawbacks early on can be successful with planning that anticipates problems and addresses concerns in a timely manner. It is well known that benefits derived from water efficiency initiatives may extend the life of existing supply sources, conserve energy, reduce costs, lower the frequency of emergency incidents, and reduce environmental impacts on water resources.

On the other hand, potential problems can result from increased efficiency. These may include over expansion of service relying on a misleading concept of "additional supply", an overall reduction in revenue, increased drought vulnerability during critical low water periods, or the delay and increased expense of necessary water development projects if efficiency efforts prove inadequate. Also the age of water in the pipes affects the water quality to be delivered and maintaining adequate pressure in the pipes for fire fighting should also be considered in framework of efficiency programs.

A water utility creates income by charging fees for water used. Historically, water rates have been set to reflect the average cost of water; that is, the total cost divided among users without regard for how users influence the costs. Water has traditionally been an inexpensive commodity in RI, and rates are based on the cost of obtaining, treating, and transporting the water. Often, water systems have benefited from past investments and, because of their age, have not required a large amount of capital input, setting a precedent for artificially low prices.

As discussed in Part 2, pricing is one of the most significant factors in affecting and achieving efficient water use. The average cost of water, compared to our neighboring states, is extremely low in RI. Pricing has been used as a water efficiency practice throughout the country. It has been shown in other areas of the Country that both public education and conservation pricing have been most effective in reducing seasonal residential peak use and average use of commercial and industrial users.

Water efficiency is beneficial to both consumers and water suppliers, saving water, conserving energy, and increasing system efficiencies related to treatment and operations. Experience indicates, however, that top-down conservation strategies no longer work as they might have 20 years ago. But reliance on bottom-up approaches alone will not work either.

Public awareness of water resource issues and its importance to everyday life is minimal. More emphasis must be placed on local action, ongoing public education, and management combined with partnerships and incentives of state and federal programs. Considerable accomplishments in the water efficiency field have been made over the past several years, especially in technological advances and increased understanding of the importance of the efficient use of water. Attitudes and policies are changing as population growth and land development change due to our economy, degradation of ground and surface water quality, and competition for limited supplies continue. The implementation of water efficiency initiatives is a proactive, preventative approach to meet future water supply needs. Whether the strategy is retrofitting toilets and shower heads, alternating outdoor water use, or installing drip irrigation, the assumption is that the final count will be measured in our favor when everyone is contributing to the whole.

The residential water use target set by the Water Use and Efficiency Act is 65 gallons per person per day. Some water suppliers experience residential use of more than 100 gallons per person per day. The concept that demand management policies convey is that long-term water efficiency measures may be initiated and waste reduced through practices implemented at the state, municipal, and individual level. In this way water resources can be protected with programs designed to promote efficient use and reduce waste prior to tapping new supply sources. The WR Board has adopted the target of 65 GPCD number for major suppliers subject to the WSSMP process and encourages that the target be also used statewide by other suppliers.. By accepting the function of efficiency as a long-term mechanism to reduce demand, we may reduce the need to develop additional supplies.

The demand management and public education policies of this plan should be used by every water system, regardless of size. Independent planning and tailoring of demand management and educational programs must be done because of variations in public water system characteristics. Individual plans used by suppliers will have to use basic water efficiency practices applicable to the conditions of the water resources and the mix of water sectors and users served by each supplier.

Goal WRM-3: Ensure a reasonable supply of quality drinking water for the State.

Demand Management Policy

- Reduce the overall demand for potable water.
  Strategies A - J

Drought Mitigation & Response

This section identifies the key areas of concern for mitigating long-term drought and establishes a framework for coordinated responses in time of such a drought. The coordinated response for the State is to be overseen by the WRB staff as advised by a Drought Steering Committee (DSC).

Drought is a reoccurring natural hazard that evolves over months or even years, affects a specific area or an entire spatial region, and causes little structural damage. Generally, drought can be defined as deficiency of precipitation over an extended period of time. The deficiency results in a water shortage for some activity, group or environmental sector. Annual seasonal dry periods are not to be considered droughts.

**See Goal WRM-1
Drought Mitigation Policies
8 Strategies**

Drought should be measured relative to some long-term average precipitation in a particular area, what is often perceived as "normal". It is also related to the timing and effectiveness (the intensity & number of rain events) of the area's rainfall. Other climatic factors such as high temperatures, high wind, and low relative humidity are often associated with it and can significantly aggravate it. But drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result form the interplay between a natural event and the demand people place on water supply. Human beings often exacerbate the impact of drought.

The amount and the timing of precipitation received are key indicators of a developing drought for Rhode Island according to both the National Weather Service and National Drought Mitigation Center. The amount of fall and winter precipitation is critical to the evolution and intensity of all drought episodes in Rhode Island. Under normal conditions in RI, the United States Geological Survey states that late fall and winter precipitation recharges ground water and stream systems prior to the green-up period in the spring. Long-term droughts involve several seasons and/or years of lower than normal precipitation. The National Weather Service has documented that historical long-term droughts have begun with lower than normal precipitation during the preceding fall and winters and evolved into major drought status in the subsequent fall after the annual seasonal dry periods were over. Rhode Island has had at least 6 major droughts since 1929. The last long-term drought in RI was in the early to mid-1960s. This is considered the drought of record for data and planning purposes.

Drought Impacts

Droughts can be divided into differing types depending upon what activity, group or environmental sector is affected. For the purpose of this plan, 2 types of drought will be discussed; to clarify the differences and implications for water supply: agricultural droughts and hydrological droughts.

Agricultural drought links various characteristics of drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, reduced ground water or reservoir levels, and so forth. Plant water demand depends on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. A good definition of agricultural drought should be able to account for the variable susceptibility of crops during different stages of crop development, from emergence to maturity. Deficient topsoil moisture at planting may hinder germination, leading to low plant populations per acre and a reduction of final yield. However, if topsoil moisture is sufficient for early growth requirements, deficiencies in subsoil moisture at this early stage may not affect final yield if subsoil moisture is replenished as the growing season progresses or if rainfall meets plant water needs.

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (stream flow, reservoir and lake levels, ground water). Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, stream flow, and ground water and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors. For example, a precipitation deficiency may result in a rapid depletion of soil moisture that is almost immediately discernible to agriculturalists, but the impact of this deficiency on reservoir levels may not affect water supply uses for many months. Also, water in hydrologic storage systems (reservoirs, rivers) is often used for multiple and competing purposes further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought and conflicts between water users increase significantly. The primary focus of this Plan will be on hydrological droughts.

Hydrological Drought and Land Use

Although climate is a primary contributor to hydrological drought, other factors such as changes in land use, land degradation, and the construction of dams all affect the hydrological characteristics of hydrologic storage systems. Because regions are interconnected by hydrologic systems, the impact of hydrological drought may extend well beyond the borders of the precipitation-deficient area. Similarly, changes in land use upstream may alter hydrologic characteristics such as infiltration and runoff rates, resulting in more variable stream flow and a higher incidence of hydrologic drought downstream. Creating more impervious surface through land use changes is one of the ways human actions alter the frequency of water shortage even when no change in the frequency of the drought has been observed.

Sequence of Drought Impacts

The sequence of impacts associated with agricultural and hydrological drought further emphasizes their differences. When precipitation deficits begin, the agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water. Soil water can be rapidly depleted during extended dry periods. If precipitation deficiencies continue, those who rely on surface water and ground water will be the last to be affected. The annual seasonal dry periods that persist for 3 to 4 months may have little impact on these sectors, depending on the characteristics of the hydrologic system and water use requirements. When precipitation returns to normal and agricultural drought conditions have abated, the sequence is repeated for the recovery of surface and subsurface water supplies. Soil water reserves are replenished first, followed by stream flow, reservoirs and lakes, and ground water last. Drought impacts may diminish rapidly in the agricultural sector because of its reliance on soil water, but linger for months or even years in other sectors dependent on stored surface or subsurface supplies. Ground water users, often the last to be affected by drought during its onset, may be last to experience a return to normal water levels. The length of the recovery period is a function of the intensity of the drought, its duration, and the quantity and effectiveness of precipitation received as the episode terminates.

Response Framework

Rhode Island's framework for responding to long-term drought seeks to coordinate and organize the efforts of key agencies and organizations having management responsibilities, important data, and or representation of important interests affected by drought. The primary responsibility for coordination of the drought management process and implementation of this plan rests with the WR Board, as advised by a Drought Steering Committee (DSC). The DSC should include, but is not limited to, agencies which collect and monitor water resource data critical to assessing drought phases in the State, as well as federal officials, water suppliers, and municipal officials. The WRB staff is responsible for monitoring conditions, convening the DSC when needed, and recommending to the Governor to declare the appropriate phases of drought.

Figure 12, Rhode Island Drought Management Process, illustrates the process as coordinated by the WRB staff. During normal conditions, the WRB staff is responsible for ongoing monitoring of water resource conditions based on data from the United States Geological Survey (USGS), the National Weather Service (NWS), the National Drought Mitigation Center and other experts as appropriate. When extreme dry conditions persist beyond the annual seasonal dry period and long-term drought appears evident, the WRB staff shall convene the DSC to provide for expert advice and multi-disciplinary input to assist the Board in shaping a coordinated state response.

Short-term dry periods occur every year as seasonal events. They involve a spring, summer and maybe fall of decreasing rainfall. These short-term dry periods are characterized by extremely dry and often hot weather, but they do not extend from one year to the next. They do occur almost every year. **Annual Seasonal Dry Periods _are not to be considered droughts._** They should be considered in ongoing demand management planning by water suppliers. Annual seasonal dry periods in RI usually commence just after the spring green-up period, reaching their greatest intensity during the mid-summer and early fall (July-August- September)

See Goal WRM-1
Drought Mitigation Policies
11 Strategies

Figure 12

Rhode Island Drought Mitigation Framework

Drought Steering Committee

- Reviews information & indices collected by WRB
- Recommends phases of drought
- Facilitates communication and coordination between agencies & suppliers.
- Recommends appropriate actions
- Advises the WRB

Water Resources Board

- Collects and monitors data monthly
- Convenes and staffs the Drought Steering Committee as necessary
- Communicates on behalf of the Drought Steering Committee
- Facilitates communication and coordination between agencies, suppliers, municipalities, and water use sectors/interests
- Coordinates actions of agencies, suppliers, & municipalities
- Makes recommendations to the Governor
- Coordinates agency drought responses
- Implements Executive Orders & Emergency Declarations

Governor

- Declares phases of drought
- Issues Executive Orders
- Issues Emergency Declarations

Water Resources Board (WR Board)

The WRB staff will coordinate public communication and education efforts. It will assemble and coordinate the efforts of state and federal agencies, organizations, municipal officials and suppliers. Specific drought responsibilities of the WRB staff are as follows:

- Maintain a list of DSC members and convene the DSC when conditions warrant
- Collect, correlate, and disseminate data on the status of hydrological conditions and drought indices
- Publish a summary report that summarizes current water resource conditions and drought indices
- Communicate the DSC recommendations and coordinate communications between government agencies, water suppliers and the general public
- Appraise the DSC of agency, municipal, suppliers, and public responses
- Recommend, as advised by the DSC to the Governor:
  - Initiating phases of, changes to phases, and the end of drought
  - Declaring local, regional, or statewide emergencies
  - Developing and coordinating emergency actions
- Advise all parties of gubernatorial actions and/or directives

Drought Steering Committee (DSC)

An advisory Drought Steering Committee (DSC) shall be convened when **at least three of the major hydrologic indicators** listed in Table 2 are exceeded for normal conditions by the WRB staff. The DSC shall be used to provide technical expertise and advice to the WR Board on monitoring, coordinating, and managing the State's response to drought situations. The DSC will advise in coordinating actions and communications related to drought conditions. The DSC will make recommendations to the WR Board concerning drought phases and mitigation measures to assist the WR Board in advising the Governor, municipal officials and other appropriate entities on actions needed.

The primary responsibilities of the DSC include:

- Reviewing information gathered by the WRB to assess the impact of worsening dry conditions.
- Recommending drought phases for various regions of the State and appropriate responses for drought mitigation.

The DSC membership shall be flexible and consist of representatives from agencies and organizations that have responsibility for functions related to drinking water resources and or interests likely to be affected by drought conditions. It shall also include agencies that manage water resource data necessary for assessing the severity of drought conditions, representatives of large public water systems served by surface water and groundwater, and representatives of small public water systems. The DSC members will advise their respective agencies or constituencies on necessary mitigation. The DSC shall select the Chair when it is activated. When long-term hydrological conditions cross the threshold listed in Table 2, the WRB staff will convene the DSC. The DSC will meet as determined necessary by the Committee throughout a long-term drought to review data and make recommendations.

Water Suppliers

The twenty-eight major public supply systems subject to the provisions of the Water Supply Systems Management Plan (WSSMP) Act have primary responsibility for assuring continuity of supply to their customers and for taking actions to mitigate the effects of drought on the ability of their systems to meet essential needs. Contingency plans for drought circumstances are a critical component of all WSSMPs in order to establish what levels of dry or drought conditions are likely to cause a water supply emergency particular to each system. They are also critical in defining actions that will be taken to mitigate the emergency should one occur.

Because each water supplier may be affected differently by drought due to the location within various drought regions, sources of supplies, capacity, demands, timing, and permitting requirements, it is essential that each supplier identify drought triggers, within its WSSMP. The drought triggers for a particular water supply system will depend upon the specific conditions of the system, such as the capacity of storage and treatment facilities, storage tank elevation, and reservoir storage, system operating pressures, stream flows, groundwater levels, and precipitation. They will also depend upon the location and sensitivity of environmental resources in source water areas. The purpose of triggers is to link the triggers with specific response actions for developing extreme dry conditions and to mitigate drought impacts. A key response action for suppliers will be to restrict water use. Water use restrictions when needed generally

move from limited and voluntary to more mandatory restrictions depending upon the phase of drought. The development of triggers and responses for suppliers within the WSSMPs will provide communities and water users predictable responses to dry conditions and droughts. The WRB staff is responsible for overseeing the contents of the WSSMPs

It is important for all water suppliers, regardless of size, to have access to contingency water supplies. All suppliers should establish connections to other nearby public suppliers where possible, identify emergency sources of water, and have in place up to date contingency contracts for the purchase of emergency supplies and/or distribution processes. All suppliers should identify non-potable water sources that can be used for fire protection and/or for other non-potable purposes where such may be available. By having these contingencies in place prior to the onset of drought, water suppliers can ensure that they can protect the public health and safety during droughts.

Municipal Government

Currently at this time, 14 municipal governments share the responsibilities for the management of some of the major water systems. As discussed in Part 1, some municipalities do not have any major public systems within their borders. Municipalities should ensure that drought preparedness measures are included in WSSMPs where appropriate and also within local emergency operation plans, as well as coordinating with adjacent municipalities and their water suppliers to ensure emergency interconnections exist and are functional. Based upon site specific water supply conditions, municipalities may initiate their own actions ranging from voluntary water use restrictions to declarations of local water emergencies and prohibition of the use of non-essential uses of potable water when necessary.

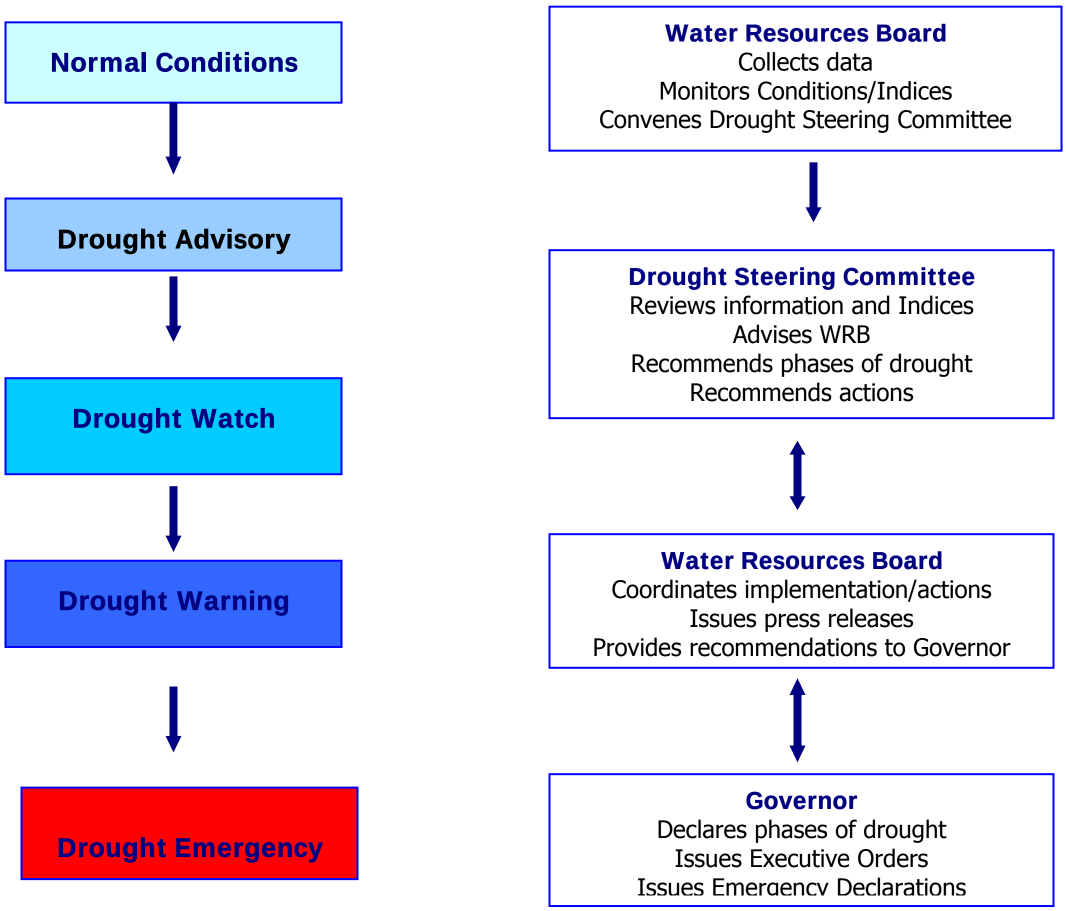
Municipal governments have a role in preparing for and mitigating all stages of drought at the community level. Information-sharing between state and municipal and other officials is essential. Water entities must provide the specific information about their districts for state agencies to assess the broader situation faced by a region. Similarly, state drought levels and information to water suppliers should prompt action by municipalities. Municipalities should ensure beyond the WSSMP or where no WSSMPs may apply that regulations and procedures are in place to respond to drought conditions. Emergency powers are conferred upon the chief elected municipal officer pursuant to RI General Laws, 30-15-12. This State law and individual municipal charters confer the authority to the municipality to plan for and declare an emergency on the municipal level.

The municipal government's most visible role in the community may be in providing public education on the drought status and in the development and enforcement of regulations as the situation worsens. However, not all restrictions may be ordered by municipal government as in some cases as discussed in Part 2, municipal governments have little control over water supply districts. Regional water suppliers will have to work with multiple communities in some cases. The WRB staff will work with municipalities on an ongoing basis on drought–related contingency plans and ordinances needed prior to declaring advanced stages of drought.

Other Organizations

Local conservation commissions, environmental groups and designated watershed councils can assist in efforts to encourage efficient water use in normal times and as well as during drought conditions. They can serve as outreach agents to educate the public on the impacts of drought to natural resources and to coordinate and deliver information. In addition, designed watershed councils can work to assure that the minimum stream flows necessary for supporting healthy and naturally diverse populations of flora and fauna are recognized. They can serve as another important local source of for public education information concerning water quality and quantity during long-term drought conditions.

Figure 13, Rhode Island Drought Mitigation Process



Drought Indices and Phases

The drought indices and drought phases of this Plan have been adopted after considering national indices from the National Drought Mitigation Center and the National Weather Service and reviewing historic precipitation patterns and historical drought events in RI. What is considered "normal" has different meaning to different persons depending on whether one is examining trends in relation to specific time periods involved, the percentage of normal, or examining average precipitation or mean precipitation The indices and phases chosen for this Plan are designed to anticipate long-term drought conditions in order to begin early public education and outreach efforts on a statewide basis or regional basis as needed. The drought phases are complementary to those used by the National Drought Mitigation Center and our neighboring states of Massachusetts and Connecticut. They are also designed to coordinate with the WSSMPs of large public suppliers, particularly in the later and more severe phases of drought.

5 drought phases are established to describe drought conditions in RI:

1. Normal
2. Advisory
3. Watch
4. Warning
5. Emergency

The WRB staff will work closely with water suppliers to identify and assess applicable regional indicators including but not limited to, source of supply, static groundwater levels, reservoir levels and other storage and capacity issues. The information which is collected by the DSC will be used to help assess drought levels, taking into account the time of year and the severity of the drought event. The WRB staff will provide such information to the DSC as is necessary to assess conditions and to make recommendations to the Governor regarding drought phases for the state.

According to the National Drought Mitigation Center, drought indices assimilate data on rainfall, snowfall, stream flow, and other water supply indicators into a comprehensive big picture. There are several indices that measure how much precipitation for a given period of time has deviated from historically established norms. Using normal as the baseline condition seems common sense. Although none of the indices is inherently superior to the rest in all circumstances, some indices are better suited than others to Rhode Island's climatic conditions and for the purposes of this plan to predict drought impacts on water supply. The recommendations for phases may be, but are not limited to, additional supplier information and the following hydrological indices:

- Palmer Drought Index (PDI) - available from the National Weather Service, the National Climatic Data Center, or national Drought Mitigation Center. This index reflects soil moisture and weather conditions including temperature.

- Precipitation – Percent of Normal (%) – This is a simple calculation well suited to the needs of weathercasters and general audiences. The percent of normal precipitation is one of the simplest measurements of rainfall for a location. Analyses using the percent of normal are very effective when used for a single region or a single season. Percent of normal is also easily misunderstood and gives different indications of conditions, depending on the location and season. It is calculated by dividing actual precipitation by normal precipitation—typically considered to be a 30-year mean—and multiplying by 100%. This can be calculated for a variety of time scales. Usually these time scales range from a single month to a group of months representing a particular season, to an annual or water year. Normal precipitation for a specific location is considered to be 100%. One of the disadvantages of using the percent of normal precipitation is that the mean, or average,

A new index that needs to be considered is the Standardized Precipitation Index (SPI)

The SPI is an index based on the probability of precipitation for any time scale. The SPI can be computed for different time scales, can provide early warning of drought and help assess drought severity, and is less complex than the Palmer. The understanding that a deficit of precipitation has different impacts on groundwater, reservoir storage, soil moisture, snowpack, and stream flow led to the development the SPI. The SPI was designed to quantify the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water resources. Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, stream flow, and reservoir storage reflect the longer-term precipitation anomalies. The SPI calculation for any location is based on the long-term precipitation record for a desired period. Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way, and wet periods can also be monitored using the SPI. A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and intensity for each month that the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude". This standardization allows the SPI to determine the rarity of a current drought, as well as the probability of the precipitation necessary to end the current drought. It can be provided by the National Drought Mitigation Center.

precipitation is often not the same as the median precipitation, which is the value exceeded by 50% of the precipitation occurrences in a long-term climate record. The reason for this is that precipitation on monthly or seasonal scales does not have a normal distribution. Use of the percent of normal comparison implies a normal distribution where the mean and median are considered to be the same. Because of the variety in the precipitation records over time and location, there is no way to determine the frequency of the departures from normal or compare different locations. This makes it difficult to link a value of a departure with a specific impact occurring as a result of the departure, inhibiting attempts to mitigate the risks of drought based on the departures from normal. Data is collected by the National Weather Service at 8 data points and reported by county in RI. The data is evaluated relative to normal conditions in 3, 6, and 12-month intervals to determine drought level. Additional sources of data may be available through other sources such as local news networks.

- Stream flow - condition maps showing areas of above-normal, normal, and below-normal are provided monthly by the USGS. A drought level determination can be based on the number of months the stream flow levels are below normal (lowest 25% or period of record).

- Ground water levels - condition maps showing areas of above-normal, normal, and below-normal groundwater are provided monthly by the USGS. A drought level determination can be based on the number of months the groundwater levels are below normal (lowest 25% or period of record).

- Reservoir levels – Percent of Capacity (%) - level data will be considered relative to normal conditions. The WRB staff will maintain a list of water supply reservoirs and their percent of capacity. Drought phases will also be based on the water levels of small, medium, and large reservoirs across the State.

Setting Drought Phases

The WRB staff shall work with the National Weather Service, USGS, and water suppliers to correlate information for the DSC in order to prepare recommendations on drought phases for the Governor. Table 2, Rhode Island Drought Indices and Phases, shows the thresholds for each of the indices by drought phase. Drought mitigation actions follow this table. To assign a drought phase, the WR Board, as advised by the Drought Steering Committee, must determine that 3 of the 4 major hydrologic indicators have reached the designated threshold. The major hydrologic indicators are the Palmer Index (PDI), precipitation, stream flow and groundwater levels. However, it is important to note that time of year may influence the process considerably. In the fall and winter months, PDI may react slowly but decline rapidly once the spring green-up occurs. The lag between surface water levels and groundwater levels could similarly skew the relative importance and number of indicators that are critical to determining the phase of drought. Finally, in the last 2 phases, groundwater and reservoir data particular to an area will also be used in conjunction with statewide data to determine drought phases. Local triggers developed by large water suppliers in WSSMPs shall be coordinated with the state drought phases by the WRB staff. The local WSSMPs' thresholds will also be used in conjunction with the statewide indices to help determine those regional areas that have entered the warning and emergency phases.

Drought Regions

The WR Board, as advised by the DSC, will recommend drought phases and actions statewide for the first three phases of drought, Normal, Advisory and Watch for the Governor to declare. The WR Board, as advised by the Drought Steering Committee, will recommend drought phases and actions by drought planning regions for the final two phases of drought, Warning and Emergency for the Governor to declare. The Governor shall declare the phase of drought for the state during a long-term drought. Figure 14, Rhode Island Drought Regions shows the 7 drought planning regions for the state.

The regions are based upon a number of considerations, including existing water supply area boundaries, areas that are not served by large public water suppliers, precipitation differences, temperature variations, soils, municipal boundaries, and source of water supplies. The drought planning regions have been delineated to facilitate more focused monitoring of drought conditions and to differentiate areas of the state by basic water-related characteristics. For areas not served by major water suppliers the WRB staff will convey information to the general public through various media.

Drought Planning Regions:

1. Northwest Region
2. Northeast Region
3. Central West Region
4. Central East Region
5. Southern Region
6. Eastern Region
7. New Shoreham Region

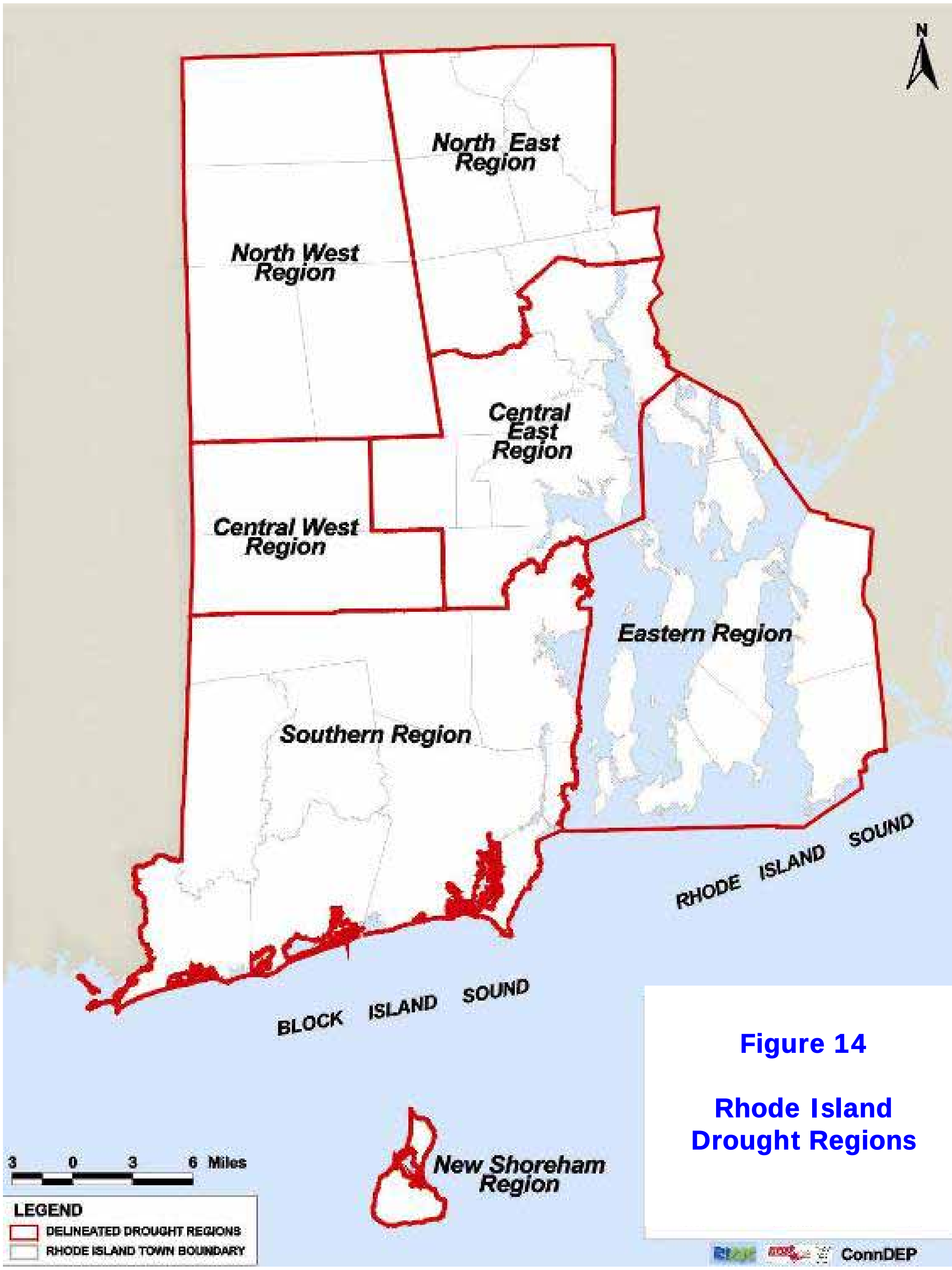


Figure 14

Rhode Island Drought Regions

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Table 2, Rhode Island Drought Indices and Phases

Drought Phase	Palmer Drought Index +	Crop Moisture Index	Precipitation +	Ground Water** +	Stream flow +	Reservoirs**
Normal	-1.0 to -1.99	0.0 to -1.0	Slightly Dry	1 month below normal 1 month below normal	2 consecutive months below normal	Reservoir levels at or near normal for the time of year
Advisory	-2.0 to -2.99	-1.0 to –1.9 Abnormally Dry	2 month cumulative below 65% of normal	At least 2 out of 3 months below normal	3 consecutive months below normal	Small index Reservoirs below normal
Watch	-3.0 to -3.99	-2.0 to –2.9 Excessively Dry	1 of the following criteria met: 3 month cum. <65% or 6 month cum. <70% or 12 month cum. <70%	4-5 consecutive months below normal	At least 4 out of 5 consecutive months below normal	Medium index Reservoirs below normal
Warning	-4.0 and below	> -2.9 Severely Dry	2 out of 3 of the above criteria met: 3 month cum. <65% and 6 month cum. <65% or 6 month cum. <65% and 12 month cum. <65% or 3 month cum. <65% and 12 month cum. <65%	6-7 consecutive months below normal observation wells recording monthly record lows	At least 6 out of 7 consecutive months below normal	Large index reservoirs below normal
Emergency	-4.0 and below	> -2.9 Severely dry	Same criteria as Warning and Previous month was Warning or Emergency	>7 months below normal Observation wells recording monthly record lows	>7 months below normal	Continuation of previous month's conditions

+ Major Hydrologic Indicators.

****** Local triggers from the water system supply management plans will also be considered in a assessing drought phases on a regional basis. The WRB staff will review local plans and work with suppliers to coordinate regarding drought phases and to collect, review and report surface reservoir and ground water data.

"Normal" is defined as the statistical average of the data for the period of record. Percentages for precipitation are relative to normal.

Communication

Effective drought response will be dependant upon effective communication of accurate, timely and consistent information on drought conditions and response actions to the public, major water users, and other targeted interests. One of the primary responsibilities of the Water Resources Board is to use the Drought Steering Committee to develop and disseminate clear and consistent information.

The Water Resources Board is primarily responsible for communicating the declarations of the Governor and the recommendations of the Drought Steering Committee to the public and targeted water users. Individual water suppliers are primarily responsible for communicating the decisions and recommendations of both the Governor and the Water Resources Board to their customers. Other agency members of the Drought Steering Committee will communicate the decisions and recommendations of the Drought Steering Committee to constituencies and interests they serve. Table 3 outlines the agencies and audiences for communication during the time of a drought.

Table 3
Communication of Drought Recommendations

Agency/Organization	Audience
Water Resources Board & staff Governor's Office	General Public
Water Resources Board staff	Cities & Towns**,** Watershed Councils
Water Suppliers RI Water Works Association	Customers, Water Resources Board
Water Resources Board staff Department of Health	Water Suppliers
Department of Environmental Management RI Agricultural Council	Foresters ,Farmers/Agricultural Interests
Water Resources Board staff Department of Environmental Management	Other Large Water Non-agricultural users e.g. Industrial, golf courses, etc.
Narragansett Indian Tribe	Tribe members
Water Resources Board staff State Fire Marshal	Local Fire Departments
RI Economic Development Corporation Chambers of Commerce	Industries/Businesses

Drought Mitigation Actions

This section describes the drought management actions for each of the 5 phases of drought. The process evolves from general information collection and sharing under normal or drought advisory conditions to preparation and declaration of an emergency situation by the Governor for drought emergencies. ***All response actions in early phases of drought will be continued in later phases of drought as needed.***

The WR Board, as advised by the DSC, will recommend to the Governor whether conditions warrant a change in drought phase. Once the precipitation index triggers a drought phase of warning or emergency, conditions must improve beyond the previous level to reduce the drought phase. The following tables list the actions to be undertaken during the 5 phases of drought.

A given drought phase can change in 1 of 3 ways:

1. If conditions worsen and at least three of the four the criteria are reached for the next most severe drought phase, the drought severity level will be increased accordingly.
2. If conditions persist but do not reach the next phase, the drought phase will be held constant.
3. If conditions begin to improve the drought phase may be reduced.

RHODE ISLAND DROUGHT MITIGATION ACTIONS
Drought Phase: **Normal**
1. WRB staff collects basic weather and hydrological data. 2. USGS monitors surface and groundwater levels. 3. WRB staff works with municipalities on drought related policies for comprehensive plans.
Drought Phase: **Drought Advisory**
1. WRB staff communicates with public, municipalities and water suppliers about dry conditions. 2. WRB staff convenes DSC and recommends to the Governor to declare an advisory phase. 3. WRB staff develops press announcements. 4. WRB staff collects information and advises DSC on list of water restrictions. 5. WRB staff coordinates necessary meetings of the DSC to review information and circulate educational materials. 6. WR Board works with DEM and USGS in order to expand data collection and monitoring to measure stream flow and groundwater levels and to relay this data to farmers, golf courses, other water users and watershed councils in the affected watershed(s). 7. WRB staff forwards "Current Conditions" report to the DSC, general public, municipalities and major water suppliers. 8. WR Board develops and recommends statewide voluntary conservation measures and begins public awareness campaign on water conservation. 9. DEM-Agriculture mails listing of water conservation techniques to farmers, requests farmers to conserve, and initiates appropriate steps of the DAG Drought Response Plan for Agriculture (See Appendix B). 10. WRB staff offers technical assistance to water suppliers to enhance efficiency of major users.

Drought Phase: **Drought Watch**

1. WRB staff distributes monthly current conditions report to the Governor, DSC, major water suppliers, and municipalities.

2. WR Board advised by the DSC recommends to the Governor to declare a watch phase.

3. WRB staff works with the DSC to distribute consistent public information regarding current conditions and general water conservation measures.

4. WRB staff offers technical assistance to municipalities on managing water use during dry conditions.

5. WRB staff works with state agencies to intensify monitoring and appraisal of drought situation.

6. WR Board works with state agencies to initiate contact and planning efforts with federal agencies.

7. WR Board develops, recommends and encourages continued water conservation and use restrictions.

8. The WRB staff updates and distributes the statewide map reporting the drought status by region.

9. Large water systems follow triggers and actions from WSSMPs to determine their drought level.

10. DEM-Agriculture continues to implement response plan for agriculture.

11. When rivers approach their 7Q10 low flow, DEM requests voluntary reductions in the quantity of pollutants discharged from industrial sources.

12. WRB staff works with DEM-Agriculture to provide a list of water suppliers and water transporters willing to supply farmers.

13. WRB staff develops and distributes a list of well drillers.

14. DOH provides a list of private laboratories for water testing.

15. DOH expedites permitting and gives priority reviews to replace public wells that have gone dry, where practical.

16. Fire districts/departments identify alternative sources of water or call on a regional tanker force, when water bodies are low.

17. WR Board, as advised by the DSC, encourages fire departments to distribute educational materials stating that dry conditions may cause problems for sprinkler systems.

18. DEM expedites dry hydrant permits for fire departments.

Drought Phase: **Drought Warning**

1. WR Board, as advised by the DSC, recommends to the Governor to declare a warning phase and WRB staff works with all constituencies (the public, municipalities, suppliers, etc.) to implement measures to reduce water use.
2. WRB staff implements and promotes public information and provides technical assistance to conserve water and reduce water demand.
3. WRB staff intensifies media coverage and public education efforts.
4. WRB staff works with suppliers and updates statewide maps to report those regions that have entered the warning stage.
5. WR Board, as advised by the DSC, adopts list of non-essential water uses and strongly recommends that water users cease all non-essential water uses.
6. WRB staff reviews readiness and availability of emergency interconnections and sources of water with suppliers.
7. DOH assesses public health threats and acts as needed.
8. WRB staff initiates contact and planning with northeast states regarding regional conditions and responses.
9. WRB staff works with the Governor's Office to declare a warning phase and to prepare a proclamation for the Governor in case of a drought emergency and develops a communications strategy.
10. WRB staff coordinates with RIEMA to investigate potential funding and assistance.
11. Individual water systems implement drought-response actions outlined in their WSSMPs.
12. DEM-Agriculture follows steps in the Drought Response Plan for Agriculture.
13. Regulated water suppliers may petition the Public Utilities Commission for emergency rate relief.
14. DEM and WRB staff identifies adverse environmental impacts and advise the DSC regarding mitigation.

Drought Phase: **Drought Emergency**
1. WR Board, as advised by the DSC, recommends to the Governor to declare an emergency, and recommends on implementing emergency responses and mitigation measures. 2. The Governor may issue a proclamation of a drought emergency. Municipalities shall implement procedures necessary to implement the declaration of emergency. The proclamation may stipulate mandatory bans on non-essential water use as defined by this Plan. Water use restrictions shall be in accordance with WSSMPs for large water suppliers. More restrictive measures may be required according to regionalized conditions and added to the Governor's Emergency Proclamation. 3. WRB staff continues to coordinate the responses of state, municipal and federal agencies. 4. WRB staff coordinates with RIEMA to seek disaster declarations and secure emergency funding/assistance.

Non-Essential Water Uses

Maintaining adequate potable water supplies is essential to protect the public health, to support the economy of the state and to protect the environment. Yet water can be depleted quickly and used faster than it can be replenished during a long-term drought. An important drought mitigation measure for water suppliers and users is demand reduction. Demand reduction measures implemented for water shortages generally follow a logical progression from voluntary reductions in usage to mandatory reductions in usage, and, finally under severe water shortage conditions, to water rationing.

Non-essential Water Uses in Rhode Island during Drought

- Washing any impervious or hard surface areas, such as but not limited to streets, gutters, sidewalks, walkways, driveways, parking lots, and tennis courts.
- Wetting any building or structures other than for immediate fire protection.
- Washing any vehicle including automobiles, motor bikes, boats, trailers, and airplanes.
- Supplying water to any decorative water bodies, including all fountains, scenic and recreational water bodies, except for the minimum necessary to support aquatic life.
- Filling or maintaining the water level in private swimming pools.
- Watering any ornamental, nonagricultural lawns, plants, trees and other flora.
- Using water from hydrants for any purpose other than fire-fighting.
- Flushing of sewers.
- Serving water in restaurants, except upon request.
- Continuing water service to customers who have been issued a 10-day notice to repair one or more leaks and who have failed to comply.

Large water suppliers will implement demand reduction strategies as outlined in their WSSMPs. The second two phases of this plan, advisory and watch, require voluntary water use reduction. During the warning phase the Water Resources Board, as advised by the Drought Steering Committee, shall recommend more stringent use reductions and, in the final severe emergency stage, provide the Governor with recommendations on bans for non-essential water uses.

The actual uses banned may depend upon the time of year of the drought emergency since many non-essential water uses are seasonal in nature and often are outdoor household or workplace water uses such as landscape and lawn watering. Water suppliers should promote water conservation practices as a part of normal operating procedures and early during developing drought conditions. Water users should be alerted to developing drought conditions, informed of actions required to respond to water shortages and updated as more severe conditions develop. An important aspect of implementing the demand reductions will be early notification to appropriate municipal officials and water suppliers of the non-essential water uses ban and the measures they must use to enforce them. The textbox lists the non-essential water uses that shall not be used during the times of warnings and emergency drought phases. To encourage use of treated wastewater as a conservation measure, water uses which employ treated wastewater or recycled water are exempted from the list.

Returning to Normal

The WR Board, as advised by the Drought Steering Committee shall recommend any reductions in drought phases to the Governor. After return to normal conditions, the WRB staff will provide a post-drought evaluation report to the Governor and the Drought Steering Committee. The report shall describe lessons learned and problems experienced during the drought situation and may make recommendations for amendments to this plan.

In order to determine the end of a drought, the 2 key indices, precipitation and ground water levels, will be examined*.* These two indices have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires. Precipitation is a key factor because it is the overall cause of improving conditions. The water table responds slowly to improving conditions and is a good indicator for monitoring the return to normal conditions. According to the National Drought Mitigation Center, when precipitation levels return to normal, surface and sub-surface supplies return to normal in the same sequence they were affected. Soil water reserves are replenished first, followed by stream flow, reservoirs and lakes, and then groundwater. The length of the recovery period is a function of the intensity of the drought, its duration and the quantity of precipitation received as the drought ends.

In order to ensure long-term improvement, the reduction of a drought level in any given region should be carefully scrutinized. Generally, drought phases should only be revised to a less severe phase when normal conditions for both precipitation and groundwater have been reached for a sustained period of time, as set forth in Table 3, Returning to Normal. (Please note that Table 2 Rhode Island Drought Indices and Phases, establishes the baseline references). Due to the complexity of factors to be examined, the WR Board and DSC will rely heavily on the professional judgment of members of the Committee.

Precipitation from large storms such as hurricanes will need to be weighed based on the individual impact of the large storm. While these storms may return long-term precipitation totals to normal and may fill reservoirs, they often do little to replenish groundwater levels necessary for long-term water resource protection. The long-term cumulative precipitation deficits listed in Table 4 can be changed to up to twelve months depending on the time of year and length of the drought. For example, the fall and spring months are ideal for groundwater recharge, and precipitation that occurs during the fall and spring can result in a quicker return to normal conditions.

Table 4
Returning to Normal

Current Drought Phase	Next Drought Phase	Reduce Drought Phase by one category
Emergency	Emergency-continued below normal conditions	Groundwater levels at or above normal and no precipitation deficit for past 3 months; and/or water resource problems which prompted the emergency have abated
Warning	Emergency-worsening conditions or continued below normal conditions	2 consecutive months of groundwater levels at or above normal and near normal precipitation for past 6 months
Watch	Warning-worsening conditions Watch continued below normal	2 consecutive months of groundwater levels at or above normal and near normal precipitation for past 6 months
Advisory	Watch-worsening conditions	2 consecutive months of groundwater levels at or above normal and near normal precipitation for past 3 months

Goal WRM-1: Manage and plan for the sustainable water use and development of the water resources of the State.

Drought Planning Policies

- Reduce Rhode Island's vulnerability to long-term drought.
  Strategies A - C
- Minimize the effects of drought on public health, safety, economic activity, and environmental resources.
  Strategies A - E

Emergency Management

Potable water supply emergencies may result from any natural or man-made event such as floods, hurricanes, earthquakes, tornadoes, hazardous substance spills, mechanical or dam failure, or civil disorder, which disrupt the supply system. These events may result in pollution or contamination of water supplies, prolonged power outages, transmission or distribution system failure, or other structural damage causing a disruption of service, and/or water shortage. The importance and vulnerability of drinking water is not new territory; though the focus of the threat is always in flux. In 1941 Federal Bureau of Investigation Director J. Edgar Hoover said

> *"It has long been recognized that among public utilities, water supply facilities offer a particularly vulnerable point of attack to the foreign agent, due to the strategic position they occupy in keeping the wheels of industry turning and in preserving the health and morale of the American populace."*

Post September 11, 2001, the typical envisioned threat is that of terrorist groups. Historic RI flooding in 2010 and Hurricane Katrina caused a revisit to preparing for natural disasters. An all-hazards approach is where the focus is on establishing and ensuring ongoing water system resiliency.

Consequence management planning complements a utility's overall emergency preparedness, recovery, and response planning. Most Emergency Response Plans describe specific actions to be taken in response to specific incidents that can affect a utility, such as tornados, hurricanes, or earthquakes. All-hazard consequence management planning does not focus on the types of incidents that may cause problems; it focuses on addressing the problems (or consequences), such as loss of power. All-hazard consequence management makes utilities more resilient because it helps to identify specific actions that will eliminate or mitigate consequences associated with specific problems, regardless of the cause. Consequence management planning is driven by the fact that during a crisis or emergency it is more important to address the problem than to spend time and resources identifying the cause of the problem.

This section identifies the key areas of concern related to providing drinking water to citizens of the State at times of extraordinary circumstance when coordination is needed between municipalities, interagency services are required, or transportation of water is required beyond the scope of the supplier. Varying degrees of emergency response depend on the scope of a situation and type of disaster or crisis. The purpose of this Section is to provide drinking water utilities and municipalities with planning recommendations derived from emergency management, mitigation planning, and emergency response resources. The intention is to help drinking water and wastewater utilities incorporate all-hazard consequence management concepts into their existing emergency preparedness, response, and recovery planning.

Public water suppliers direct their resources and management strategy toward guaranteeing a continuous and uninterrupted supply of quality water to consumers. From time to time, however, a crisis arises that has the potential to compromise both the supply and quality of our water resources; and the significance of the resource is both realized and appreciated. This Section is not a medical response plan, nor is it a terrorism response plan. While portions of this Section will be valid, this part was not designed to address these types of incidents Responders should refer to the RI State Emergency Operations Plan for guidance in such events.

See Goal WRM-4
Emergency Management
Policy
Strategies A - J

Planning for emergencies before they happen will not forestall the event or its occurrence interval, but it will enable a more efficient response and in turn help to maintain drinking water quantity and quality. Implementing efficient and effective emergency response plans guarantees a mechanism for providing direction and oversight to ensure that desired results are attained in a timely manner by personnel who understand their roles and responsibilities.

Recognizing that there is shared responsibility among state agencies, water suppliers, and municipal governments in responding to emergency situations (regardless of size), this Section establishes policies to ensure that the State is prepared for water emergencies. It is the responsibility of the RI Emergency Management Agency (RIEMA) that coordinated emergency communication and response procedures exist to address water emergencies in order to provide adequate water to Citizens of the State at times of a crisis.

In most cases, primary reliance is on emergency plans developed and implemented by major water suppliers. The Water Supply Systems Management Act (Chapter 46-15.4) requires water suppliers to prepare water supply system management plans (WSSMP) with emergency response procedures identified within for each system as appropriate. Twenty-eight water suppliers in Rhode Island have emergency response plans on file as part of their WSSMP with the WR Board. Suppliers are obligated to develop plans under "Rules and Procedures for Water Supply System Management Planning". The WSSMPs address the most important and common considerations, varying with unique system configurations. Individual components of the collection, transmission, treatment, and distribution systems are analyzed for adequacy as part of the WSSMP review.

Both the RIEMA through the State's Emergency Operations Plan and the Emergency Operations portions of Water Supply Systems Management Plans (WSSMPs) establish the responsibilities for responding to the most probable emergencies faced by water suppliers. These Plans set out organizational relationships for carrying out efficient and constructive solutions based on an analysis of potential crises and risks. Declarations of emergency in response to water crises may be adopted on a statewide basis, regionally, or locally. It is expected that water suppliers will promptly implement emergency components of their plans if the situation is beyond standard operating or routine response procedures. As outlined in the National Response Framework (NRF) emergency response is first and foremost the responsibility of the water system and municipal government with their own resources. They also rely on the RI Water/Wastewater Agency Response Network (RIWARN), described further below, mutual aid and assistance agreements with neighboring systems and local governments when they need additional resources. When local jurisdictions cannot meet incident response resource needs with their own resources or with help available from other local jurisdictions, they may ask the State for assistance. However, this does not relieve the water system from the obligation to notification to DOH of exceedances of the drinking water standards.

Planning for water emergencies must accommodate the decentralized management of our state's water resources. Our traditional independent and often single-discipline approach to water-related issues combined with current resource management concerns makes it all the more critical to develop management plans for individual water systems.

State involvement is intended to support local water supply response efforts and coordinate additional assistance to municipalities and water suppliers only when the scope of the emergency is beyond the ability of the water supplier and the municipality to respond. Rhode Island has significant resources, including RIEMA, Rhode Island State Police, DOH, DEM, DOT, Rhode Island National Guard, incident management teams, specialized teams, and various other resources. If additional resources are required, the State may request assistance from other States through interstate mutual aid and assistance agreements such as the Emergency Management Assistance Compact (EMAC). Administered by the National Emergency Management Association, EMAC is a congressionally ratified organization that provides form and structure to the interstate mutual aid and assistance process.

This Section is intended as a guide for responding to water emergencies regardless of system size. Not all recommended actions may be suitable to all emergency conditions dependent on system size and the number of persons affected. Nor is this Section intended to replace any existing Emergency Response Plans but rather to complement and improve water systems overall emergency preparedness, recovery, and response planning. In every case, qualified judgment is necessary to predict the scope of an incident, and to assess the available options for mitigation of impacts. Water suppliers, municipal officials, state department directors, or the Governor may serve in this decision-making capacity dependent on the scope of the incident. It is the intent of this Section to specify roles for the levels of each incident, which can be undertaken as emergencies occur.

Most water systems have some inherent degree of emergency response capacity. Many of the major suppliers have water storage facilities emergency connections, redundancy, and standby power at pumping stations and treatment facilities. Few small systems, however, are equipped with adequate emergency connections to other communities or can demonstrate much stand-alone preparedness.

Hurricanes Katrina and Rita illustrated how difficult it could be for utilities to assist other utilities in recovery efforts. Realizing that utilities needed a different approach, the American water Works Association and state agencies have joined together creating WARN programs nationwide[19]. The idea of "Utilities Helping Utilities" has become a critical element in establishing resiliency for water and wastewater utilities. All disasters are local and can include major weather events or other natural or manmade events.

RIWARN is a Water/Wastewater Agency Response Network (WARN) that allows water and wastewater systems in Rhode Island to receive rapid mutual aid and assistance from other systems in RI to restore facilities damaged by natural or man-made incidents. The RIWARN network is available to provide mutual aid whenever a significant service interruption may require assistance beyond a utility's immediately available resources. The goal is to assist in the rapid recovery of service for the protection of the public health, the environment and your local community. State and Municipal Emergency Coordinators are used in the RIWARN system to help utilities better prepare and assist when necessary.

Utilities sign the RIWARN standard agreement, which then allows them to share resources with any other system in RI that has also signed the standard agreement. RI WARN is available to all public and private water and wastewater systems in RI. Participation is voluntary, and is not mandated by any local, state, or federal regulation. In RI, there is no fee to participate in the program. During an emergency, the process and procedures to give and receive mutual aid and assistance are governed by the articles in the RIWARN agreement. The agreement covers issues such as requesting assistance, giving assistance, reimbursement, worker's compensation, insurance, liability, and dispute resolution.

Participation in mutual aid and assistance agreements such as RIWARN is a way for utilities to efficiently and effectively share resources during an incident. Utilities who are signatories to a RIWARN or other mutual aid agreement should include the agreement and Operational Plan in their planning process and incorporate actions needed to access assistance and aid from the RIWARN or other mutual aid in their consequence management plan.

[19] http://www.riwarn.org/index.html

For the most part, water emergencies are not statewide but are confined to a portion of the state, in most cases to the service areas of an individual supplier. The emergency component of WSSMPs will establish methods for each water system to obtain appropriate relief and order additional measures as conditions worsen, as well as provide an approach for easing use restrictions as conditions improve.

A detailed analysis by water suppliers at a system level should include temporary or permanent losses of supply, transmission main breaks, extraordinary emergency pre-treatment options, cost preparedness, , major users' needs, etc. Municipal emergency plans should identify phases of response that achieve demand reduction according to objectives established by the supplier, as they are needed. The overall record of maintaining sufficient quantity and quality of water for Rhode Island is commendable, but disruptions do occur. It is important to realize that most water suppliers experience routine occurrences of pipe breaks, sticking valves, broken hydrants, and power outages. These are anticipated and are generally serviced without a disruption to service or notification to consumers and are not considered emergencies. Water Suppliers have already developed procedures for handling emergencies that occur routinely. Most suppliers have the men and materials available to take care for any normal emergency that may arise.

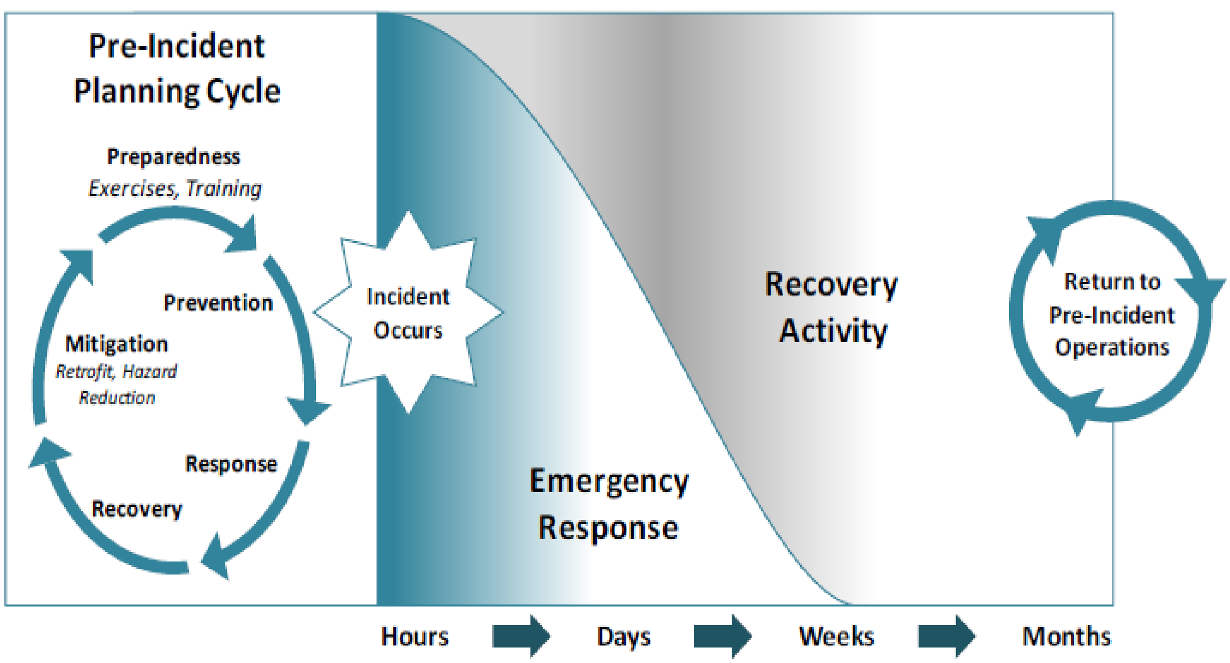
All Hazard Approach and Consequence Management Planning

All-hazard consequence management planning does not focus on the types of incidents that may cause problems; it focuses on addressing the problems (or consequences), such as loss of power. The Preparedness, Emergency Response, and Recovery Critical Infrastructure Partnership Advisory Council (CIPAC) Working Group developed the following table listing common hazards and their potential related consequences. The table will be used as the basis for identifying consequences the associated vulnerabilities that are addressed herein. It is understood that all systems will not share the same hazards or vulnerabilities. When thinking about emergency preparedness, response, and recovery, it is important that utilities consider high probability hazards that they may face and all the potential consequences that flow from them. The hazards each utility should consider will vary depending on factors such as their location, source water, infrastructure and there latest vulnerability assessment.

	Hazards																	
Potential Related Consequences	Flood	Extreme Winds	Lightning	Drought/Water Supply Loss	Hurricane, Tornado	Earthquake	Severe Weather (e.g. ice/snow storms)	Fire/Wildfire	Power or Communication Failure	Weapons of Mass Destruction	Cyber Attack	Infrastructure Failure	Hazardous Material Release	Vandalism/ Sabotage/ Terrorism	Economic Disruption	Supply Chain Disruption	Pandemic Flu	Perceived Incidents
Service disruption of source water, water or wastewater treatment system, storage system, distribution system, collection system, communications and power	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
System contamination including problems that are associated with threatened contamination, actual contamination and perceived contamination. All types of contamination are to be considered, including chemical, radiological, and biological.	●				●	●	●	●	●	●	●	●	●	●			●	
Damage to infrastructure	●	●	●		●	●	●	●	●	●	●	●		●				
Environmental impacts	●			●	●	●	●	●		●		●	●	●		●		
Loss of revenue or other serious economic disruption in the community, or loss of essential supplies either because contracts are voided or supplies cannot get to the area	●	●	●	●	●	●	●	●	●	●	●	●			●	●		
Denied or limited access to utility facilities and infrastructure; for example, if facilities are unsafe or unreachable	●	●			●	●	●	●		●	●	●	●					
Loss of employees/contractors; for example, if employees or contractors cannot come to work because roads are impassable or they are too sick, or they are taking care of their family	●	●			●	●	●	●		●							●	
Loss of public confidence				●					●	●	●	●	●	●	●	●		●
Loss of SCADA systems	●	●	●		●	●	●	●	●	●	●	●		●			●	

Preparing in advance to continue to provide services during recovery operation is very important in reducing human and economic hardships during incidents. Many utilities may be prepared to respond to the immediate consequences of an emergency and address short-duration, relatively straightforward incidents. However, when an incident is complex and extends beyond one or two work periods or shifts, a utility's response capabilities may be overwhelmed. Additionally, in a large and complex incident, recovery may need to begin while initial response occurs. The following figure illustrates the incorporation of recovery efforts into initial response activities.

The pre-incident planning cycle is meant to help utilities continuously reevaluate and improve their preparedness, response, and recovery planning through assessment, training, exercises, and implementation of improvements (retrofit, physical, and operational) that reduce their vulnerability. The shading in the figure below is meant to indicate the intensity of activity during the emergency response and recovery activity phases—response activity is most intense when an incident occurs and then tapers off; recovery activity is most intense sometime after the initial response is over. As the initial emergency situation is stabilized, over hours or days, focus shifts from immediate response and control to recovery and improvement of systems. At the end of the recovery phase, the utility will return to a new level of pre-incident operations. Often, this new level of pre-incident operations will include lessons learned and implementation of actions that improve the operation of the utility.



Preparedness Actions to Improve Resiliency Across All Hazards

- Know the Utility's hazards and consequences.
- Connect with the Emergency Management Agency in the Utility's area.
- Identify response roles and responsibilities in the Utility's organization.
- Ensure resources to maintain minimum operations.
- Create backup plans for key functions and resources.
- Identify and safeguard key utility information for response and business continuity.
- Understand and plan for cost reimbursement procedures.
- Practice and improve Utility's emergency response & recovery Plans over time
- Establish protocols for communication with the public.
- Continue operations during recovery.
- Support employees during an emergency.

Ensure Incident Action Plans to:

- Conduct damage assessment procedures and report data.
- Coordinate actions with emergency responders, local law enforcement, and the local community Emergency Operations Center(EOC).
- Implement plans to provide for alternate fire suppression (if this has been affected) and alternative potable drinking water supplies and wastewater facilities, if needed.
- Determine personal protective equipment needed to ensure employee safety.
- Conduct safety briefings on unusual hazards and personal safety (e.g. downed power lines, hazardous materials, standing water, poisonous snakes, etc.).

Planning Recommendations

- Create a Utility Action Plan based on incident objectives provided by management or incident command and, in the case of multi-agency incidents, in coordination with the overall plan established by the municipal EOC.
- Activate utility damage assessment procedures and document.
- Access what is damaged and how.
- Access what services the utility can still safely deliver.
- What is needed to recover minimal service.
- What is needed to restore to full service.
- How long these different stages of recovery will take.
- Access emergency/backup data, maps, and systems as needed.
- Determine if utility and local incident resources are adequate or if the utility needs to access additional resources such as more specialized resources for damage assessment, longer-term recovery, site characterization, and/or management and disposal of contaminated water, wastewater, and other materials.
- Establish work priorities for incoming mutual aid resources as appropriate.
- Obtain any permits or other regulatory authorizations (e.g., waivers) that may be needed for response and recovery activities.
- Create a Demobilization Plan when appropriate. This plan should include the process to demobilize initial response resources including those provided through mutual aid arrangements and alternative water supplies or bypasses as appropriate.
- Upon demobilization, evaluate lessons learned, identify steps to take to prevent recurrence or lessen impacts, and document successes.

Responsibilities

Addressing the principal issues and fundamental needs in a crisis situation depends on a reliable response from emergency personnel. In many circumstances, the local water supplier will be among the first to acknowledge an incident, as suppliers are equipped with alarm systems for mechanical and power losses and normally monitor water volume and pressure in the transmission and storage system. It is primarily the responsibility of the water supplier to notify its customers as well as the DOH when drinking water standards are violated and assistance is needed. All water suppliers should consider maintaining stand-by contracts for purchasing water through emergency interconnections and purchasing potable water at competitive prices when either are needed in large volume.

Communities must assist and play a supportive role in responding to water emergencies within their geographic boundary; municipalities should be prepared to offer equipment, personnel, and other resources if feasible. In the case of a disaster declaration, which requires the exhaustion of resources on a local level, the municipality must have knowledge of what they have to offer both financially and physically so that they can promptly realize what situations are beyond their response capability and may therefore require state assistance.

Every municipality has an approved EOP cooperatively developed by the community and the state Emergency Management Agency (RIEMA). The EOP provides a framework in which elected officials, department heads, and emergency services personnel plan and perform emergency functions during a disaster or national emergency. Annex H, Emergency Resources of the EOP, should be expanded to address water emergencies. It should include a list of resources, personnel equipment, and supplies available for use in water emergencies. Each municipality should conduct an inventory and maintain a list of available water supplies, including regional stockpiles that are available for use in emergency situations. This refers only to those supplies not presently utilized and may include surface, groundwater, and bottled water resources.

State and Federal Agencies

State and federal agencies have multiple programs and functions pertaining to emergency water supply management. This section describes the responsibilities of state and federal agencies and other organizations relative to their role in emergency water supply. This is not intended to be an exhaustive list of all services and functions but addresses regulatory authority, operating responsibility, and sources of funding for drinking water crises. State agencies who are actively involved in water emergency management should review in-house procedures and prepare written and detailed operational plans for emergency response similar to the emergency preparedness plans of the PUC. The plan should address personnel roles and responsibilities, lines of authority and communications, training, and emergency alert and response procedures, particularly the DEM, DOH, and DOT.

State Police - may be the primary responder to accidents or hazardous material releases occurring throughout the state. The state police secure areas protecting the general public along with local police. They notify local fire officials and emergency crews as necessary.

Department of Health (DOH) has primary responsibility for health, safety and welfare of the State's population. The DOH Office of Drinking Water Quality has primary responsibility for assessing water quality, determining effects on public health, and enforcing the standards of the Safe Drinking Water Act. The DOH responds to water emergencies and has primary responsibility for incidents involving contamination. Department staff monitors the potablity of principal and emergency water sources including trucked and bottled water, supervise the collection of chemical and bacteriological samples, and issue "boil water" notices or other health advisories when necessary to protect public health and safety. The DOH provides laboratory support for water testing and assesses the extent of an incident by sampling results before determining the magnitude and degree of assistance required. The Director keeps the Governor's office appraised of emergency events and of the need for additional assistance. The DOH routinely works directly with water suppliers and local officials notifying them of their obligation to inform the public of violations and emergency status as violations occur. In worst case scenarios the DOH may require that continuity of water supply be maintained at least to meet firefighting and sanitary flow.

Department of Environmental Management (DEM) has primary responsibility for regulation and use of the state's natural resources. The DEM obligation in the realm of drinking water extends to several divisions of the department, each having a unique responsibility.

> Office of Waste Management is responsible for the intermediate and long-term response to releases of hazardous materials and petroleum to the environment. The DEM Emergency Response Program responds to immediate instances of such releases. The DEM assesses the type and level of response required and usually activates an emergency response team for containment and clean up of hazardous releases. The DEM maintains stand-by contracts with private firms whose service or expertise may be required during a hazardous spill emergency. DEM is responsible for enforcing regulations regarding hazardous material mitigation and response.
>
> Office of Water Resources is charged with establishment of policy to protect the purity of present and future groundwater supplies. The Office monitors surface and groundwater supplies for extent of contamination or plumes as necessary in an emergency. Other DEM staff in groundwater protection, freshwater wetlands, and water resources participates in evaluating the extent of contamination incidents and proximity to drinking water supplies for hazardous releases. The DEM keeps the Governor's office appraised of emergency incidents and assesses the type and amount of additional assistance required when responding to hazardous materials releases. The DEM works cooperatively with DOH to estimate damages and ascertain the best methods of protecting the public from the consequences of potable water emergencies.

Public Utilities Commission (PUC) is a tariff setting entity comprised of the three commissioners, staff attorneys, accounts, and analysts. It is charged with responsibility for the regulation of all public water companies that sell retail water to customers beyond corporate boundaries of the municipality. These include: the Kent County Water Authority, Newport Water Department, Pawtucket Water Supply Board, Providence Water Supply Board, Woonsocket Water Department, and a private water company; the United Water Company. The PUC reviews and is responsible for approval of tariff rate increases for all regulated public utilities.

The Division of the PUC (DPUC) is a separate agency with specifically defined tasks including acting as the ratepayer advocate in water rate cases according to the" *Rules and Regulations Proscribing Standards for Water Utilities*", engineering, consumer issues, cable tv regulations, motor carrier operations. The DPUC is not a division of the PUC. The DPUC is the primary responder to water emergencies that involve prolonged power failures and affect the ability of a water supplier to maintain a safe and adequate water supply. The DPUC Emergency Preparedness Plan directs DPUC employees to emergency locations and positions staff to review operations of utilities, or aid in consumer support or communications. Mobile field crews are notified of restoration priorities and directed to areas of highest need. The DPUC monitors restoration efforts by the utility companies and coordinates any unforeseen circumstances with the utilities. The DPUC generally activates its emergency function in response to emergencies as they are declared by the Governor, but it is also prepared to respond without this notice. The DPUC administrator is responsible for informing the Governor's office of the extent of damage to utilities and the effect on operational public service systems.

The Emergency Management Agency (RIEMA) is charged with assuring prompt, proper and effective discharge of fundamental responsibilities related to disaster preparedness operations and recovery. RIEMA will assume a critical role in ensuring coordination of needed services and supplies and communication among state, federal and local government. Through the Emergency Support Functions established at RIEMA coordination of acquisition and transportation of large amounts of bottled water or other equipment and supplies can be coordinated at the Emergency Operations Center (EOC).

As part of its statutory responsibility, RIEMA may act as the State’s coordinating agency with all other state and federal agencies including FEMA and the RI National Guard. Coordination efforts may include requests for disaster declarations with SBA, US Army Corps of Engineers, or USDA. Assistance of this type may require a local declaration of emergency by the municipal government, when the situation exceeds their capacity to respond. Likewise the State may be required to declare a limited state of emergency to request federal assistance to mitigate the potential water emergency.

The Department of Transportation (DOT) assists in the clean up of major accidents or spills, as the Department has diverse equipment and supplies at hand to respond to many types of roadway incidents. The RIDOT responds at the request of state public safety officials. The RIDOT also maintains engineered maps of state roadways, which may be useful to reference in the containment efforts of large hazardous spills.

The Federal Emergency Management Agency (FEMA) monitors, oversees, and coordinates federal disaster relief and emergency assistance programs under a Presidential Declaration of a major disaster or emergency. Assistance during water supply emergencies includes repairing and restoring public and private non-profit facilities and providing community services including water, loans, grants, etc. Federal agencies may be directed to provide technical assistance and advisory personnel when the disaster is beyond the capability of the local government or the State. The local government must identify the problem, actions being taken, and appropriate assessment data as well as declare an emergency and request emergency aid from the Governor.

The Environmental Protection Agency (EPA) and the Coast Guard share federal responsibility for hazardous substance releases including oil. Notification is required for any incident affecting inland waters, and under the National Response Plan the EPA is able to access all available federal agencies to assist The EPA responds to hazardous material releases affecting inland waters; generally the Coast Guard maintains purview over coastal waters.

National Incident Management System (NIMS) and the Incident Command System (ICS)

The National Incident Management System (NIMS) and the Incident Command System (ICS) provide a consistent framework for preparedness, response, and recovery activities, allowing responders with different backgrounds and from different jurisdictions to respond effectively together. Understanding NIMS and ICS is very important to a utility's ability to participate and coordinate effectively in any response effort. During response and recovery efforts a utility will play two roles. First, it will manage the direct effects of the incident on the utility by directing utility response and recovery actions. Second, it will support the local Emergency Operations Center (EOC) by coordinating the utility response with the overall action plan objectives and priorities set by the local community and/or State EOC management. Communication and coordination between the utility EOC, the community EOC and State EOC is critical. Both the utility-level response and the overall community-level response are carried out using NIMS and ICS. NIMS and ICS are built around a common structure and functional organization to emergency response. The specific NIMS and ICS functions and their roles are:[20]

- **Management:** establishes policy, sets priorities, creates the course for successful accomplishment of set objectives, approves plans, manages/coordinates deployment of resources, and communicates with the public and other agencies.

- **Operations**: develops and implements strategies and tactics to carry out incident objectives, coordinates field resources, and identifies needed personnel or resources.

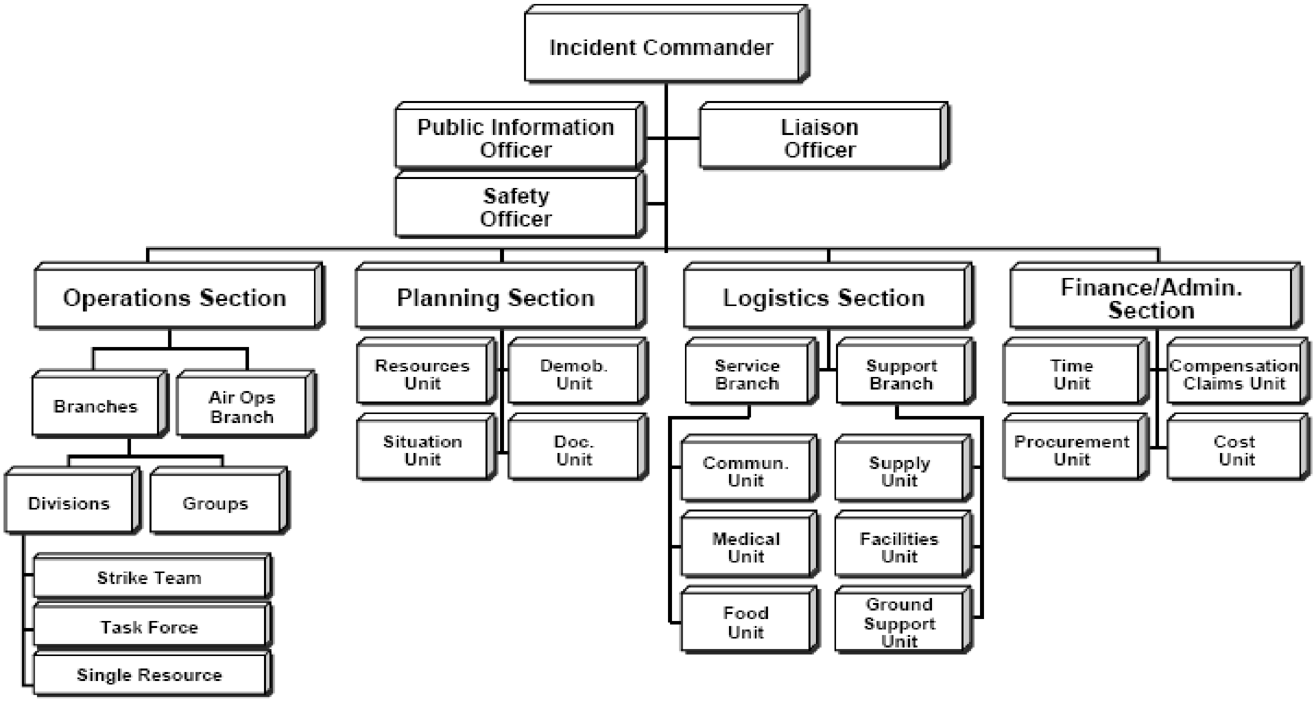
- **Planning**: collects, analyzes, and disseminates information and intelligence, manages the planning process, compiles an Action Plan and other related documents, and manages technical specialists.

- **Logistics**: provides transportation, communications, supplies, equipment maintenance and fueling, food, and medical services for incident personnel, and all off-incident resources.

- **Finance**: provides financial and cost analysis, oversees contract negotiations, tracks personnel and equipment time, processes claims for accidents and injuries, and works with Logistics to ensure resources are procured.

Federal, state, and local emergency response organizations use NIMS and ICS in responding to multi-agency incidents, and they will expect utilities to understand and function within the NIMS and ICS structure. Building relationships with the local emergency management agency and other responsible partners and understanding ahead of time how they implement NIMS and ICS will help make an actual response much smoother. Utilities should identify the city or county Emergency Coordinator or Local Emergency Manager within their jurisdiction and develop operational relationships with them. These individuals can provide critical support and identify resources for a utility in an incident of any size or complexity. For information and training on how utilities can implement NIMS, please visit: http://training.fema.gov/IS/NIMS.asp

[20] The descriptions of the NIMS and ICS functions are paraphrased from the NIMS and ICS references to illustrate the concepts for purposes of this document. They are illustrative descriptions and are not intended to replace the formal definitions established by NIMS.



Rhode Island has established a State Emergency Response Committee (SERC), which has regionalized the state into 9 districts for hazardous materials (Haz-Mat) emergency response. SERC policy complies with federal Haz-Mat regulations and assigns key personnel in each of the districts to serve on Local Emergency Planning Committees (LEPC). In Rhode Island, the SERC has recommended adoption of the incident command system for all Haz-Mat emergencies.

Small Water System Failures

Much of this Section addresses the major public water systems. It is recognized, however, that there are more public small systems (462) in the State than major public systems. The small systems must ensure that they too have the resources to address emergencies. Short-term failures in these systems may never be municipal or state emergencies, as problems are analogous to piping or plumbing problems that should be considered a part of regular maintenance. Small public suppliers must be ready to secure plumbers or contractors when necessary and to address minor contamination episodes with the purchase of bottled water. There is an assumption that municipalities will assist water suppliers with available emergency equipment and supplies when requested. Response, however, will vary dependent on the resources of the community where the supply is located. State assistance may be requested in these incidents but will likely be limited to ensuring safety or health of the population at risk.

There is no blanket provision for state assistance to small systems. Limits of state assistance will include the resolution of concerns related to public health by offering expertise and resources. However, further assistance should be forthcoming when the municipality has followed proper procedure for declaration of an emergency (Appendix E, Declaration of Local Disaster Example), which assures state assistance for items beyond the municipality's capacity. The State is not obligated to provide bottled water for any small water system, whether public or private, except under the express conditions of existing state programs managed by the DEM and the DOH.

Goal WRM-4: Ensure the protection of public health, safety and welfare and essential drinking water resources during water supply emergencies

Emergency Management Policy

- Manage and conserve essential potable water resources in times of emergencies and or shortages
  Strategies A - J

Case Study: Loss of Power - Specific Actions

Loss of power can interrupt the utility's ability to treat or deliver drinking water and to treat and discharge wastewater. It is very important that water utilities prepare for a loss of power through redundant and back-up electrical service supplies and know what they will do to respond and recover in the event of a loss of power. Utilities should document and understand electrical service system operation and power needs. Performing regular maintenance on primary and backup electrical systems is also helpful to prepare for (and recover quickly from) a loss of power.

Utilities should incorporate the following suggested actions specific to loss of power incidents into their planning for hazard mitigation preparedness, and their emergency response and recovery planning. These actions supplement the all-hazard actions described earlier in this document.

Preparedness Actions for Loss of Power Incidents

- Document water, wastewater, and electrical system information (e.g., maximum day demand, average daily demand, and equipment specifications).
- Evaluate electrical distribution within the facility. Consider alternative or dual electrical service sources and consider establishing feed capabilities so that electrical service can be distributed within the plant in case of an internal interruption.
- Ensure that critical equipment can be operated using the alternative power source. For alternative sources such as a portable generator, ensure that all required electrical wiring is pre-installed.
- Update critical equipment lists, generator capacity calculations, and start/connect lists annually or as new equipment is phased into a facility.
- Verify critical equipment that is served by redundant primary feeds, and also have redundant secondary control voltage electrical service supply sources.
- Calculate electrical service demands for start-up of critical equipment. Remember, start-up surge requires two to three times more electrical load than normal running demands.
- Identify critical equipment at each site and document voltage, phase configuration, and horsepower/amperage requirements.
- Ensure radio equipment has alternate electrical service sources and is compatible with first responder radio equipment. It may also be worthwhile to ensure radio compatibility with neighboring utilities; utilizing compatible communications equipment that meets federal standards will facilitate information flow among responders and the utility. Be sure to also evaluate compatibility of data networks, if possible.
- Regularly test operational capability of alternate power sources in real-time situations.
- Identify any insurance rate reductions that could apply given the effort to manage operations during a loss of electrical service.

Case Study Continued: Loss of Power - Specific Actions

Work with the Local Electric Utility in Advance

- Establish a liaison with the electric utility service provider to communicate information on the power restoration process and status. It is critically important that the electric utility understand the water system's priority needs well in advance of an incident.
- Determine treated water/wastewater storage capability within the utility's collection and distribution systems. This will allow the utility to develop alternate pumping plans to continue to provide service during short term power outages.
- Determine whether or not current generators can support all electrical service critical needs equipment.
- Determine if staff is well-versed in operating and maintaining existing generator(s). If not already written, consider developing a "start and connect" checklist specific to each individual generator.
- Develop service agreements for semi-annual inspections from an authorized service center.
- Establish routine (weekly, monthly, bi-monthly) internal start procedures for all generators. Frequency may depend on air quality rules.
- Obtain a list of generators available for rent in the utility's area and establish priority rental agreements with local companies.
- Establish agreements with surrounding utilities. Identify equipment available for use.
- Determine how long it is reasonable to power systems locally from back-up generators by coordinating with the power company and local emergency managers. The utility can then determine if it has the proper switching equipment to run existing generators or the interconnection for portable generators to provide electrical service for critical equipment.
- Determine whether adequate fuel supply exists on-site to run generators for critical systems and for how long. For diesel generators, the typical consumption rate is typically 2.5 gallons per hour for every 10kW of power generated.
- Determine how accessible fuel sources for generators and other critical equipment would be during hazardous conditions, including power outages at refueling depots. Consider how additional fuel can be delivered if primary roads are impassible.
- Evaluate the size and lengths of portable power generator cables needed to keep on hand to power critical process areas and equipment with portable generators during an incident.
- Evaluate the generator(s) location and protection to withstand area hazards and operate in all conditions.
- Perform regular preventative maintenance and testing of automatic transfer switches and generators to ensure proper operation and reliability of performance.

Response and Recovery Actions for Loss of Power Incidents

- Initiate back up power systems to maintain utility operations, if possible.
- Take actions necessary to respond to the outage and repair the problem; this likely will involve coordination with the electrical service company. Determine if utility resources are adequate to respond to the loss of power or if assistance is needed.
- Establish a maintenance plan to support generators, including a schedule to mitigate generator down time for maintenance activities.
- Establish a fueling plan to support generators.
- Repair equipment that may have been damaged by the loss of power.
- Identify loss of revenue and costs associated with response to file claims with insurance or public assistance, if available.

The Future

No one knows exactly what the future holds. Management, conservation and development of the water resources of the State, will continue to be critical to the State. Water planning for current and future needs is critical and should continue. As Rhode Island changes, water suppliers, municipalities and state agencies will continue to use different methods for managing water resources. Population changes, the economy, evolving regulations, long-term climate changes and changing public attitudes are a few conditions that will continue to influence water decisions. No single response package will work for all areas of the State. Facing an uncertain future, the differing regions of the State need to invest in an appropriate mix of strategies based on integrated regional water management plans that are diversified, satisfy regional and state needs, meet multiple resource objectives, include public input, address environmental justice, mitigate impacts, protect prior public investments in infrastructure, and address contaminants of emerging concern.

The technology, data, management and financing of water systems are coping but need to be upgraded. Most of the environment and aquatic habitats affected by water supply are relatively stable and with appropriate management will continue to function. Exceptions, such as the Chipuxet and the Hunt- Annaquatucket-Potowamut (HAP) aquifer systems, need correction. Rhode Island has sufficient supplies but water is not always located where it is needed or available in sufficient quantities for all uses at all times. Storage capacity must be increased in order to provide long-term supply reliability, especially in groundwater dependent areas. Back up water supplies in the event of emergencies or system failures are few. There is no major back up for the Scituate Reservoir. Freshwater can become contaminated and potable drinking water is routinely used for purposes not requiring water of drinking water quality. Contaminants of emerging concern (CECs) are a diverse group of relatively unmonitored and unregulated chemicals found in consumer and industrial products that have been shown to occur at trace levels in wastewater discharges, ambient receiving waters, and drinking water supplies. CECs include pharmaceuticals, personal care products, and other commercial and industrial compounds. There are 129 priority chemicals currently regulated under the Clean Water Act and additional chemicals regulated under the Safe Drinking Water Act, but there are tens of thousands of CECs that may potentially require assessment to ensure their impacts to human and ecological health are minimal.

A lack of basic information and the technology to efficiently measure CECs at trace levels (i.e., parts per trillion) hampers our ability to assess their potential risks, though scientists are beginning to generate such information. Federal and State health and regulatory agencies are aware of (and, in some cases, are funding this research), but have not yet synthesized the information into a comprehensive strategy for developing their monitoring and regulatory actions.

We must invest in Rhode Island's aging potable water systems. Rhode Island needs more stable and continuous sources of revenue to invest in statewide and regional integrated water management and to build resilience back into the State's potable water systems, as well as into the watersheds, groundwater basins, and ecosystems that support them. The conclusion of this water plan is clear: Rhode Islanders can meet their potable water needs into the future by making the right choices and investments today. *Rhode Island Water 2030* provides the guidance state policymakers, local and regional entities and others need to take actions to meet the State's water demands now and in the years to come.

Implementation Matrix

The Implementation Matrix which follows contains the goals, policies, and strategies for the 2 over arching general areas and the 9 policy themes outlined above. All policies are referenced by the goal /policy abbreviations cited in the text. Strategies for the Plan were developed around each subtheme as follows:

- Goal(s)
  - Policies
    - Strategies for each policy
      - Lead agency (Lead)
        - Supporting agencies (Support)
          - Timeframes
            - As Necessary
            - Ongoing
            - Short Term (1-2 years)
            - Medium term (3-5 years)
            - Long term (more than 5 years)

It is intended that this Element provides the prevailing goals and polices for potable water supply planning in the State. In cases of conflicting or outdated polices and recommendations, this Element has precedence.

VISION	**To ensure safe, reliable, ample water supplies to meet the State's short and long range needs while preserving the physical, biological, and chemical integrity of the water resources of the State.**
GOALS	**Integrated Management & Planning**
	IPP-1. Integrate water resources and supply planning for water systems across intergovernmental and regional jurisdictions.
	IPP-2. Ensure the adequate technical, managerial, and financial capacity of water systems.
	IPP-3. Manage and plan for water systems that support sustainable, compact land use and concentrate development within the urban service boundary and or growth centers.
	Water Resource Management
	WRM-1. Manage and plan for the sustainable water use and development of the water resources of the State.
	WRM-2. Protect and preserve the health and ecological functions of the water resources of the State.
	WRM-3. Ensure a reasonable supply of quality drinking water for the State.
	WRM-4. Ensure the protection of public health, safety and welfare and essential drinking water resources during water supply emergencies

Implementation Matrix Acronyms and Abbreviations

All	All of parties in this listing
BCC	Building Code Commission
BRWCT	Bay Rivers Watersheds Coordination Team
CRMC	Coastal Resources Management Council
DEM	Department of Environmental Management
DOP	Division of Planning Statewide Planing Program
DOT	Department of Transportation
DSC	Drought Steering Committee
FHA	Federal Highway Administration
GA	General Assembly
GOV	Governor's Office
M	Municipalities
NRICD	Northern RI Conservation District
PWSB	Providence Water Supply Board
PUC	Public Utilities Commission
RICWFA	RI Clean Water Finance Agency
RIEMA	RI Emergency Management Agency
RIGIS	RI Geographic Information System
RILA	RI Landscapers Association
RISAF	RI Chapter of Society of American Foresters
RIWWA	RI Water Works Association
SA	State Agencies
SP	State Police
SS	Self-suppliers
T	Tenants residing in the Big River Watershed
USGS	United States Geological Survey
U	Users
WRB	Water Resources Board
WRBS	Water Resources Board Staff
WC	Watershed Councils
WS	Water Suppliers
WWA	Waste water authorities
URI	University of Rhode Island Cooperative Extension

TimeLine

AN	As Necessary	
O	Ongoing	
ST	Short term	1-2 years
MT	Medium Term	3-5 years
LT	Long Term	more than 5 years

	Integrated Management & Planning	Lead	Support	Timeline
Goal IMP-1	**Integrate water resources and supply planning for water systems across intergovernmental and regional jurisdictions**			
Planning Policies	1. Include water quality/quantity issues for water supply sources in state water use and or municipal land use regulations			
	♦ Strategies			
	A. Revise Water Supply Systems Management Plan Rules and Regulations for consistency with Water Use & Efficiency Act	WRB	WS,RIWWA,DOP	ST
	B. Coordinate Water Supply Systems Management Plans with comprehensive community plans	WS,M	WRBS,DOP	O
	C. Ensure that Executive Summaries of WSSMP are included in comprehensive community plans	M,DOP	WRBS,WS	O
	D Ensure that relevant elements of comprehensive community plans are included in WSSMPs	WS, WRBS	M, DOP	O
	E. Develop water supply availability estimates for water suppliers and municipalities.	WRBS	DEM.USGS	ST
	E.1. Develop guidance and technical assistance regarding use of water supply availability estimates by general public	WRBS	DEM, USGS,URI	ST
	E.2. Develop guidance and technical assistance regarding use of water supply availability estimates in WSSMP and CCP	WRBS	DEM,M,WS,DOP	ST
	E.3. Develop guidance and technical assistance for using water supply availability estimates in municipal and or state regulations	WRBS	M,DEM	MT
	F. Encourage use of USGS Pawcatuck Optimization Model for water supply siting applications	WRBS	USGS,DEM	MT
	G. Develop land use / water use information tables	WRBS	DEM,USGS,DOP	MT
	H. Develop guidance and technical assistance for using water supply availability estimates and land use / water use information in municipal planning	WRBS	DEM	MT
	H.1 Plan the use of land and availability of water resources in cooperation with water suppliers	M	WS,WRBS	O
	H.2. Plan the use of land that uses existing infrastructure efficiently before creating new systems	M	WS,WRBS,DOP	O
	H.3. Revise regulations to ensure water supply availability is considered for major development reviews	M	WRB,WS	MT
	I. Provide assistance to municipalities to ensure consideration of water supply availability in major development reviews	WRBS	WS,DEM	O
	J. Develop an education and outreach program for water quality/quantity issues	WS, WRBS	URI,DEM,WC,DOH	MT
	2. Promote regional planning and management for existing and future sources of water supply			
	♦ Strategies			
	A. Ensure potable source protection through land acquisition and or state / municipal land use regulations or ordinances	WRB,DEM	DOH, DOP	O
	B. Educate users on water resource planning and management	WS	WRB,DOH,M,WC, BRWCT	O
	C. Continue coordination with municipalities, watershed organizations and NOGs	WS,M,WRB	DOP,WC,URI	O
	D. Work with educators, URI Co-Operative Extension, and others on educational programs.	WS,M,WRB	URI, DOP,WC,DOH	O
	E. Work with neighboring states to assure water supply resources are afford the highest protection regulations allow	DEM	WS,DOP,NBEP, BRWCT	MT
	F. Use the WRB Strategic Plan to study and encourage regionalization of major systems in 4 water planning areas of the State.	WRB	DOP,DOH	O
	G. Use the WSSMP and CCP to encourage the regionalization of multiple major systems within a single municipality	WRB	DOP,DOH	O
	H. Encourage regionalization of public systems for improving technical, managerial, and financial capacities of water systems	WRB	DOP,DOH.RIWWA	O

Integrated Management & Planning		Lead	Support	Timeline
Goal IMP -2	**Ensure adequate technical, managerial, and financial capacity of water systems**			
Planning Policies	1. Ensure the reliability of water supply infrastructure and water supply sources			
	♦ Strategies			
	A. Ensure that AWWA best management practices for water supply operations are implemented	WS	DOH,RIWWA	O
	B. Identify and evaluate improvement or practices required to extend the life of existing sources and systems	WS	DOH	ST
	C. Locate and fix leaks on a regular basis	WS	M	ST/O
	D. Maintain a level equal to or less than 10% non-account water	WS	M	ST/O
	E. Adopt and enforce standards for cross-connections and back flow prevention	DOH	WS,M	MT
	F. Ensure that new water systems demonstrate capacity to comply with all drinking water regulations before granting approval	DOH	WS	O
	G. Ensure that new water systems demonstrate financial and managerial capacity before granting approval	DOH	WS,M	O
	H. Continue to implement Clean Water Infrastructure Replacement Plans	WS	M, DOH	LT
	I. Update and Implement WSSMP	WS	M, WRB	LT
	J. Continue to develop standards to implement Safe Drinking Water Act	DOH	EPA	O
	K. Revise Water Facilities Assistance Grant Program for consistency with Water Use & Efficiency Act and *Land Use 2025*	WRB	WS,RIWWA,DOH, DOP	MT
	L Continue to support and fund the Water Facilities Assistance Grant Program	WRB	GA,WS	O
	M. Continue to support and fund the Emergency Interconnection Program	WRB	GA,WS	O
	N. Continue to support and fund the Drinking Water State Revolving Loan Fund	RICWFA	DOH, GA,WS	O
	2. Ensure the investment in and charge all customers the full capital, operating and replacement costs of water systems			
	♦ Strategies			
	A. Operate water systems as enterprise funds	WS	M	ST
	B. Initiate quarterly or more frequent billing	WS	M	ST
	C. Test and or replace water meters regularly and check for accuracy	WS	M	O
	3. Fairly impose the total cost of meeting the requirements of sustainability and demand management on all users			
	♦ Strategies			
	A. Eliminate flat or fixed rates	WS	M,PUC	ST
	B. Adopt rates which encourage water efficiency	WS	M,PUC	ST
	C. Institute seasonal rate and or drought surcharges	WS	M,PUC	AN
	D. Establish hook up fees for new users	WS	M,PUC	ST
	4. Investigate regionalization where viable			
	♦ Strategies			
	A. Identify opportunities for regionalization	WS	M,DOH,DOP, BRWCT	LT
	B. Provide technical assistance to owners for annexation benefits/ requests.	DOH	WS	O
	C. Create incentives for regionalization	DOH	GA, BRWCT	LT
	D. Use the SRF for technical assistance and to aid in restructuring small systems	DOH	WS,M	AN

Integrated Management & Planning		Lead	Support	Timeline
Goal IMP-3	**Manage and plan for water systems that support sustainable, compact land use and concentrate development within the urban service boundary and or growth centers**			
Planning Policies	1. Consider the cumulative impacts on water quality, overall water availability and public health when establishing the density of development			
	♦ Strategies			
	A. Relate future land use to water supply availability estimates	M	WRB, DOP	O
	B. Concentrate new public water systems in USB or areas planned as growth centers to maximum extent possible	M	DOP,DOH,WRB	O
	C. Locate new growth centers in areas served by or adjacent to public water and /or wastewater systems with available capacity to maximum extent possible	M	DOP,DOH,WRB,DEM	MT
	D. Adopt regulations regulating shared private systems at state and municipal levels.	DOH,M	M,DOH	LT
	E. Use alternative zoning /conservation design principles to help protect water bodies and wetlands	M	DEM,DOP	O
	2. Match future land use to existing water supply availability & demand, water use priorities and infrastructure capabilities			
	♦ Strategies			
	A. Coordinate new source development with *Land Use 2025*	DOP	WRB,DOH,DEM, WS,M	O
	B. Evaluate major water sources and systems, forecast future water needs and determine where unmet needs exist.	WRBS	WS,DEM,DOH	MT
	C. Maximize the use of exiting infrastructure and discourage the creation of new small water systems	M	DOH,WRB	O
	D. Establish guidelines for service extensions and service area definitions consistent with USB	M,WS	DOP	LT
	E. Provide public water to areas served by private water with documented water quality problems where feasible	WS	M,DOH,RICWFA	AN

Water Resource Management (WRM)		Lead	Support	Timeline
Goal WRM-1	**Manage and plan for the sustainable water use and development of the water resources of the State.**			
Resource Assessment Policy	1. Ensure the overall long-term availability of potable water statewide			
	♦ Strategies			
	A. Continue to assess and quantify water use, water demand, safe yield and supply availability within the State			
	A.1. Develop a technically sound and universally applied calculation for safe yield	WRBS,DEM	USGS,GA	ST
	A.2. Complete build-out analysis scenarios of available water for all basins.	WRBS	DEM,URI	ST
	A.3. Translate USGS basin studies and other appropriate information into a breakdown of available water for all users	WRBS	DEM.URI	ST
	A.4.Create water resources /use information portal	WRBS	URI,DOA,BRWCT	ST
	B. Standardize water data reporting methods for water production, water use by sector, per capita, non-billed water, and leakage	WRBS	WS	ST
	B.1. Use electronic reporting technology for water data reporting	WRBS	WS	O
	B.2 Develop consistent methods of calculating demand for sound projections of water use	WRBS	WS,USGS	MT
	C. Prevent abandonment of existing potable sources except when justified	WRB	DEM, WS,M	O
	C.1. Use water allocation to prevent the abandonment of potable sources.	WRB	DEM, DOH	O
	C.2. Ensure the viability of new or alternative sources of supply prior to abandonment of existing supplies for protection of public health and safety purposes	DOH	WRB,DEM	O
	D. Continue studies to augment overall long-term water reliability through supplemental supply alternatives.	WRB	USGS,WS	MT
	E. Identify where existing storage can be augmented and supplemental storage can be added	WS	DOH	MT
	F. Maintain and expand the state's stream and groundwater gage network	WRB	DEM,GA, BRWCT	ST
	G. Monitor desalination projects in neighboring states and emerging desalination technologies	WRBS	CRMC,DEM,DOH	O
	H. Continue to plan strategically for water availability and update agency strategic plans on regular basis	WRB	DEM,DOH, DOP,BRWCT	O
Quantity Policy	2. Manage water use and withdrawals based on water availability that considers hydrologic capacity, public health, and protection of aquatic resources			
	♦ Strategies			
	A. Develop and implement water use targets through water allocation program	WRB	WS,M	ST
	B. Expand the water use data reporting system.			
	B.1 Establish reporting system for Major public suppliers	WRBS	WS	ST
	B.1.1 Categorize water use on a quarterly basis and provide a breakdown of usage vs. availability	WRBS	WS	MT
	B.1.2. Publish water use data through water information portal	WRBS	URI	MT
	B.2. Establish reporting system for Minor public suppliers	WRBS	WS	MT
	B.3. Establish reporting system for Self-suppliers	WRBS	SS	LT
	B.4. Allocate available water	WRB	DEM, DOH	LT
	C. Provide support to agricultural users for installing technology to enhance water efficiency	DEM	NRCS	O
	D. Consider commutative impacts of interbasin transfers to ensure transfers do not negatively impact sustainable water use in the donor or benefactor basins	DEM	WRB,USGS	O
	E. Identify stressed basins & mitigation techniques	DEM	WRBS,USGS	ST
	F. Establish stream flow depletion standards	DEM	WRBS, DOP	ST

Water Resource Management (WRM)		Lead	Support	Timeline
Goal WRM-1 (Continued)	**Manage and plan for the sustainable water use and development of the water resources of the State.**			
Climate Change Policy	3. Ensure adequate potable supplies for now and the future in the context of a changing climate			
	♦ Strategies			
	A. Assess state wide water resources and water systems vulnerability and needs for adaption / mitigation to climate change	DOH	WS, BRWCT	ST
	B. Educate water suppliers on climate change impacts	All	All	O
	C. Adopt use of EPA climate change tool box	WS	EPA	ST
Potable Supply Management Policy	4. Ensure the protection of public health, safety and welfare as the priority use of potable water while striving to protect other uses and the economic well-being of the State			
	♦ Strategies			
	A. Assure that water systems meet Safe Drinking Water Act standards	WS	DOH, RIWWA	O
	B. Ensure that the quality of water provided is matched to the quality needed for proposed uses	WS	DOH,M	O
	C. Minimize the use of potable water for non-potable purposes	WS,M	WRB,DEM	O
	D. Ensure adequate capital planning and ongoing investment in water system infrastructure	WS,M	DOH,RICWFA	O
	E. Ensure that potable water is provided at equitable costs	WS,M	PUC	O
Drought Mitigation Policies	5. Reduce Rhode Island's vulnerability to long-term drought			
	♦ Strategies			
	A. Monitor and respond to drought through a coordinated and cooperative interagency process			
	A.1. Convene Drought Steering Committee when conditions warrant	WRBS		AN
	A.2. Implement drought management actions by phases in drought regions	WRBS	DSC	AN
	A.3 Ensure that WSSMPs establish procedures for drought preparedness and response	WS,M	WRB	O
	A.4 Ensure municipalities participate in coordination of drought preparedness and response	M	WRB	O
	A.5. Ensure that a drought water use reporting system is completed and implemented	WRBS	WS,M	ST
	B. Continue public education and outreach in drought preparedness and management	WS,M,	WRB,DSC,WC	O
	B.1 Ensure community comprehensive plans acknowledge drought coordination responsibilities	M	DOP	O
	C. Review drought indices and phases and adjust for emerging drought planning standards and science	DOP	DSC	AN
	6. Minimize the effects of drought on public health and safety, economic activity, and environmental resources			
	♦ Strategies			
	A. Allocate potable water during droughts to essential and high priority uses which require that quality			
	A.1 Implement the non-essential water use priority listing for water use demand reductions	WRBS	DSC,GOV	AN
	B. Manage resources during droughts to sustain water-using industries and other economic activities to the extent practicable	WRB	DSC,GOV	AN
	C. Manage available resources during droughts to sustain environmental resources to the maximum extent practicable	WRB	DSC	AN
	D. Implement rate changes when water usage is in excess of demand deduction targets for each phase of drought	WS,M	DSC,WRB,PUC	AN
	E. Prepare post-drought mitigation evaluation reports for future drought mitigation in the State	WRBS	DSC	AN

Water Resource Management (WRM)		Lead	Support	Timeline
Goal WRM-2	**Protect and preserve the health and ecological functions of the water resources of the State**			
Quality Policies	1. Mitigate and prevent water contamination to protect existing and future sources of potable water			
	♦ Strategies			
	A. Require Low Impact Development d (LID) design techniques for stormwater management	M	DEM, CRMC	ST
	B. Implement Source Water Protection Plans	WS	DOH,M	O
	C. Develop and or continue to implement onsite wastewater management plans	M	DEM	ST
	D. Continue to acquire land or development rights for water supply protection	M,WS,DEM	WRB	O
	E. Establish or update setbacks for high impact activities from water bodies and wetlands in drinking water supply areas and sole source aquifers	M	DEM	MT
	F. Promote alternative approaches to development that reduce potential impacts to water quality	M	DEM,DOP,WC	O
	G. Make sewer leak detection and repair a priority in source water areas	M,WWA	DEM	O
	H. Evaluate need for advanced treatment wastewater systems in source water protection areas and sole source aquifers when nitrogen 5 mg/l threshold is exceeded	DEM	M	MT
	I. Prohibit siting of new underground storage tanks in source water areas and sole source aquifers	M, DEM	DEM	O
	J. Prohibit siting of new facilities that use, store , or generate hazardous materials and wastes in source water protection areas	M	DEM,DOH	AN
	K. Eliminate illicit discharges in source water protection areas and sole source aquifers	DEM	M, WS	O
	L. Coordinate drinking water protection with implementation of storm water planning Phase II storm water plans	M,DOT	DEM,BRWCT	ST
	M. Update watershed and sole soucre aquifers protection strategies in community comprehensive plans	M	DOP	LT
	N. Prohibit water and or sewer utility extensions in source water areas unless necessary to remediate existing water quality problems	M	DOH,DEM	AN
	O. Continue to expand public education to promote awareness of local water resources and the need for protection	WRB,DOH	WS,WC,URI	O
	P. Continue to acquire land and or development rights for water supply protection	M,DEM	Land Trusts,WRB	O
	Q. Establish or update setbacks for high impact activities from surface waters and wetlands in source water areas	M	DEM.DOP	MT
	R. Reduce sodium application rates on roadways to reduce sodium loadings in source water areas and sole source aquifers	M,DOT	DOH	O
	S. Ensure municipal HAZMAT plans in source water areas are updated	M	WS,DOH	O
	T. Manage point and nonpoint sources of pollution on multiple levels to protect water quality	M,DEM	DOP,EPA, BRWCT	O
	2.Assure sufficient water is available to support other functions of water resources such as wastewater dilution without water quality impacts			
	♦ Strategies			
	A. Promote increased efficiency of water use in stressed watersheds where demand exceeds available water	WRB	DEM,DOH	O
	B Continue to collect and asses data on water resources for sustainable water supply purposes	WRBS	DEM,USGS	AN
	3. Prohibit public access and recreational use of surface water supply reservoirs	ALL	ALL	O
	♦ Strategies			
	A. Post watershed lands to alert public to locations of wellhead or watershed areas and restrict nonessential access	WS	M,WC	O
	B. Work with municipal police to enforce nonessential access	WS	M	AN
	C. Educate and inform public on need for protecting water quality on watershed lands	WS	M,DOH,WC	O

Water Resource Management (WRM)

		Lead	Support	Timeline
Goal WRM-2 (Continued) Protect and preserve the health and ecological functions of the water resources of the State				
Resources of State Significance Policies				
Big River Policies	1. In addition to water supply uses the area shall be kept as open space for use by state residents			
	♦ Strategies			
	A. Individual activities which do not require WRB approval include, but are not limited to, hunting, fishing, hiking, canoeing and horseback riding.	U	WRBS	O
	B. Activities that are prohibited include swimming, trapping, camping, off-road biking, clear-cutting, firewood cutting and canoeing on ponds.	U	WRBS,SP	O
	C. Fuel, electric motors and all terrain vehicles are prohibited.	U	WRBS,SP	
	D. Individuals and organizations recreational and training activities must apply for authorization 30 days prior to the activity date	U	WRBS	AN
	E. General liability insurance coverage shall be provided for approved recreational and training activities	U	WRBS	AN
	2. A safe and habitable environment shall be maintained for the tenants and uses within the watershed lands controlled by the State			
	♦ Strategies			
	A. Rent concessions to original owners shall continue	WRB		AN
	B. To maintain rental market comparability, fair market rents shall be reviewed on a 5 year update basis through appraisals	WRBS		O
	C. No tenants shall sublease any portion of any property controlled by the WRB	WRBS		O
	D. Conduct inspections no less than once a year of the residential and commercial facilities located within the watershed	BCC	WRBS	O
	D.1 Raze structures deemed irreparable and/or condemned as soon after the vacancy as practicable.	WRBS	BCC	O
	E. Leased properties shall be maintained in leased in a state of good repair, ordinary wear and tear excepted	T	WRBS	O
	3. Encourage proactive watershed management for water quality protection			
	♦ Strategies			
	A. Coordinate drinking water protection with implementation of storm water planning Phase II storm water plans	M,DOT	DEM,BRWCT	ST
	B. Update watershed protection strategies in CCP	M	DOP	LT
	C. Develop Develop average municipal impervious cover percentage standards	M	DEM	MT
	D. Prohibit water and or sewer utility extensions in watershed unless necessary to remediate existing water quality problems	M	DOH,DEM	AN
	E. Expand public education to promote awareness of local water resources and the need for protection	WRB	WC,URI	O
	F. Reduce sodium application rates on roadways to reduce sodium loadings in the watershed	DOT	M	O
	G. Continue to enforce motor carrier safety and hazardous material transport regulations within the watershed.	SP,DOT	FHA, SP	O
	H. Ensure that annual street sweeping is completed in the watershed	M,DOT	M,DOT	O
	I. No hazardous substances as identified by 40 CFR 302.4, Superfund Hazardous Materials List shall be stored in the watershed	WRB	DEM,SP	O
	J. Update the 1996 Land Use Study	WRB	SP,DEM,DOP	ST
	J.1 Include a forest resources management program and sivicultural BMPs in updated land use study	WRBS	DEM, DOP	ST
	K. Update the Land Use Plan for the watershed on a reagular basis.	WRB	DOP,DEM	MT
	4. Use the watershed for water supply augmentation though ground water development			
	♦ Strategies			
	A. Continue environmental assessment and mitigation studies for wellhead development	WRB	USGS,DEM	ST
	B. Complete business plan for use of ground water	WRBS		ST
	C. Submit water withdrawal and water quality certification permits	WRBS	DEM	ST

Water Resource Management (WRM)

		Lead	Support	Timeline
Goal WRM-2 (Continued)	**Protect and preserve the health and ecological functions of the water resources of the State**			
Resources of State Significance Policies				
Scituate Reservoir Policies	1. Encourage proactive watershed management for water quality protection			
	♦ Strategies			
	A. Coordinate drinking water protection with implementation of storm water planning Phase II storm water plans	M	DOT,PWSB,DEM,BRWCT	ST
	B. Update watershed protection strategies in community comprehensive plans	M	PWSB,DOP	LT
	C. Hold bi-annual municipal / regional workshops on progress in meeting municipal watershed protection strategies	M	PWSB,DEM	O
	D. Develop average municipal impervious cover percentage standards	M	PWSB, DEM	MT
	E. Prohibit water and or sewer utility extensions in watershed unless necessary to remediate existing water quality problems	M,PWSB	DOH,DEM	AN
	F. Continue to acquire land and or development rights for water supply protection	PWSB	M,DEM,Land Trusts	O
	G. Establish or update setbacks for high impact activities from surface waters and wetlands in source water areas	M	PWSB,DEM	MT
	H. Use alternative zoning /conservation design principles to help protect water bodies and wetlands	M	PWSB, DEM,DOP	O
	I. Continue to expand public education to promote awareness of local water resources and the need for protection	WS	WC,DOH,WRB	O
	J. Continue to provide assistance to municipalities in review of major development proposals	PWSB	M	AN
	K. Reduce sodium application rates on roadways to reduce sodium loadings in the watershed	DOT	M	O
	M. Continue to enforce motor carrier safety and hazardous material transport regulations within the watershed.	SP,DOT	FHA	O
	N. Participate in review processes for state permits which impact water quality	PWSB	DEM,DOT,M	O
	O. Ensure that annual street sweeping is completed in the watershed	M,DOT	PWSB	O
	2. Develop and implement tools that foster controls to minimize water quality impacts in the watershed			
	♦ Strategies			
	A. Continue to maintain and update the PWSB GIS database	PSWB	RIGIS	AN
	B. Continue to control nonessential access by fencing, posting, and inspecting watershed lands owed by PWSB	PSWB	SP,M	MT
	C. Update and continue to implement the Forest Management Program and sivicultural BMPs	PSWB	DEM	ST
	D. Continue to work with USGS on stream gauging and monitoring in the watershed.	PWSB	USGS,DEM	O
	E. Continue to support the Scituate Reservoir Watershed Education Program	NRICD	PSWB,WRB	O
	E.1. Publish information for general public on BMPs for oil use & storage	NIRCD	PWSB,DOH	ST
	E.2. Publish information for general public on home fertilizer and pesticides BMPs for proper use & storage	NIRCD	PWSB,DOH	ST
	F. Continue to review and update raw water quality monitoring programs to respond to changes in watershed conditions	PWSB	DOH	AN
	H. Implement HAZMAT response Plan	PWSB	DOT,DEM,RIEMA	AN
	I. Assist with updates of municipal HAZMAT plans in watershed	M	PWSB	O
	J. Continue to implement the PWSB WSSMP & Clean Water Infrastrutcure Plans	PWSB	DOH	ST
	K. Periodically conduct a watershed wide property survey	PWSB	M	LT

Water Resource Management (WRM)		Lead	Support	Timeline
Goal WRM-3	**Ensure a reasonable supply of quality drinking water for the State**			
Demand Management Policy	1. Reduce the overall demand for potable water			
	♦ Strategies			
	A. Identify areas where water reuse for nonpotable purposes is feasible	DEM	WS, DOH	MT
	A.1 Establish opportunites for nonpotable water reuse	DEM	DOH.WS	LT
	A.2 Develop capacity to review and assist with water reuse projects	DOH	DEM,WRBS	LT
	B. Continue existing Interagency MOU for review of water withdrawals and include aquifer replenishment projects	DEM	DOH,WRB,DOP	O
	C. Reduce seasonal demands	WS,U	WRB,URI	O
	D. Reduce Rhode Island's vulnerablity to annual seasonal dry periods			
	D.1 Adopt fines for improper lawn watering /outdoor water use	M	WS	ST
	D.2 Work with URI Master Gardeners/landscapers to encourage use of water efficient landscaping	WS,M	WRB,WC,RILA	ST
	D.3 Require use of rain sensors and soil moisture sensors in lawn irrigation systems.	M	WS	MT
	D.4 Educate public on installation and care of lawn irrigation technology	WS,M	WRB,RILA	O
	D.5 Educate private well owners and users not on public distribution systems on the need for water efficiency	WRB	DSC	O
	E. Promote public education for implementation of water efficiency measures	WS,M	WRB,URI	O
	E.1 Continue to support Drinking Water Week	WS	RIWWA,All	O
	E.2 Revise Plumbing code to futher promote effiicent water use	WRBS	BCC	MT
	E.3 Promote use of EPA Water Sense Appliances	WRB	BCC,URI	O
	F. Continue to promote water use/meter sizing reviews for major users	WS	M, RIWWA	O
	G. Promote rate structures and conservation pricing	WRB	WS,M,PUC	O
	H. Investigate other incentives to further reduce demands	WRBS	WS, WS, GA	LT
	I. Ensure that leakage shall not exceed 10% of total system water produced or purchased	WS	WRBS, DOH	O
	J. Reconsider reuse of abandoned supplies in light of new technologies, non-potable use needs and anticipated future demands without impacting public health	WS	DOH,EPA	LT
Goal WRM-4	**Ensure the protection of public health, safety and welfare and essential drinking water resources during water supply emergencies**			
Emergency Management Policy	1. Manage and conserve essential potable water resources in times of emergencies and or shortages			
	♦ Strategies			
	A. Evaluate intersystem temporary capabilities and needs for supply during emergencies	DOH	WS,M	MT
	B. Ensure emergency memorandums of understanding, stand-by-contracts for emergency connections, and price agreements for purchasing potable water at competitive prices are kept current	WS,M	WRBS	O
	C. Ensure all water systems have emergency plans for alternative distribution before emergencies occur	WS,M	WRBS,RIEMA	O
	D. Ensure all water systems have established priority uses and use restrictions for use during emergencies before emergencies occur	WS,M	WRBS	O
	E. Idenitfy interconnections for ongoing uses and for emergency responses	WS,M	DOH	ST
	F. Develop and enhance the redundancy capability of all systems	WS,M	WRB,DOH	ST
	G. Ensure that municipalities know the procedures to declare a water supply emergency	M,WS	DOH	O
	H. Ensure that state agencies involved in water emergency management have updated operational plans for water emergencies	SA	RIEMA	O
	I. Implement emergency preparedness plans of the PUC	WS,M	PUC	O
	J. Ensure that the state and municipal emergency operations plans and the emergency operations portions of WSSMPS are updated and implemented	WS,M	RIEMA	O

Appendix A
Major Public Water Suppliers by RI City/Town

City / Town	Major Water System
Barrington Bristol	Bristol County Water Authority http://www.bcwari.com/bcwa/
Burrillville	Harrisville Fire District http://www.harrisvilleri.org/ Pascoag Utility District http://www.pud-ri.org/
Central falls	Pawtucket Water Supply Board http://www.pwsb.org/
Coventry	Kent County Water Authority http://www.kentcountywater.org/
Cranston	Kent County Water Authority Providence Water Supply Board http://www.provwater.com/
Cumberland	Cumberland Water Department http://www.cumberlandri.org/water.htm Pawtucket Water Supply Board http://www.pwsb.org/
East Greenwich	Kent County Water Authority Warwick Water Division http://www.warwickri.gov/index.php?option=com_content&view=article&id=866&Itemid=183
East Providence	East Providence Water Department http://www.eastprovidenceri.net/content/666/738/746/782/826/default.aspx
Jamestown	Jamestown Water Department http://www.jamestownri.net/pw/w&s/utilities.html
Johnston	Johnston Water Control Board http://www.townofjohnstonri.com/ Providence Water Supply Board
Lincoln	Lincoln Water Commission http://www.lincolnwatercommission.com/
Middletown	Newport Water Department http://www.newport-ri.gov/departments/utilities/water/home.cfm
Narragansett	Narragansett Water Department http://www.narragansettri.gov/index.aspx?nid=-404&badlink=/eng.htm North Kingstown Water Department http://www.northkingstown.org/waterdept/ United Water Rhode Island http://www.unitedwater.com
Newport	Newport Water Department
North Kingstown	North Kingstown Water Department
North Providence	Providence Water Supply Board
North Smithfield	Woonsocket Water Department http://www.ci.woonsocket.ri.us/water.htm

Pawtucket	Pawtucket Water Supply Board
Portsmouth	Portsmouth Water & Fire District http://www.portsmouthwater.org/
Providence	Providence Water Supply Board
Smithfield	East Smithfield Water District http://eastsmithfieldwater.com/default.aspx Greenville Water District http://www.smithfieldri.com/water_conservation.htm Smithfield Water Supply Board http://www.smithfieldri.com/water_conservation.htm
South Kingstown	Kingston Water District http://www.kingstonwaterdistrict.com/ South Kingstown Water Department http://www.southkingstownri.com/town-government/municipal-departments/public-services/water United Water RI University of RI – Facilities & Operation http://www.uri.edu/facilities/utilities.html
Tiverton	North Tiverton Fire District http://www.tiverton.ri.gov/government/dpwdept.html Stone Bridge Fire District http://www.tiverton.ri.gov/index.html
Warren	Bristol County Water Authority
Warwick	Kent County Water Authority Warwick Water Division
West Greenwich	Kent County Water Authority
West Warwick	Kent County Water Authority
Woonsocket	Woonsocket Water Department
	Other large public Water Suppliers by RI City/Town
Hopkinton	Richmond Water Supply System http://www.richmondri.com/index.asp?Type=B_BASIC&SEC={9C7C0E3F-5A3A-49AD-8B19-9A3417516CC9}
Richmond	Richmond Water Supply System
New Shoreham	Block Island Water Department http://www.blockislandwater.org/

For other public suppliers see the RI Department of Health's website:
http://www.health.ri.gov/drinkingwaterquality/

Appendix B
DROUGHT RESPONSE PLAN FOR DEM DIVISION OF AGRICULTURE

Introduction

The *Rhode Island Drought Management Plan* establishes coordinated procedures for the State of Rhode Island's response to severe drought episodes. It outlines the responsibilities of state, federal and local entities involved in water resources management, and it defines the roles these key entities are to play in the state's response to a long-term drought. Duties related to data gathering, anticipation of drought conditions, and mitigation of the effects of drought are described. Policies and recommendations are established to anticipate drought conditions, respond early and coordinate resources to effectively manage the state's water resources during a drought.

This document outlines the role of the DEM Division of Agriculture (DAG) in responding to a drought.
In general, DAG responsibilities increase with the volume and duration of shortfalls in available water supplies. (See appended table of "Rhode Island Drought Indices and Phases" as well as the *Rhode Island Drought_Management Plan*, Sections 04-04 and 04-05.)

- During **Normal** conditions, DAG develops and implements long-term plans to minimize the vulnerability of agriculture to droughts, contributes to the monitoring of stream flow and groundwater, and relays relevant information to agricultural stakeholders.
- During a **Drought Advisory**, DAG also publicizes water conservation techniques in agriculture, requests farmers to conserve, and initiates appropriate steps of the "Drought Response Plan for Agriculture," listed below.
- During a **Drought Watch**, DAG increases its monitoring of agricultural impacts and works with the WRB to provide a list of water suppliers and water transporters willing to supply farmers.
- During a **Drought Warning**, DAG also assesses actual and predicted impacts of drought on agriculture, and when appropriate, coordinates with the Governor the development of an emergency declaration, as in applying for state or federal disaster assistance.
- All of these actions are likely to be appropriate in responding to and recovering from a **Drought Emergency**:

Monitoring

The Division of Agriculture (DAG) will monitor stream flow at the United States Geological Survey gauging stations, predominately within the Pawcatuck Basin. Stream flows will be evaluated in relation to selected flow levels indicative of low flow or drought conditions, as well as in relation to rainfall and groundwater levels. DAG will provide written information on stream flow and precipitation levels on a regular basis to farmers and stakeholders.

Disaster Funding

DAG, in coordination with the United States Department of Agriculture (USDA), will seek federal and state disaster and emergency response funding for agriculture as necessary. DAG will coordinate with the Governor's Office for a disaster declaration, if necessary, which will enable the state to seek federal disaster assistance. Federal disaster assistance will be sought to provide compensation for crop losses attributable to drought and cost sharing on ponds and wells constructed for emergency water supply.

Media Campaigns and Marketing

DAG will conduct a media campaign and special marketing program to increase and maintain public awareness of the importance of local agriculture, and to foster support under drought conditions. The campaign will use a variety of available media to deliver information.

Emergency Water Supply

DAG will coordinate with appropriate state and federal agencies to provide emergency water supplies. The DAG and the Water Resources Board will develop and provide to farmers a list of water suppliers and transporters available to provide and/or transport water. DAG in coordination with USDA and the Emergency Management Agency will provide and set up water bladders at farms where water supply is critically low and where there is imminent danger of livestock or crop losses. DAG in coordination with appropriate offices of DEM, Army Corps of Engineers and USDA will issue emergency permits for pond or well construction in accordance with the protocol listed below in item G. DAG will facilitate any available effort to provide water to farmers under drought conditions.

Long Term Planning

DAG in coordination with the USDA shall continue long-term planning efforts to reduce the potential vulnerability of farmers to drought conditions, including water supply and use management by farmers of adequate water supplies, improvements to pumping and irrigation conveyance systems, and emergency response planning.

Construction and/or Expansion of Agricultural Ponds

The Director of DEM may authorize revised and expedited permitting procedures for farmers during a drought. These procedures pertain to the review by DAG of the construction of new ponds, expansion of existing ponds, or the construction of temporary wells by farmers for agricultural purposes. The following **standards and conditions for construction and/or expansion of ponds or wells under drought conditions** shall apply:

1. Project construction shall not initiate prior to written authorization by DAG. (See Agricultural Wetlands Permit Application, ERP 6-12-3.) The DAG may verbally authorize on site the initiation of construction for critical situations, and shall follow-up in writing within 24-48 hours. Approvals are valid for a period of sixty (60) days and all construction must take place during this period. All plan modifications must be approved by DAG and be reflected in an amendment to the original permit. The DAG shall coordinate all project reviews with the Division of Water Resources.

2. Revised and expedited permitting procedures shall pertain to “legitimate” farmers who do not meet the definition of farmer pursuant to RIGL 2-1-22 (j), where critical water needs exist. Permitting procedures shall also pertain to the construction and use of wells on a temporary basis, and fill for pond embankments where absolutely necessary. Authorization to use wells is limited to drought conditions as determined by the Director. A Memorandum of Understanding shall be executed between the DAG and Division of Water Resources regarding this section.

3. Permits shall be issued only for projects determined to be insignificant alterations for freshwater wetlands. Adverse effects to the flow and circulation patterns and chemical and biological characteristics of freshwater wetlands and the aquatic environment shall be minimized. The water quality status of surface waters and their tributaries within the project area must not be degraded. Projects shall not divert or impound stream flows.

4. All project plans and proposals shall be consistent with USDA/Natural Resources Conservation Service standards. The farmer is responsible for providing supporting documentation regarding the project, field delineation of the proposed pond footprint, and site

characteristics. Supporting documentation for the project shall include plans describing the pond features, wetland edge, and a written description of the project.

5. No fill material may be placed into any wetland either onsite or offsite unless specifically authorized either as a part of the approval for this project or a separate approval. Adequate measures shall be taken prior to, during and following construction to ensure protection of wetlands areas from sediment deposition. Soil and erosion and sediment controls shall remain in place until all areas have stabilized.

6. Approvals issued by DAG do not remove the applicants obligation to obtain necessary permits from other federal, state or local agencies, and must be consistent with the U. S. Army Corp of Engineers Programmatic General Permit for Rhode Island. (Note: irrigation ponds by farmer are specifically exempt from Section 404 permitting requirements).

7. DAG staff will visit and review the site during construction for conformance.

Source: Rhode Island Statewide Planning Program, Department of Administration, State Guide Plan Element #724, *Rhode Island Drought Management Plan,* Appendix E, pp. E1-E2. That Plan is on-line at: http://www.planning.ri.gov/landuse/dmp.htm

Rhode Island Drought Indices and Phases

Source: Table 724-(2) of the Rhode Island Drought_Management Plan.

In developing recommendations on drought phase to the Governor, the WRB will consider the following Indices, in consultation with the U.S. Geological Survey (USGS) and the National Weather Service (NWS). See Rhode Island Drought Management Plan, Sections 04-04 and 04-05.

Drought Phase	Palmer Drought Index +	Crop Moisture Index	Precipitation +	Ground Water** +	Stream flow +	Reservoirs**
NORMAL	-1.0 to -1.99	0.0 to -1.0	Slightly Dry	1 month below normal 1 month below normal	2 consecutive months below normal	Reservoir levels at or near normal for the time of year
ADVISORY	-2.0 to -2.99	-1.0 to –1.9 Abnormally Dry	2 month cumulative below 65% of normal	At least 2 out of 3 months below normal	3 consecutive months below normal	Small index Reservoirs below normal
WATCH	-3.0 to -3.99	-2.0 to –2.9 Excessively Dry	1 of the following criteria met: 3 month cum. <65% or 6 month cum. <70% or 12 month cum. <70%	4-5 consecutive months below normal	At least 4 out of 5 consecutive months below normal	Medium index Reservoirs below normal
WARNING	-4.0 and below	> -2.9 Severely Dry	2 out of 3 of the above criteria met: 3 month cum. <65% and 6 month cum. <65% or 6 month cum. <65% and 12 month cum. <65% or 3 month cum. <65% and 12 month cum. <65%	6-7 consecutive months below normal observation wells recording monthly record lows	At least 6 out of 7 consecutive months below normal	Large index reservoirs below normal
EMERGENCY	-4.0 and below	> -2.9 Severely dry	Same criteria as Warning and Previous month was Warning or Emergency	>7 months below normal Observation wells recording monthly record lows	>7 months below normal	Continuation of previous month's conditions

\+ indicates major hydrologic indicators.

** Local triggers from the water system supply management plans will also be considered in a assessing drought phases on a regional basis. The WRB will review local plans and work with suppliers to coordinate regarding drought phases and to collect, review and report surface reservoir and ground water data.

"Normal" is defined as the statistical average of the data for the period of record. Percentages for precipitation are relative to normal.

Appendix C WSSMP Anticipated Demands vs. Available Water

Water Supplier	Recent ADD	Maximum DD	5 Year Anticipated ADD	20 Year Anticipated ADD	Available Water	Available Water -20 Yr ADD
Bristol County	3.75	5.01	4.80	5.00	10.9	5.90
Cumberland	2.86	5.57	3.36	3.80	8.94	5.14
East Providence	5.25	8.81	5.33	5.59	7.34	1.75
East Smithfield	0.71	2.22	0.83	1.16	0.91	**-0.25**
Greenville	0.97	Not available	1.26	1.36	1.21	**-0.15**
Harrisville	0.55	1.09	0.60	0.65	1.45	**0.80**
Jamestown	0.19	0.39	0.21	0.23	0.58	**0.35**
Johnston	0.81	1.23	4.70	4.70	4.7	0.00
Kent County	11	21.1	11.60	13.40	31.79	18.39
Kingston	0.42	0.68	0.33	0.33	2.4	2.07
Lincoln	2.25	Not available	2.40	2.71	3.32	0.61
Narragansett	0.76	1.82	0.79	0.81	2.57	1.76
Newport	7.8	12.48	8.34	9.30	12.2	2.90
North Kingstown	3	5.7	2.86	3.75	7.8	4.05
North Tiverton	0.52	Not available	0.86	1.12	0.7	**-0.42**
Pascoag	0.65	1.23	0.90	0.85	4.7	3.85
Pawtucket	10.42	20.23	11.02	11.32	19.6	8.28
Portsmouth	1.31	2.56	1.37	1.45	1.53	**0.08**
Providence (Retail Service Area)	31.45	Not available	32.18	33.63	83	*
Quonset	0.63	1.2	0.81	1.37	4.95	3.58
Smithfield	0.95	1.7	1.10	1.70	1.97	**0.27**
South Kingstown	0.47	1.11	0.58	0.78	1.38	**0.60**
Stone Bridge	0.65	Not available	0.81	1.12	1.9	**0.78**
United Water	3	5.91	3.72	Not available	6.74	Not available
URI	0.42	Not available	0.44	0.50	0.49	**-0.01**
Warwick	8.81	19.84	9.54	9.60	11.35	1.75
Westerly	3.43	6.49	3.52	3.95	6.93	2.98
Woonsocket	5.3	6.9	5.80	6.80	8	1.20
Total ADD	**108.33**		**120.06**	**126.98**		
Providence (Retail Service Area)	31.45	Not available	32.18	33.63	83	*
Providence (Wholesale)	32.32	Not available	32.32	34.44	83	*
Providence (Total)	68.14	113.5	71.7^	75.6^	83	*

Appendix D Water Rates

The challenges of providing safe drinking water have undeniably become as much about financial management as about treatment technologies. The financial decisions affecting water enterprises typically fall on governing boards that were chosen not as business or technical experts but as representatives of their constituents on a broad range of matters. The challenge is to evaluate and implement such decisions without forgetting that ultimately the water business is primarily about public health, not the bottom line.

Rate setting is a forward-looking process based on assumptions of how much water will be produced and delivered in the coming year. If the annual revenue of the water system is insufficient to meet requirements, future rates may have to be increased to make up the difference. The fiscal fortunes of the water utility are somewhat dependent upon the weather. Hot, dry weather generally results in more water sales and extra revenue to be used by the utility in a future year. Cool, damp weather can have the opposite effect, generally resulting in an annual revenue shortfall. Reserve funds should be maintained and policies established for their use to address both of these scenarios.

Water supply, treatment, and delivery are dependent on aging infrastructure that must be maintained or replaced. In addition, the level of required treatment to comply with safe drinking water standards continues to increase. Water systems are faced with the need for increased revenues that must, in most cases, be met from water rate increases. Two major expenses impact rate levels:

- Capital Improvement Program (CIP) Financing -
  - Continued improvements from an established CIP ensure reliable service for an aging infrastructure. Many CIP projects are also necessary to maintain compliance with environmental regulations. The CIP changes from year to year depending on current needs.
- Operations & Maintenance (O&M) Expense -
  - Inflation impacts both labor and equipment for O&M. This expense rises as new facilities are constructed and brought into service, increasing the amount of O&M that must be performed. O&M expense can be offset by efficiency achievement in some areas. O&M expenses are also impacted by the cost of utilities, chemicals and property insurance that can increase in price. For instance, property insurance has risen since the September 11, 2001 terrorist attack, and energy costs have more than doubled in recent years.

Community usage of water (driven by lot size and amount and type of development) has a significant impact on rate charges. Elevation and distance also have an impact. Each system has its own infrastructure of pipes, water mains, pumps, and in some cases storage tanks. This infrastructure requires maintenance. Systems also have to run billing and collection functions. Water Systems should focus on eliminating waste within their system and on educating citizens and businesses on environmentally sound watering practices. In the long run, these initiatives will reduce peak demands and will result in lower costs assigned to them.

American Water Works Association Recommended Model Rate Structure

The rate structure consists of a lifeline rate with 3 usage blocks, plus an inclining block rate structure to be made available to the whole residential class.

- 1st block is for a minimum amount of essential use at a discounted rate
- 2nd block includes everything over the minimum amount of essential use up through average use at the regular rate
- 3rd block includes everything above the average usage at a higher rate

Appendix E Declaration of Local Disaster Example

DECLARATION OF LOCAL DISASTER

WHEREAS, The City/Town of ______________________ on the _________ day of ____________, 19_____, has suffered widespread damage and threat of serious health hazards resulting from ____, and

WHEREAS, the City/Town Council President/Mayor of the City/Town of _________________________ has determined that extraordinary measures must be taken to protect the health and well being of the community;

Now therefore, be it proclaimed by the Town Council President/Mayor of the City/Town of ____.

Section 1. That a state of disaster is declared for the City/Town of ____.

Section 2. That the City/Town of Emergency Operations Plan has been implemented.

Section 3. That the state of disaster shall continue for a period of not more than seven days of the date hereof, unless the same is continued by consent of the City/Town Council of the City/Town of Rhode Island.

Section 4. That this proclamation shall take effect immediately from and after its issuance.

Ordered this the ____________________ day of __________________, 19_________.

____
Town Council President/Mayor
City/Town of ______________________

Water Glossary

For the purpose of this Plan, the words and phrases listed below shall have the following meanings. The key terms are based upon accepted definitions published by the EPA and or the American Water Works Association (AWWA). Where federal (EPA), Rhode Island General Law or agency rules/regulations have established a specific definition an identifying citation follows in parenthesis. Examples: (DOH) (EPA) or (§ 46-13.2-1)

A

Abandoned water supply sources, sources that are no longer used or maintained; they are permanently disconnected surface waters or wells

Abandoned water supply sources shall mean sources that are no longer used or maintained permanently disconnected surface waters or wells.

Abandoned well, A well whose use has been permanently discontinued. (§ 46-13.2-1)

Active water supply sources, Approved sources of supply connected to a water supply system and available for distribution; these sources may be surface waters or wells (DOH)

Advisory Committee, the Water Supply Advisory Committee assembled by the Division of Planning for the purpose of advising on the assembling of a draft consolidating the State Guide Plan Elements related to potable water supply

Annexation Fee, A fee levied on the individual water system connections, or accounts, in addition to their normal water consumption and service charges. The annexation fee shall remain in effect until the financial responsibility of annexation is discharged (§ 46-30-3)

Aquifer, A geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells, springs, or surface water(§ 46-15.3-4)

Artificial recharge. The addition of surface water to a groundwater reservoir by human activity, such as putting surface water into recharge basins (See also: groundwater recharge and recharge basin.)

B

Back Flow hydraulic condition caused by a difference in pressures, in which non-potable water or other fluids flow into a potable water system

Base flow. River surface flow, not counting storm flow and/or purchased imported water

Base Rate, 1st tier of water rate that covers supplier's fixed costs (AWWA)

Best Available Technology, The water treatment(s) that EPA certifies to be the most effective for removing a contaminant (EPA)

BMP - **Best Management Practices**. Common system fiscal and operational management that the Rhode Island Water Works Association agrees to implement among members

Brackish water. Water containing dissolved minerals in amounts that exceed normally acceptable standards for municipal, domestic, and irrigation uses. Considerably less saline than seawater

C

Chief Elected Official, The highest elected official charged with the responsibility of managing the day to day normal operations of a city or town. In cities and town where the mayor, town administrator town manager or other official is not elected by the people, the city or town council president shall be considered to b the chief executive for disaster.

Community Water System, A public water system which supplies drinking water to 25 or more of the same people year-round in their residences (EPA & DOH)

Condensation, In condensation, a gas or vapor turns into liquid or solid form. (USGS)

Conservation Rate,1 tier of water rate beyond the base rate

Consumptive use, That part of withdrawn water that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment.

Contamination, any violation of federal or state standards within any part of a water treatment system that affects public health or welfare (EPA & DOH)

Cost of Service, A water system's total cost of providing water to its customers (EPA)

D

Declaration of Emergency (Federal) is a proclamation issued by the President of the United States upon request of the governor that provides specialized assistance to meet specific emergency relief needs. "Emergency", as used in Public Law 93-288 means any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mud slide, snowstorm, drought, fire, explosion, or other catastrophe which threatens lives and property, public health and safety, and for which federal assistance is required to supplement state and local response efforts.

Decreasing Block Rate, A rate structure under which the price of water per unit (block) decreases as the amount used increases. Blocks are set according to consumption (e.g., up to 2,000 gallons used, 2,000 to 6,000 gallons used, etc.) (EPA)

Degraded water. Water within the groundwater basin that, in one characteristic or another, does not meet primary drinking water standards (EPA)

Demand Management, any conscious effort to modify water use; the best utilization of existing supply.**Desalination**. Specific treatment processes, such as reverse osmosis or multi-stage flash distillation, to demineralize seawater or brackish (saline) waters for reuse. Also sometimes used in wastewater treatment to remove salts other pollutants

Desilting. The physical process of removing suspended particles from water.

Disinfection. Water treatment which destroys potentially harmful bacteria

Distribution Facilities, The pipes and appurtenant facilities employed specifically to deliver, to dispense, to render, or to circulate potable water directly for the benefit of a consumer or a community of consumers (§ 46-15.2-3)

Drainage basin. The area of land from which water drains into a river.

Drought, a continuous period of time in which rainfall is significantly below the norm for a particular area.

Drought of Record – the period of time during recorded history when natural hydrological conditions provided the least amount of water supply. For RI the drought of record is generally considered to be from about 1960 to 1964.

E

Effluent. Wastewater or other liquid, partially or completely treated or in its natural state, flowing from a treatment plant

Emergency Operations Plan (EOP) is a basic plan covering general instructions on disaster response procedures for local government. The plan delineates responsibilities, functions, and organizations and is supported by annexes outlining detail for specific emergency functions. (DOH)

Emergency response shall mean the actions taken to minimize the effects created during an unexpected event by protecting the water supply environment and returning to a normal pre-emergency condition.

Emergency water supply sources shall mean not regular sources of supply but supplies held in reserve for use in emergencies. The use of emergency water supply sources must be approved by the RI Department of Health; these may be surface waters or wells. (DOH)

Enterprise Fund, A form of accounting that utilizes a separate fund or cost center for a specific purpose (EPA)

Equitable Rate Structures, Rate structures under which all customer classes are paying their “fair” share of the full cost of water service (EPA)

Evaporation, Evaporation is the process by which water changes from a liquid to a gas or vapor. USGS

Evapotransporation. The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surface. Quantitatively, it is expressed in terms of depth of water per unit area during a specified period of time. (USGS)

F

Flat Rate/Fixed Fee, Rate structure under which all customers pay a set fee (monthly, quarterly, etc.) for water service that is not tied to the amount of water used (EPA)

Freshwater---water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L of dissolved solids is undesirable for drinking and many industrial uses.

Full Cost Recovery, Recouping the entire cost of water provision through rates, fees, charges, and other revenue derived from water sales (EPA)

G

Governing Agency, The public water supply system into which the small public water supply system is being merged or annexed (§ 46-30-3)

Gray water reuse. Reuse, generally without treatment, of domestic type wastewater for toilet flushing, garden irrigation and other nonpotable uses. Excludes water from toilets, kitchen sinks, dishwashers, or water used for washing diapers

Ground Water, Water found underground which completely fills the open spaces between particles of sand, gravel, clay, silt, and consolidated rock fractures. The zone of materials filled with groundwater is called the zone of saturation (§ 46-15.3-4)

Groundwater basin. A groundwater reservoir is defined by all of the overlying land surface and the underlying aquifers that contain water stored in the reservoir.

Groundwater recharge, The processes of addition of water to the zone of saturation, that zone beneath the water table (§ 46-15.3-4) (§ 46-13.1-3)

Groundwater table. The upper surface of the zone of saturation (all pores of subsoil filled with water), except where the surface if formed by an impermeable body

GPD. gallons per day

H

Hazardous materials release is defined to include a large universe of chemical compounds in amounts and concentrations that, when released in an uncontained area into the environment, present a threat to human health or the environment. (EPA).

Hydrologic balance. An accounting of all water inflow to, water outflow from, and changes in water storage within a hydrologic unit over a specified period

Hydrologic cycle. The process by which water constantly circulates from the ocean, to the atmosphere, falling to the earth in some form of precipitation, and finally returning to the ocean

I

Incident Commander (IC), the individual responsible for the management of all emergency related operations and responses

Incident Command System (ICS) is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

Increasing Block Rate, A rate structure under which the price of water per unit (block) increases as the amount used increases. Blocks are set according to consumption (EPA)

Infiltration, a portion of the water that falls as rain and snow infiltrates into the subsurface soil and rock.(USGS)

Intersystem Facilities, Transmission facilities designed and constructed by the owner of any public water system having the capacity to serve two (2) or more water systems (§ 46-15.2-3)

Interbasin transfer: Conveyance of water across a drainage- or river-basin divide.

Irrigation water use: The artificial application of water on lands to assist in the growth of crops or pasture including greenhouses. Irrigation water use may also include application of water to maintain vegetative growth in recreation lands such as parks and golf courses, including water used for frost and freeze protection of crops.

L

Leakage, The difference between non-billed water and the total of the estimated or measured allowances for fire fighting, meter inaccuracy, theft, system usage, main flushing, sewer cleaning, storm drain cleaning, and other allowances that may be developed by the water resources board (§ 46-15.3-4)

Low Impact Design, a comprehensive approach to stormwater management that minimizes the hydrological impacts of development

M

Major Water Supply System, A system which sells water registered through a metering device or pumps over fifty (50) million gallons of water per year (§ 46-15-1.1)

Major user, any public or private organization or entity using more than 3 million gallon of water per year (§ 46-15.1.1)

MCL. Maximum contaminant level. Set by EPA for a regulated substance in drinking water (EPA)

MGD. Million gallons per day

N

NPDES. National Pollutant Discharge Elimination System. A federal permit authorized by the Clean Water Act, Title IV, which is required for discharge of pollutants to navigable waters of the United States, which includes any discharge to surface waters-lakes, streams, rivers, bays, the ocean, wetlands, storm sewer, or tributary to any surface water body. (EPA)

Natural flows. Flows that are not placed into a system by man-made activities

NOAA, National Oceanic and Atmospheric Administration

Non-billed water, The difference between water produced by a supplier and water sold by the same supplier (§ 46-15.3-4)

Non-point source. Water discharge other than from point sources See also: point source.

Non-Transient, Non-Community Water System, A water system which supplies water to 25 or more of the same people at least six months per year in places other than their residences. (EPA)

Non viable system, a water system without the financial, technical, or human resources to maintain a safe water supply (DOH)

O

Owner of the Facilities, The holder of title to the water supply system facilities supplying water (§ 46-30-3)

P

Palmer drought severity index is a numerical index value calculated by the National Oceanic and Atmospheric Administration (NOAA) which depict prolonged abnormal dryness or wetness. The index reflects soil moisture, runoff, recharge, percolation, and evapotranspiration.

Per capita use---the average amount of water used per person during a standard time period, generally per day.

Percolation. The downward movement of water through the soil or alluvium to the groundwater table

Permeability. The capability of soil or other geologic formations to transmit water

Point Source, Any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture (§ 46-12-1)

Pollutant, Any material or effluent which may alter the chemical, physical, biological, or radiological characteristics and/or integrity of water, including, but not limited to, dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, cellar dirt or industrial, municipal, agricultural, or other waste petroleum or petroleum products, including but not limited to oil (§ 46-12-1)

Potable water. Suitable and safe for drinking, bathing, culinary, or other personal purposes that meets current state and federal drinking water standards (EPA & DPH)

Power failure shall mean a prolonged insufficiency to provide service, which may affect the ability of a water supplier to maintain a safe and adequate drinking water supply.

Primary treated water. First major treatment in a wastewater treatment facility, usually sedimentation but not biological oxidation

Privately Organized Water Supplier, Any water company not owned or operated by a local governmental unit, existing under the laws of the state, and in the business of operating a safe drinking water facility (§ 46-12.8-2)

Public Water Supply System, A system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if the system has at least fifteen (15) service connections or regularly serves at least twenty-five (25) individuals daily at least sixty (60) days out of the year;

(i) Any collection, treatment, storage and distribution facilities under control of the operator of the system used primarily in connection with the system; and

(ii) Any collection or pretreatment storage facilities not under the control of the operator which are used primarily in connection with the system. (§ 46-13-2)

R

Rate, The charge a system assesses its customers for use of the water system's services (EPA)

Rate Structure, A set of fees and rates that a water system uses to charge its customers for water. The structure can take into account the system's characteristics (e.g., location in a highly industrialized area) and goals (e.g., to generate enough revenue to cover the full cost of water provision and encourage conservation). The structure can also account for customers of different classes, income levels, and water-use habits. (EPA)

Raw Water, Water in its natural state prior to any treatment (§ 46-15.3-4)

Recharge Area. An area in which water is absorbed that eventually reaches the zone of saturation (§ 46-15.3-4)

Recharge basin. A surface facility, often a large pond, used to increase the infiltration of surface water into a groundwater basin.

Reclaimed wastewater. Wastewater that becomes suitable for a specific beneficial use as a result of treatment. See also: wastewater reclamation

Reclamation project. A project where water obtained from a sanitary district or system undergoes additional treatment for a variety of uses, including landscape irrigation, industrial uses, and groundwater recharge

Recycled Water- Treated wastewater used for beneficial purposes such as agricultural and landscape irrigation, toilet flushing, and replenishing a groundwater basin (a process known as groundwater recharge).
Recycling. A type of reuse, usually involving running a supply of water through a closed system again and again

Regionalization, A creation of an appropriate management or contractual administrative organization or a coordinated physical system plan of 2 or more community water systems in a geographical area for the purpose of utilizing common resources and facilities to their optimum advantage.(AWWA)

Revenue Funds earned by the system through the sale of water or by other means (EPA)

RO/Reverse osmosis. A method of removing salts or other ions from water by forcing water through a semi-permeable membrane

S

SDWA, the federal Safe Drinking Water Act

Safe and Potable, Suitable or fit for human consumption as drinking water (§ 46-13-2)

Safe Yield, A sustainable withdrawal that can be continuously supplied from a water source without adverse effects throughout a critical dry period with a one percent (1%) chance of occurrence, or one that is equivalent to the drought of record, whichever is worse(§ 46-15.7-2)

Sale, All retail sales of potable water to end users for any purpose in the ordinary course of business by a supplier, except for sales exempt pursuant to § 46-15.3-5(c), (d) and (e) (§ 46-15.3-4)

Salinity. Generally, the concentration of mineral salts dissolved in water. Salinity may be measured by weight (total dissolved solids - TDS), electrical conductivity, or osmotic pressure. Where seawater is known to be the major source of salt, salinity is often used to refer to the concentration of chlorides in the water

Seasonal Rate A rate that varies depending on the time of the year. Seasonal rates can be used in conjunction with any other rate structure, including flat rates and uniform, decreasing, or increasing block rates. (EPA)

Seawater Intrusion. The movement of salt water into a body of fresh water It can occur in either surface water or groundwater basins

Seawater barrier. A physical facility or method of operation designed to prevent the intrusion of salt water into a body of freshwater

Self-supply water: Water withdrawn from a ground- or surface-water source by a user or group of users that are not on a public water-supply system. (EPA & DOH)

Service area shall mean the geographic boundary within which service connections to customers of a water supply system are committed by charter of the water commission, board, or authority.

7Q10- 7-day, 10-year low flow: The discharge at the 10-year recurrence interval taken from a frequency curve of annual values of the lowest mean discharge for 7 consecutive days (the 7-day low flow). The 7-day, 10-year low flow is commonly used to assess the capacity of a river to carry pollutants.

Sole Source Aquifer. A groundwater aquifer which has been designated as the "sole or principal" source of drinking water for an area where no other water supplies are available except for the groundwater in the aquifer (EPA)

Source, The raw water upon which a public water supply system abounds, and refers to both groundwater and surface water(§ 46-15.3-4)

State of Emergency shall indicate a situation where the Governor declares an emergency condition sufficient to warrant state or federal involvement. State involvement is typically requested when local resources are exhausted and assistance is requisite to meet the public safety and welfare demands of the incident.

Streamflow-gaging station: is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Sublimination, the conversion between the solid and the gaseous phases of matter, with no intermediate liquid stage in the water cycle

Supplier(s), Any city, town, district, or other municipal, quasi municipal, or public or private corporation or company engaged in the sale of potable water and the water supply business in Rhode Island; provided, however, that only suppliers which withdraw water from wells, reservoirs, springs, or other original sources in potable quality shall be entitled to disbursements pursuant to § 46-15.3-11(§ 46-15.3-4)

Surface Runoff, When rain hits saturated or impervious ground it begins to flow overland downhill.(USGS)

Surface Water, water that systems pump and treat from sources open to the atmosphere, such as rivers, lakes, and reservoirs

T

TMDL, Total Maximum Daily Load, A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. TMDLs are based on the relationship between pollution sources in the watershed and instream water quality conditions. A TMDL addresses a single pollutant or stressor for each waterbody or waterbody segment. (DEM)

Total Dissolved Solids, a measure of the combined content of all inorganic and organic substances contained in a liquid in: molecular, ionized or micro-granular (colloidal sol) suspended form.

Transmission Facilities, The pipes, pumping stations, and storage facilities required to carry potable water, or raw water to a treatment facility or storage facility for later treatment, from a water source to or throughout an area served or to be served by a public water system for the specific purpose of supplying water to support a general population. Transmission facilities shall not include the distribution system(§ 46-15.2-3)

Transient, Non-Community Water System, A water system which provides water in a place such as a gas station or campground where people do not remain for long periods of time. (EPA & DOH))

Transpiration. The process in which plant tissues give off water vapor to the atmosphere as an essential physiological process

Turbidity. Thick or opaque with matter in suspension; muddy water

U

Uniform Rate A rate structure under which customers pay a single charge per unit of water. The cost remains constant even if usage changes. (EPA)

Ultraviolet light disinfection. A disinfection method for water that has received either secondary or tertiary treatment, used as an alternative to chlorination

V

W

Water Emergency, a sudden situation or event, natural or induced by human action, that threatens to cause damage or disruption of normal water supply functions

Wastewater: Water that carries wastes from domestic, industrial, and commercial users; a mixture of water and dissolved or suspended solids.

Wastewater reclamation, Treatment of previously used water to produce water of suitable quality for additional beneficial uses

Water Quality Criteria, A designated concentration of a constituent that, when not exceeded, will protect an organism, an organism community, or a prescribed water use or quality (§ 46-13.1-3)

Watersheds, Those land areas which, because of their topography, soil type, and drainage patterns, act as collectors of raw waters which replenish or recharge existing or planned public drinking water supplies(§ 46-15.3-4)

Water Source, Any location at which ground or surface water may be withdrawn for any purpose, including tidal waters, harbors, estuaries, rivers, brooks, watercourses, waterways, wells, springs, lakes, ponds, impoundments, diversion structures, wetlands, aquifers, recharge areas, and any others that are contained within, flow through, or border on this state or any portion thereof (§ 46-15.7-2)

Water Supply Facility or Facilities, Water reservoirs, wells and well sites, transmission or distribution system, any and all real estate or interests in real estate held in connection therewith, all equipment and improvements held in connection therewith, and any property or interests therein, real, personal or mixed, used or held on to be used in connection therewith (§ 46-12.8-2)

Water shortage shall indicate a condition when water that can be supplied by a system is less than the demand.

Water Supply Emergency shall include, but not be limited to, one or a combination of the following situations: (DOH)_

> **Mechanical failure** or similar type of emergency including loss of power, loss of pumping capacity, loss of storage capability or major breaks or leaks which result in an inability to meet average daily demand of water.
>
> **Water quality emergencies** due to contamination of the water supply, the distribution system or storage tanks which result in the inability to meet the average daily and maximum daily demand with remaining public water supplies.

Water supply Sources, Temporarily Inactive, seasonal sources of supply or are sources temporarily not in use due to mechanical or water quality problems or lack of demand and require update approvals from the Department of Health prior to use (DOH)

Water Supply System Management Plan (WSSMP) is a comprehensive water supply management plan that is developed by each water supplier selling greater than 50 million gallons per year that includes an emergency management component outlining responsibilities and actions the supplier will take to assure water supply during an emergency. (WRB)

Water Table, The upper surface of groundwater in the saturated zone of an aquifer system (§ 46-13.1-3)

Well, An artificial sanitary excavation or opening in the ground, by which groundwater can be obtained or through which it flows under natural pressure or is artificially withdrawn (§ 46-13.2-1)

Wellhead Protection Area, The surface and subsurface area surrounding a public well or well field through which water will move toward and reach that well or well field (§ 46-13.1-3)

Wellhead treatment, Water quality treatment of water being produced at the well site

Withdrawal, Taking of water from a water source for any purpose, regardless of the quantity or quality of the water taken or its eventual disposition including return to the same water source (§ 46-15.7-2)

References & Footnotes

(All URLS accessed as of 06.14.12)

Part 1

A Cost-Effective and Environmentally Friendly Desalination Option, Water Efficiency, Feb 2007

Coalition for Water Security, *Water for Today & Tomorrow,* 2006

Department of Administration:
Division of Planning, Statewide Planning Program:
State Guide Plan Elements: 110, 125, 611, 721, 7222, 723, and 724
http://www.planning.ri.gov/publist/online.htm

Water Resources Board (WRB)
Big River Locus Map: http://www.wrb.ri.gov/images/pm_map.jpg
Big River Artist Concept:
http://www.wrb.ri.gov/reports/WaterSupply_Mariscal_091707.ppt#390,26,Slide 26
Executive Study, Big River Management Area, *Land Use Study*, July 1996.
General information: http://www.wrb.ri.gov/
Water Suppliers: http://www.wrb.ri.gov/watersuppliers.htm

Division of Municipal Affairs: general information: http://www.muni-info.state.ri.us/municipalities/

Department of Environmental Management:
General information: http://www.dem.ri.gov/
Footnote (1) DEM, State of the State's Waters, 2006, Section 305(b)
http://www.dem.ri.gov/pubs/305b/305b2006.pdf

Department of Health
General information: http://www.health.ri.gov/
Footnote (2) 2010 Water Quality Compliance Report:
http://www.health.ri.gov/publications/annualreports/2010DrinkingWaterQualityCompliance.pdf

Footnote (3) Providence Water Supply System Management Plan, Providence Water Supply Board, April 2010

Rhode Island Geographic Information System: various data shapefiles
http://www.edc.uri.edu/rigis/data/all.aspx

Stone, J.R., and Dickerman, D.C., 2002, Glacial Geology and Aquifer Characteristics of the Big River Area, Central Rhode Island: U.S. Geological Survey Water-Resources Investigations Report 01-4169, 12 p., 1 pl.

United States Environmental Protection Agency
National Water Program Strategy: Response to ***Climate Change***, Office of Water, U.S. Environmental Protection Agency, Washington, D.C. 2008
General information: http://water.epa.gov/drink/
Types of water systems: http://www.epa.gov/safewater/pws/index.html

United States Geological Service:
Water Cycle: http://ga.water.usgs.gov/edu/watercycle.html
General water data: http://www.wrb.ri.gov/waterdata.htm
Glacial Geology and Aquifer Characteristics of the Big River Area, Central Rhode Island, Janet Radway Stone *and* David C. Dickerman, 2001.

World Atlas.com > Figure 1:
http://www.worldatlas.com/webimage/countrys/namerica/usstates/weathermaps/riprecip.htm

Part 2

A Sustainable Approach to Water Supply and Use in Rhode Island: Initial Findings and Recommendations, Rhode Island Coalition for Water Security, April 2006

Department of Administration:
Division of Planning, Statewide Planning Program:
Land Use 2025: Rhode Island State Land Use Policies and Plan, Statewide Planning Program, Division of Planning, Department of Administration, One Capitol Hill, Providence, Rhode Island, 2006, http://www.planning.ri.gov/landuse/121/landuse2025.pdf
Draft Chapter for Integrated Plan for Narragansett Bay, *Land Use & Development*_06.04.10_Nancy Hess
Footnote (8) *Land Use 2025*, state Guide Plan Element 121, April 2006.
http://www.planning.ri.gov/landuse/121/landuse2025.pdf

Water Resources Board:

Footnote (2 & 3) Strategic Planning Workshop, Water Resources Board, June 2, 2010
Annual Survey of Rhode Island Residential Water Rates: 2010
Footnote (4 & 5) Water Supply for Rhode Island… Today and Tomorrow, Presentation by Juan Mariscal, General Manager, New England Water Works Association, 9/17/2007
The Economic, Social and Environmental Impacts of Water Use in Rhode Island, Impact Analysis Subcommittee Report, Water Allocation Program Advisory Committee, Water Resources Board, October 2003
Footnote (13) Water Resources Board 2010 Annual Report
http://www.wrb.ri.gov/reports/AR_RIWRB_2010.pdf
Footnote (18) *Preliminary Findings of the Subcommittee on Water Rights and Regulatory Authorities*, Water Resources Board Implementation team, water Management System Program., December 2003

"Climate Change Challenges: Water Futures Might be in Doubt", On Tap, Fall 2006, Volume 6, Issue 3, National Environmental Services Center, USDA Rural Development, West Virginia.

Department of Environmental Management:

Footnote (14) http://www.dem.ri.gov/programs/bnatres/agricult/pdf/riprofile07.pdf

Footnote (16) Streamflow Depletion Methodology, RI Department of Environmental Resources of Water Resources, DRAFT, May 13, 2010

"*It Seems like we have Enough Rain..Why Don't We Have Enough Water?*" Alisa Richardson, Principal Engineer, Office of Water Resources, Coalition for Water Security, 2007 Conference

http://www.dem.ri.gov/programs/bnatres/agricult/pdf/riprofile07.pdf

http://www.dem.ri.gov/programs/bnatres/agricult/index.htm

Desalination Feasibility Study Report, Quonset Business Park, Quonset Development Corporation, North Kingstown, RI October, 2007.

Emerging Climate Change Impacts on Freshwater Resources, Alan P. Covich, An Initiative of the Climate Policy Program at Resources for the Future (RFF), July, 2010

Environment Council for Rhode Island:

Footnote (1) Water for Rhode Island: Today and Tomorrow, Environment Council of Rhode Island, 2006

Footnote (10) *Infrastructure 2008: A Competitive Advantage*, Urban Land Institute, and Ernst & Young, Washington, D.C. ULI, 2008

Footnote (13) *2009 Connecticut Water Rate Survey* & *2009 Massachusetts Water Rate Survey,* Tighe & Bond, 457 main street, Danbury, CT www.rates.tighebond.com

Footnote (23) *Global Climate Changes Impacts in the United States*, US Global Change Research Program, Cambridge University Press 32 Avenue of the Americas, New York, NY, 2009

Integrated Plan for Narrgansett Bay, *Freshwater Flow Draft Chapte*r, M. Kerr, Version 3. June 2, 2010

More Than One out of Three US Counties Face Water Shortages Due to Climate Change, Water Efficiency, July, 2010

Footnote (21) North Kingstown Water Department:

http://www.northkingstown.org/departments/water/water-data

"Preparing for the Calm or Relying on the Storm?" The Rhode Island Water Supply Management System, A Master's Thesis, Megan J. Terebus, Center for Environmental Studies, Brown University, Providence, RI, 2002

Providence Water Supply Board:

Footnote (6) Water Supply System Management Plan, 5 Year Update, April 2010

http://www.provwater.com/

Footnote (7) PWB Supply/Demand Analysis Position Paper DTD, Richard Rafanovic, Chief Engineer, 1992,

Footnote (8) RI Economic Policy Council, 2007, using Providence Water Supply Board data sources

2009 Annual Report

Footnotes (11 & 12) http://www.provwater.com/pennies_a_day.htm

Footnote (18) *Reuse in Action*, Water Efficiency, November/ December 2010

RI Clean Water Finance Agency *Annual Report 2010,* Providence RI

RI General Assembly:

Footnotes (1,2 & 18) *Water for Tomorrow: From Planning to Implementation,* Findings and Recommendations from the RI General assembly Joint Hearings on Water Related Issues, Report of the Committee on Government Oversight and Environmental and Agriculture, State House, Providence, June 2007.

RI Senate: Commission to Study the Kent County Water Authority Report, Special Legislative Commission to study all aspects of the Kent County Water Authority, RI, Providence RI, March 2007 http://www.rilin.state.ri.us/Kentwater/documents/KCWAFinalReport.doc

Chapter 15.8, Water Use & Efficiency Act, 2009 http://www.rilin.state.ri.us/publiclaws/law09/law09288.htm

Rhode Island Bays, Rivers and Watersheds Coordination Team, Systems-Level Plan: 2009-2013, July 2008, BRWCT Strategic Planning Work Group

Footnote (22) *Reuse in Action*, Water Efficiency, November/ December 2010

Sustainable Water Systems: Step One –Redefining the Nation's Infrastructure Challenge, The Aspen Institute, Energy and Environment Program, Washington, DC. 2009.

Footnote (7) RI Water Presentation, Prepared for the Rhode Island Economic Policy Council by Local LLP, 2007

The Cost of Clean and Safe Water; Sustaining Our Water Infrastructure, New England Interstate Water Pollution Control Commission, May 2006

Footnote (10) ULI the Urban Land Institute and Ernst & Young. *Infrastructure 2008: A competitive Advantage*, Washington D.C., 2008.

United State Department of Agriculture:

Footnote (15) U.S. Department of Agriculture (2001). *Irrigation and Water Use Briefing Room*, Econ. Res. Serv.

United States Environmental Protection Agency:

Footnote (9) http://www.epa.gov/smartgrowth/

Case Studies of Sustainable water and Wastewater Pricing, Office of Water (4606M), EPA-816-T-05-007, December 2005. www.epa.gov/safewater

Climate Change Vulnerability Assessments: A Review of Water Utility Practices, Office of Water, EPA 880-R-10-001, August 2010

United States Geological Survey:

Estimated Use of Water in the United States in 2005, USGS Circular 1344, 1344, page 52

Footnote(23) US Global Change Research Program; *Global Climate Changes Impacts in the United States*,

Footnote (20) *Water Sustainability,* Water Efficiency, March / April 2011

Water Supply Analysis for the State of Rhode Island, Task Series 500- Forecast of Water Use & Unmet Needs, Report to RI Water Resources Coordinating Council, December, 1989.

http://www.water-technology.net/projects/tampa/

Part 3

American Water Works Association:

Regional Solutions to Water Supply Provision, 2nd edition, American Water Works Association Research Foundation, Robert S. Raucher et al, 2008

Comprehensive Sewerage Plan, Blackstone Valley District Commission, March 1990.

Department of Administration:

Division of Planning, Statewide Planning Program:

Footnotes (1 & 3) *Rhode Island Population Projections: State, County, and Municipal 2000-2030*, Technical Paper 154, August 2004 http://www.planning.ri.gov/census/tp154.pdf

Footnote (4) RI Land Use 2025, State Guide Plan Element 125, 2006 http://www.planning.ri.gov/landuse/121/landuse2025.pdf

Footnote (5) *Geographic Analysis for Land Available and Suitable for Development for Land Use 2025*, http://www.planning.ri.gov/landuse/121/D.pdf

Footnote (6) American Fact Finder 2010 Demographic Profile Data http://www.planning.ri.gov/census/DEC_10_Dem_profile.pdf

Footnote (17 & 18) Scituate Reservoir Management Plan State Guide Plan Element 125, 1990 http://www.planning.ri.gov/sgp/pdf/125.pdf

Water Resources Board:

Footnote (7) Strategic Planning Workshop, Water Resources Board, June 2, 2010

Footnote (8) Water Resources Board 2010 Annual Report, http://www.wrb.ri.gov/reports/AR_RIWRB_2010.pdf

Footnote (9) *Recommendations for a Streamflow Gaging Network in Rhode Island,* WRB Water Allocation Program Advisory Committee, Streamflow Committee, April 2004

Footnote (16) Big River Management Area Policies, Providence, RI July 1997 http://www.wrb.ri.gov/lawsregs/BRMA_Policies.pdf

Department of Environmental Management:

Footnote (12) Rhode Island Low Impact Development Site Planning and Design Guidance Manual, March 2011. http://www.dem.ri.gov/programs/bpoladm/suswshed/pdfs/lidplan.pdf

Department of Health:

The Scituate Reservoir Source Water Assessment, University of RI Cooperative Extension, RI DOH Source Water Assessment Program, Providence, RI, April 2003

Footnote (13) http://www.health.ri.gov/publications/plans/SourceWaterAssessment.pdf

Environment Council for Rhode Island:

Footnote (2) Water for Rhode Island: Today and Tomorrow, Environment Council of Rhode Island, 2006

Homeland Security Presidential Directives:

Footnote (15) *Homeland Security Directive 9*

Narragansett Bay Estuary Program

Indicators for Narragansett Bay Region Climate Change workshop February 17, 2011, DOA, Providence RI, Narragansett estuary Bay Program

National Drinking Water Advisory Council (NDWAC), Small Systems Working Group, *Information to States on Affordability Criteria*, US. Environmental Protection Agency, Washington D.C. 2003

New England Water Works Association:
Footnote (14) Surface Water Committee, Final Revised Policy, "Resolution and Policy Concerning Recreational Use of Public Water Supplies," 2006

Providence Water Supply Board:
Water Quality Protection Plan, Providence water Supply systems Management Plan, Volume 552 Academy Avenue, Providence, RI , August, 2001

Potential Benefits of Water Supply Regionalization, Amy G. Reese et al, University of Washington, Department of Civil Engineering, Seattle, 2000

Rhode Island General Law, Chapter 46-25, Narragansett Bay Commission
http://www.rilin.state.ri.us/Statutes/TITLE46/46-25/INDEX.HTM

RIWARN: Water/Wastewater Agency Response Network:
Footnote (19) http://www.riwarn.org/index.html

Tiverton Comprehensive Plan Adopted Version 2006, Town of Tiverton.

United States Census Bureau:
Footnote (6) American Fact Finder 2010 Demographic Profile Data,
http://www.planning.ri.gov/census/DEC_10_Dem_profile.pdf

Footnote (20) *Water Sustainability,* Water Efficiency, March / April 2011

US EPA:
Climate Ready toolbox: http://www.epa.gov/safewater/watersecurity/climate/toolbox.html
http://www.epa.gov/climatechange/effects/water/index.html
Footnotes (10 & 11) http://www.epa.gov/climatechange/effects/water/index.html

http://en.wikipedia.org/wiki/Water_cycle

Glossary

American Water Works Association:
Manual of Water Supply Practices; M1, Principles of Water Rates, Fees, and Charges, AWWA Manual, 5th Edition, Denver Co,2000,

Department of Administration:
Division of Planning, Statewide Planning Program:
State Guide Plan Elements: 110, 125, 611, 721, 7222, 723, and 724
http://www.planning.ri.gov/publist/online.htm

EPA
http://water.epa.gov/drink/resources/glossary.cfm